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A Kinetic 13-Moment Boundary Conditions Method for Particle Simulations of Viscous Rarefied Flows[1] SERGEY AVERKIN, NIKOLAOS GATSONIS, Worcester Polytechnic Institute — The kinetic 13-moment (Navier-Stokes-Fourrier) boundary condition method is developed for direct simulation Monte Carlo (DSMC) simulations of rarefied gas flows. The particles are injected into the computational domain from the inlet and outlet following the first-order Chapman-Enskog distribution function. The unknown parameters of the Chapman-Enskog distribution function are reconstructed from the full 13-moment (Navier-Stokes-Fourier) equations discretized on the boundaries with the wave amplitudes calculated by the local one dimensional inviscid (LODI) formulation used in compressible (continuous) flow computations. The kinetic-moment boundary conditions are implemented in an unstructured 3D DSMC (U3DSMC) code and are supplemented with a neighboring-cell sampling approach and a time-average smoothing techniques to speed up convergence and reduce fluctuations. Simulations of a pressure-driven viscous subsonic flow in a circular tube are used for verification and validation of the boundary conditions. In addition, the present method is compared to the previously developed kinetic-moment boundary conditions derived from the five-moment (Euler) equations.

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