Nonlinear Approximation Theory for the Homogeneous Boltzmann Equation

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Abstract: A challenging problem in solving the Boltzmann equation numerically is that the velocity space is approximated by a finite region. Therefore, most methods are based on a truncation technique and the computational cost is then very high if the velocity domain is large. Moreover, sometimes, non-physical conditions have to be imposed on the equation in order to keep the velocity domain bounded. This is the first in our series of papers to introduce a nonlinear approximation theory for the Boltzmann equation. Our nonlinear wavelet approximation is non-truncated and based on a nonlinear, adaptive spectral method associated with a new wavelet filtering technique and a new formulation of the equation. A complete and new theory to study the approximation is provided. It could also be considered as a general frame work for approximating kinetic integral equations.

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