Hyperbolic Approximation of Kinetic Equations Using Quadrature-based Projection Methods

Master Thesis

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Abstract:

We derive nonlinear hyperbolic moment equations for the approximation of the Boltzmann equation.
In order to satisfy Galilei invariance and to allow the representation of the velocity space to adapt to local features of the distribution function in real space, we perform a nonlinear transformation in velocity space.
The unknown distribution function is approximated by a series expansion with orthogonal basis functions.
The standard continuous projection method for this approach yields PDE systems for the basis coefficients, which are in general not hyperbolic.
Instead, we apply quadrature-based projection methods which modify the structure of the system, such as to guarantee hyperbolicity of the resulting moment equations.