Approximation of maxwell's microscopic boundary conditions for onedimensional nonstationary nonlinear boltzmann's twelve moment equations

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An important problem in aerospace engineering is the prediction of aerodynamic characteristics of aircraft at very high speeds and at high altitudes. In the case of a gas flowing near a solid or inside a region bounded by a solid surface, the boundary conditions describe the interaction of gas molecules with solid walls. The interaction of gas with a solid surface is the source of the drag and the lifting force of the body in the gas flow, as well as the heat transfer between the gas and the solid boundary. The boundary conditions that the particle distribution function must satisfy at the boundary of the region where the particles under study are moving depend on the state of the boundary surface, its temperature, and on the degree of its roughness and purity. Unfortunately, theoretical and experimental studies on the interactions of gas with the surface have been little carried out. The mirror-diffusive Maxwell model [1] is often used as the boundary condition imposed on the distribution function of the gas molecules reflected from the surface of the molecules. To calculate the aerodynamic characteristics of aircraft, the Boltzmann's moment equations are used. Finite system of moment equations for a specific task with a certain degree of accuracy replaces the Boltzmann equation. It's necessary, also roughly, to replace the boundary conditions for the particle distribution function by a number of macroscopic conditions for the moments, i.e. there arises the problem of boundary conditions for a finite system of equations that approximate the microscopic boundary conditions for the Boltzmann equation. The question of boundary conditions for a finite system of moment equations can be divided into two parts: how many conditions must be imposed and how they should be prepared. From microscopic boundary conditions for the Boltzmann equation there can be obtained an infinite set of boundary conditions for each type of decomposition. However, the number of boundary conditions is determined not by the number of moment equations, i.e. it is impossible, for example, take as much boundary conditions as equations, although the number of moment equations affects the number of boundary conditions. In addition, the boundary conditions must be consistent with the moment equations and the resulting problem must be correct. The initial and boundary value problem for one-dimensional non-stationary Boltzmann's equation with boundary conditions of Maxwell was approximated by a corresponding problem for the

Boltzmann's moment system of equations [2]. In this work we approximate the microscopic Maxwell boundary condition satisfied by the particle distribution function for one dimensional Boltzmann's twelve moment equations and show correctness of the initial and boundary value problem for Boltzmann's twelve moment system equations.

Keywords: Boltzmann equation, boundary conditions, nonlinear, Boltzmann's moment system equations, particle distribution functions.

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