Abstract Submitted
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Gridless DSMC using dynamic octrees[1] ANDREW CHRISTLIEB, SPENCER OLSON, University of Michigan — This work concerns the development of a gridless simulation tool for collisional plasmas. In this paper we focus on one part of this tool: a gridless algorithm for modeling the inter-particle collisions of a gas. Using an octree algorithm to automatically cluster the spatial distribution of particles, we implement a gridless Direct Simulation Monté Carlo (DSMC) algorithm. Conventional fixed-grid algorithms are susceptible to grid-mismatch to the physical system, resulting in erroneous solutions. On the contrary, a gridless DSMC algorithm can be used to simulate various physical systems without the need to perform grid-mesh optimization. This provides additional flexibility for domains with extremely complex geometries. In DSMC, local macroscopic quantities are needed to maintain correct collision rates and are used to reduce statistical noise. Many of these macroscopic quantities tracked per grid cell are time-averaged. In a gridless approach, there is no underlying structure to track such time-averaged macroscopic quantities. We have developed a method of tracking these quantities at the lowest levels of the tree. Using a spherical spline, an estimate of previous time-averaged quantities at a new tree-node location can be found. To validate this method we have performed several benchmark simulations: Couette flow, thermal Couette flow, and two-dimensional flow past an thin plate. The results compare favorably with traditional DSMC.

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