Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A continuum breakdown parameter based on the characteristic function of the molecular velocity distribution ARGHAVAN ALAMATSAZ, AYYASWAMY VENKATTRAMAN, Univ of California - Merced — Rarefied flows characterized by Knudsen numbers (Kn) greater than 0.1 are frequently encountered in several applications including low-pressure, high speed and microscale flows and require computationally expensive molecular approaches such as direct simulation Monte Carlo (DSMC) to accurately capture the physical phenomena unique to these flows. However, most of these flows also contain regions where traditional inexpensive continuum techniques such as the Navier-Stokes (NS) equations are sufficiently accurate making a hybrid NS-DSMC approach attractive and optimal. Such a hybrid method typically requires a robust continuum breakdown parameter (CBP) to determine regions where each method should be applied. Historically, hybrid methods have used CBPs based on the macroscopic properties which are lower order moments of the molecular velocity distribution function (VDF) and their gradients which can have significant inaccuracies. In this work, we propose a novel CBP that utilizes all moments of the VDF by computing the characteristic function with limited computational overhead. We also compare the performance of this CBP using standard benchmark problems including structure of a normal shock wave and Fourier-Couette flow for various Kn from continuum to free-molecular.

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Date submitted: 01 Aug 2014 Electronic form version 1.4