

Abstract Submitted
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Variance-reduced DSMC simulations of low-signal flows¹ GREGG RADTKE, HUSAIN AL-MOHSEN, Mechanical Engineering Department, MIT, MICHAEL GALLIS, Sandia National Laboratories, NICOLAS HADJICONSTANTINOU, Mechanical Engineering Department, MIT — We present a variance-reduced direct Monte Carlo method for efficient simulation of low-signal kinetic problems. In contrast to previous variance-reduction methods, the method presented here, referred to as VRDSMC, is able to substantially reduce variance with essentially no modification to the standard DSMC algorithm. This is achieved by introducing an auxiliary equilibrium simulation which, via an importance weight formulation, uses the same particle data as the non-equilibrium (DSMC) calculation. The desired hydrodynamic fields are expressed in terms of the difference between the equilibrium and the non-equilibrium results, which yields drastically reduced statistical uncertainty because it exploits the correlation between the two simulations. The resulting formulation is simple to code and provides considerable computational savings for a wide range of problems of practical interest. Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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