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Capturing shock waves in inelastic granular gases

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Abstract

Shock waves in granular gases generated by hitting an obstacle at rest are 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) 75–114], 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) 401–430], and the gravity field added as source terms. We have computed the approximate solution to a one-dimensional granular gas falling on a plate under the acceleration of gravity until the close-packed limit.

MSC: 65M06; 76L05; 65Z05

Keywords: Granular gases; Inelastic collisions; Close-packed limit; Shock waves

1. Introduction

Much experimental and theoretical work has been performed to study the fluid properties of granular gases [1,3,6,7,10,11,14,18]. Several kinetic models have been introduced to explain the complicated physical behavior of granular media [15]. Continuum models, up to Navier–Stokes order, were derived from kinetic theory in [11]. Shock waves are one of the difficult features appearing in fluidized granular gases and easily

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