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Data Structures and Adaptive Mesh Refinement for a 3-Level Embedded Cartesian Mesh DSMC Implementation CHONGLIN ZHANG, DA GAO, TOM SCHWARTZENTRUBER, University of Minnesota — The data structures and overall algorithms of a newly developed 3-D direct simulation Monte Carlo (DSMC) program are outlined. The code employs an embedded 3-level Cartesian mesh, accompanied by a cut-cell algorithm to incorporate triangulated surface geometry into the adaptively refined Cartesian mesh. Such an approach enables decoupling of the surface mesh from the flow field mesh, which is desirable for near-continuum flows, flows with large density variation, and also for adaptive mesh refinement (AMR). Two separate data structures are proposed in order to separate geometry data from cell and particle information, leading to high scalability and efficient AMR for parallel simulations. A simple and efficient AMR algorithm that maintains local cell size consistent with the local mean-free-path and therefore a constant number of particles in each cell will be detailed. The 3-level embedded Cartesian mesh combined with AMR allows increased flexibility for precise control of local mesh size and time-step, both vital for accurate and efficient DSMC simulation. Verification and validation of the code will be provided, and DSMC results for 3-D flows with large density variations will also be presented.

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