Momentum transfer during the impact of granular matter with inclined sliding surfaces

Anne Kyner , Vikram Deshpande , Haydn Wadley

PII: S0022-5096(17)30337-X
DOI: 10.1016/j.jmps.2017.06.004
Reference: MPS 3130

To appear in: *Journal of the Mechanics and Physics of Solids*

Received date: 25 April 2017
Revised date: 6 June 2017
Accepted date: 6 June 2017

Please cite this article as: Anne Kyner , Vikram Deshpande , Haydn Wadley , Momentum transfer during the impact of granular matter with inclined sliding surfaces, *Journal of the Mechanics and Physics of Solids* (2017), doi: 10.1016/j.jmps.2017.06.004

Momentum transfer during the impact of granular matter with inclined sliding surfaces

Anne Kyner, Vikram Deshpande* and Haydn Wadley

Department of Materials Science and Engineering, University of Virginia, Charlottesville, Va 22903, USA

* Engineering Department, Cambridge University, UK

Abstract

Increasing the inclination of a rigid surface that is impacted by a collimated granular flow reduces the fraction of granular matter momentum transferred to the surface. Recent studies have shown that the momentum reduction depends upon a frictional interaction between the granular flow and the impacted surface. High coefficient of friction surfaces suffer significantly more momentum transfer than predicted by resolution of the incident momentum onto the inclined plane. This discovery has raised the possibility that inclined surfaces with very low friction coefficients might reduce the impulsive transferred by the impact of high velocity granular matter. Here the use of a lubricated sliding plate is investigated as a means for reducing interfacial friction and impulse transfer to an inclined surface. The study uses a combination of experimental testing and particle-based simulations to investigate impulse transfer to rigid aluminum surfaces inclined either perpendicular or at 53^{o} degrees to synthetic sand that was impulsively accelerated to a velocity of 350 -500 m/s. The study shows that impact of this sand with lubricated plates attached to an inclined surface rapidly accelerates them to a velocity of about 55-70 m/s, and reduces the impulse transferred to the inclined surface below. The reduction of impulse by this approach is comparable to that achieved by changing the inclination of the surface.

Corresponding author: Haydn Wadley

Key words: Granular matter, fluid structure interaction, discrete particle-based simulation