A Deterministic Approach to the Solution of Model Equations in Rarefied Gas Dynamics

Liliane Basso Barichello
Instituto de Matemática - UFRGS
Av. Bento Gonçalves, 9500
91509-900, Porto Alegre, RS
E-mail: lbaric@mat.ufrgs.br.

ABSTRACT

Research in the general area of rarefied gas dynamics (RGD) has recently focused a major interest on new research fields, specially the one related to micro systems [6].

The mathematical background associated with the solution of the interest problems is related to the Boltzmann equation (BE) [5], since in the transition regime the Navier-Stokes equations do not apply. Because of the inherent difficulty of the solution of the BE, the development and solution of kinetic (model) equations derived from the BE have been also an important aspect of investigations. And, even though many problems have been solved under this basis, over the years [7, 10], modern tools have been investigated in order to seek for improvements and to be adequate to the requests associated with the new applications.

In this sense, in recent years, the derivation and solution of model equations in RGD have been studied [4]. In particular, the solution of the model equations has been associated with the use of a deterministic approach, based on an analytical version of the discrete ordinates method [3]. In this way, constant and variable collision frequency models as well the linearized Boltzmann equation itself, have been treated [2, 1, 9]. Different types of gas-surface interaction-law have been also considered.

In this talk, we present, in a general form, a class of kinetic equations and we show main steps in developing the discrete-ordinates solution. We emphasize possible differences, in regard to analytical procedures $\times$ numerical and computational tools $\times$ accuracy of the results, for the different models, in order to establish general basis for comparisons and conclusions regarding to the effectiveness of their use in solving problems of interest.

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