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Analysis of Driving Forces for Segregation in a Granular Mixture

Theoretical analysis using kinetic-theory models has been a means of studying different behaviors in rapid granular flow. For the case of binary mixtures, several kinetic theories have been developed based on different assumptions. The focus of this effort is on how one of these assumptions, namely the equipartition of energy, influences the predictive ability of such models. Previous investigations for the case of simple shear flow show that while the equipartition-of-energy assumption has little impact on the stress predictions, a non-equipartition of energy is observed, particularly for large size differences and low restitution coefficients. In addition, the degree of non-equipartition is well predicted by a theory that does not include the equipartition assumption.

Of particular interest in the current effort is a system exhibiting a segregation of unlike particles, which a simple shear flow system does not. Although similar segregating systems have been investigated previously, these works have all been based on theories that include an equipartition assumption. A careful analysis of the governing equations from a non-equipartition theory shows that non-equipartition gives rise to an additional driving force for segregation of unlike particles. To assess the importance of this new driving force, the results from event-driven, discrete-particle (molecular-dynamics) simulations for the case of a segregating flow were used in conjunction with the kinetic theory model that does not assume an equipartition of energy. Preliminary results indicate that this new driving force is of similar magnitude to other driving forces for systems with moderate values of mass differences and restitution coefficients.