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Locally-implicit Lax-Wendroff schemes for quasi-exponential moment-closure approximations of kinetic models.

In many applications, the dynamics of gas and plasma can be accurately modeled using kinetic Boltzmann equations, which are integro-differential systems posed in a high-dimensional phase space, which is typically comprised of spatial and velocity coordinates. If the system is sufficiently collisional, the kinetic equations may be replaced by a fluid approximation that is posed only in physical space. The precise form of the fluid approximation depends on the choice of the moment-closure. In general, finding a suitable robust moment-closure is still an open scientific problem.

In this work we consider a specific moment-closure based on a nonextensible entropy formulation. In particular, the true distribution is replaced by a Maxwellian distribution multiplied by a quasi-exponential function. We develop a high-order, locally-implicit, discontinuous Galerkin scheme to numerically solve resulting fluid equations. The numerical update is broken into two parts: (1) an update for the background Maxwellian distribution, and (2) an update for the non-Maxwellian corrections. We also develop limiters that guarantee that the inversion problem between moments of the distribution function and the parameters in the quasi-exponential function is well-posed. (Received September 12, 2018)