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Title: Globally Hyperbolic Regularization of Grad's Moment System

Abstract:
In the kinetic gas theory, Grad's moment equations are known to be a macroscopic model approximating the Boltzmann equation in the transition regime. However, due to the loss of global hyperbolicity, the well-posedness of this model is problematic. We first present a regularization to 1D Grad's moment system to achieve the global hyperbolicity. The regularization is based on the observation that the characteristic polynomial of the Jacobian of the flux in Grad's moment system is independent of the intermediate moments. Moreover, the proposed approach is proven to be the unique one if only the last moment equation is allowed to be altered to match the condition that the characteristic speeds coincide with the Gauss-Hermite interpolation points. The hyperbolic structures of the regularized system, including the signal speeds, Riemann invariants and the properties of the elementary waves, are investigated. Then we extend such regularization to the multidimensional case, and the elementary waves for the split Riemann problem are also studied.