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Non-monotonic $\mu(I)$-rheology of granular flows at high inertial numbers SATYABRATA PATRO[1], ANURAG TRIPATHI, Indian Institute of Technology, Kanpur — The inertial number based rheology for the dense flow regime has been used to describe flows for inertial number $I < 0.6$. We perform 3D DEM simulations of dry, inelastic, frictional spherical particles flowing over a bumpy inclined plane under the influence of gravity starting from a settled state spanning a large range of restitution coefficients and inclination angles. In contrast to the widely reported monotonically increasing variation of the effective friction coefficient that seems to saturate at high values of the inertial numbers, we find that the effective friction becomes maximum at moderate values of the inertial number and decreases with further increase in inertial number. The results suggest that both the first and the second normal stress differences become significant and cannot be ignored for $I \sim 1$. Steady state flow properties are obtained by averaging the flow properties for sufficiently long time duration in the DEM simulations. We also compute the steady state flow properties by solving the momentum balance equations analytically and accounting for both the normal stress differences. Analytical results obtained from the theory will be compared with the results obtained from DEM simulations to explore whether the $\mu - I$ rheology can be used for $I > 1$.

[1]I am currently doing my PhD in chemical engineering from IIT Kanpur. I have done my masters in mineral engineering from IIT Dhanbad. Research interests: Simulation studies of granular materials

Satyabrata Patro
Indian Institute of Technology, Kanpur

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