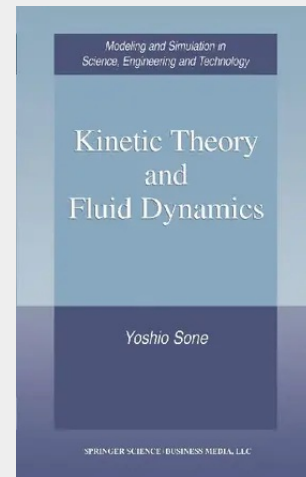


Kinetic Theory and Fluid Dynamics

This monograph is intended to provide a comprehensive description of the relation between kinetic theory and fluid dynamics for a time-independent behavior of a gas in a general domain. A gas in a steady (or time-independent) state in a general domain is considered, and its asymptotic behavior for small Knudsen numbers is studied on the basis of kinetic theory. Fluid-dynamic-type equations and their associated boundary conditions, together with their Knudsen-layer corrections, describing the asymptotic behavior of the gas for small Knudsen numbers are presented. In addition, various interesting physical phenomena derived from the asymptotic theory are explained. The background of the asymptotic studies is explained in Chapter 1, according to which the fluid-dynamic-type equations that describe the behavior of a gas in the continuum limit are to be studied carefully. Their detailed studies depending on physical situations are treated in the following chapters. What is striking is that the classical gas dynamic system is incomplete to describe the behavior of a gas in the continuum limit (or in the limit that the mean free path of the gas molecules vanishes). Thanks to the asymptotic theory, problems for a slightly rarefied gas can be treated with the same ease as the corresponding classical fluid-dynamic problems. In a rarefied gas, a temperature field is directly related to a gas flow, and there are various interesting phenomena which cannot be found in a gas in the continuum limit.

Provides a comprehensive description of the connections between kinetic theory and fluid dynamics. Presented are applications and models of physical problems such as flows induced by temperature fields, evaporation and condensation problems, examples of the ghost effect, and bifurcation of flows. The presentation is geared toward theoretical physicists, applied mathematicians, and engineers; thus, the monograph serves as a bridge for those working in different communities where kinetic theory is important. Classroom text for graduate students, or self-study resource for researchers and practitioners.



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