NUMERICAL ANALYSIS OF HIGH-SPEED THREE-DIMENSIONAL FLOWS OF RAREFIED GAS ON THE BASIS OF THE SHAKHOV MODEL

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In recent years, there has been significant progress in developing numerical methods to solve kinetic equations in three space dimensions. However, most applications have been in the area of the microchannel flows, whereas modeling of the high-speed rarefied flows remains challenging, especially for realistic three-dimensional problems.

Over the recent years the author has been developing a discrete-velocity-type numerical method to solve model kinetic equation with the E.M. Shakhov collision integral [1] for three-dimensional flows [2,3,4]. Its distinguishing features include the support of arbitrary (both block-structured and hybrid unstructured) meshes in the six-dimensional phase space, the use of efficient implicit time evolution method and two-level MPI+OpenMP parallel implementation for modern parallel computers. The method is implemented into the software package “Nesvetay”.

This presentation is a review of all recent developments of the numerical methods for high-speed flows, which have been carried out by the author alone or with the collaborators from the Russian academy of Sciences [5,6]. These primarily concern various comparative studies of the stationary high-speed flows as well as comparison of kinetic and DSMC solutions for time-dependent flows.

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