
Boltzmann Equation and PDEs for Gas Dynamics

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Abstract — The relation between Boltzmann equation and various PDEs for gas dynamics may be viewed as part of Hilbert's 6th problem. There are similarities, even direct relations. However, there are also major differences both in terms of phenomena and, in fact, in their goals. PDEs describe mainly phenomena near thermal equilibrium. Boltzmann equation's dual particle-fluid property allows for modeling of rich physical effects that PDEs cannot. On the other hand, by being simpler, the theory for PDEs yields basic understanding that is useful for the study of Boltzmann equation. We will illustrate these with some concrete problems on shock and boundary layers.