Deterministic schemes to non-linear collisional Boltzmann and Landau type models in gas dynamics and plasma simulations

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We will present an overview of novel numerical methods for nonlinear models of kinetic-statistical flow type. These models share the feature of preservation of flow invariant quantities, as those associated to classical conservation laws.

Examples of such models are the classical non-linear Boltzmann equation for hard spheres, or for Coulombic interactions in the grazing collision limit to the Landau equation, gas mixtures and collisional plasmas, Boltzmann-Poisson as well as kinetic descriptions of swarming models in self-organized flows.

We will describe some deterministic conservative solvers that enable rigorous stability, convergence and error analysis, and present numerical simulations.

This work appeared in a series of manuscripts involving collaborations with Ricardo Alonso (PUC, Rio De Janeiro, Brazil) [1], Jeff Haack (UT-Austin) [2], [4], [5], Alessandro Munafo (VKI, Belgium) [4], Jose Morales Escalante, (UT-Austin)[3], Sebastien Motsch (ASU) [5], Thierry Magin (VKI, Belgium) [4], S.Harsha Tharkahbushanam (Birmingham,UK) [6] and Chenglong Zhang (UT-Austin) [6].

References

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