Asymptotic Analysis of Rarefied Gas Flow: Inertia and Rarefaction Effects In The Weakly Nonlinear Regime

Satoshi Taguchi

Department of Informatics
Graduate School of Informatics
Kyoto University
Email: taguchi.satoshi@i.kyoto-u.ac.jp

Abstract

In this talk, we discuss the asymptotic behavior of a rarefied flow, governed by the Boltzmann equation, in the weakly nonlinear regime where both the Reynolds number and the Knudsen number are small. Specifically, we first address boundary-value problems of the Boltzmann equation and apply the Hilbert expansion for small Knudsen numbers (i.e., scaled mean free path) to derive a fluid-dynamic system in the case where the Reynolds number is of the same order as the Knudsen number. This derived system is then used to analyze the flow past a sphere, providing insights into gas behavior around the sphere. Furthermore, we derive a drag formula that incorporates both rarefaction and inertia effects.