Towards an ultra efficient kinetic scheme

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In this work we will review the development of a so-called Fast Kinetic Scheme (FKS) for the BGK model initiated by G.Dimarco further joined by J.Narksi, V.Rispoli and R.Loubère. In this presentation we will derive the numerical scheme based on a Discrete Velocity Model and a spliting between transport and relaxation phases. The transport is exactly solved which permits a large gain in CPU time. Numerical test cases will prove that this approach is valid and permits 3Dx3D computations on lab computers. Next second order extension, parallelization strategy (OpenMP and CUDA), domain decomposition with embedded objects and velocity mesh refinement will be briefly discussed. Numerical evidences will be provided to assess the efficiency of the approach in those contexts. Last the Boltzmann collision operator is considered, discretized (spectral method) and preliminary 2Dx2D results will be presented.

[1] Towards an ultra efficient kinetic scheme Part I : basics on the BGK equation , Giacomo Dimarco, RL, Journal of
Computational Physics, Volume 255, 2013, pp 680-698.
[2] Towards an ultra efficient kinetic scheme Part II : The High-order case , Giacomo Dimarco, RL, Journal of Computational
Physics, Volume 255, 2013, pp 699-719.
[3] A multiscale fast semi-Lagrangian method for rarefied gas dynamics, V.Rispoli, G.Dimarco, RL, Journal of Computational
Physics, J.Comput.Phys. 291, 2015
[4] Towards an ultra efficient kinetic scheme Part III : High Performance Computing, J. Narski, Giacomo Dimarco, RL,
J.Comput.Phys. 284, 22-39, 2015
[5] Towards an ultra efficient kinetic scheme Part IV : Boltzmann equation, Giacomo Dimarco, RL, J. Narski, in preparation 2015