Numerical method for dissipative kinetic equations applications to granular media

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NUMERICAL METHOD FOR DISSIPATIVE KINETIC EQUATIONS APPLICATIONS TO GRANULAR MEDIA

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Abstract : We present a new numerical algorithm based on a relative energy scaling for collisional kinetic equations allowing to study numerically their long time behavior, without the usual problems related to the change of scales in velocity variables. It is based on the knowledge of the hydrodynamic limit of the model considered, but is able to compute solutions for either dilute or dense regimes. Several applications are presented for Boltzmann-like equations. This method is particularly efficient for numerical simulations of the granular gases equation with dissipative energy: it allows to study accurately the long time behavior of this equation and is very well suited for the study of clustering phenomena.

Mots clefs : Boltzmann equation, spectral methods, boundary values problem, large time behavior, granular gases.

Références

[1] Bird, G. *Molecular Gas Dynamics and the Direct Simulation of Gas Flows*, 2nd ed. Oxford University Press, 1994.

[2] Brilliantov, N., and Pöschel, T. *Kinetic Theory of Granular Gases*. Oxford University Press, USA, 2004.

[3] Canuto, C., Hussaini, M., Quarteroni, A., and Zang, T. *Spectral methods in fluid dynamics*. Springer Series in Computational Physics. Springer-Verlag, New York, 1988.

[4] Carrillo, J., Francesco, M. D., and Toscani, G. Intermediate Asymptotics Beyond Homogeneity and Self- Similarity: Long Time Behavior for $u_t = \Delta\varphi(u)$. *Arch. Ration. Mech. Anal. 180*, 1 (Jan. 2006), 127–149.

[5] Carrillo, J., Pöschel, T., and Salueña, C. Granular hydrodynamics and pattern formation in vertically oscillated granular disk layers. *J. Fluid Mech. 597* (2008), 119–144.

[6] Carrillo, J., and Toscani, G. Asymptotic L^1-decay of solutions of the porous medium equation to self-similarity. *Indiana Univ. Math. J. 49*, 1 (2000), 113–142.

[7] Villani, C. *A review of mathematical topics in collisional kinetic theory*. Elsevier Science, 2002.