# The effect of anisotropy on the rheology of granular flows

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Granular shear flows are known to exhibit anisotropy in the granular temperature, i.e., the r.m.s. fluctuation velocity of particles is different in the different coordinate directions[1,2]. A consequence of such temperature anisotropy is that the normal stresses in the different directions are different[3]. A second source of anisotropy is the non-uniformity of the collision rate experienced by a particle over its surface. The effect of such anisotropy on the rheology of granular flows has not been studied in detail previously. We present results for two model systems: (1) a quiescent elastic hard sphere system in which a thermostat maintains a lower temperature ($T_z$) in one direction relative to the other two, and (2) a sheared system of frictionless but inelastic spheres. In both cases, a cubical volume with periodic boundary conditions is used. Shear flow is generated using the Lees-Edward boundary condition. The anisotropic velocity distributions and pair correlation functions are computed for both, for a range of system parameters, along with the stresses in the systems. The pair correlation function at contact and the velocity distributions vary significantly from the ideal case, and the deviation increases with solid fraction ($\phi$). A modified kinetic theory[4], taking into account the anisotropy in the temperature and pair correlation function, is derived. The predictions of the theory match the computational results reasonably well.

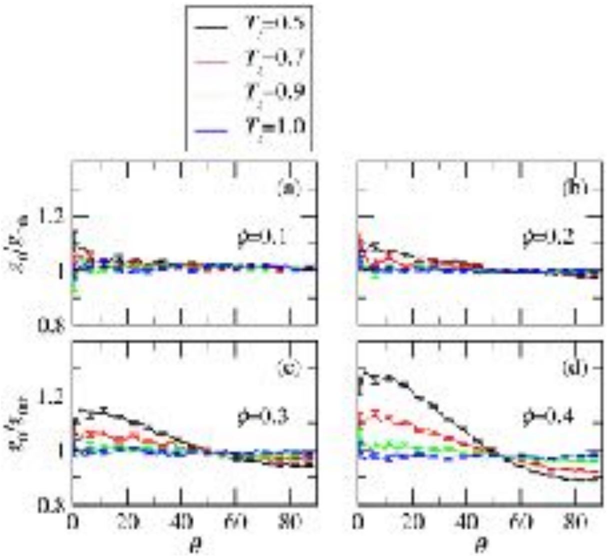


Figure 1: Variation of the pair correlation function at contact ($g_0$) normalised by the isotropic value versus the angle from the $z$-axis ($\theta$) for a hard sphere system. Data are for different temperature anisotropy ($T_z$) and solid fractions ($\phi$).

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