Clustering Induced by Blast Waves in Inelastic Granular Gases

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ABSTRACT. Clustering induced by blast waves in granular gases is treated by means of a shock capturing scheme that approximates the Euler equations of granular gas dynamics with an equation of state (EOS), introduced by Goldshtein and Shapiro [J. Fluid Mech. 282 (1995) 75], that takes into account the inelastic collisions of granules. We include a sink term in the energy balance to account for dissipation of the granular motion by collisional inelasticity, proposed by Haff [J. Fluid Mech. 134 (1983) 401], added as a source term. We have implemented an approximate Riemann solver [J. Comput. Phys. 125 (1996) 42], that works robustly under low granular temperatures, high Mach numbers and near the close-packed limit, damping post-shock oscillations. We have computed the approximate solution to a one-dimensional blast wave evolving in time in the absence of gravity.

1. Introduction

Continuum models to explain the complicated physical behavior of granular media were derived from kinetic theory in [6]. Shock waves are one of the difficult features appearing in fluidized granular gases and easily observed in laboratory, since typical speeds of sound of some granular gases are measured in cm/s [8]. Hydrodynamical models are the most convenient and efficient ones to describe shock waves [2, 3, 4, 6, 7]. In this research work we are interested in simulating blast waves using the Euler equations for compressible granular flow described by means of the granular equation of state (EOS) proposed to compute the pressure by Goldshtein and Shapiro [2], that includes both dense gas and inelastic effects. We shall use an energy loss term, proportional to $T^{\frac{3}{2}}$ where T is the granular temperature [5], that takes into account the inelastic collisions of particles.