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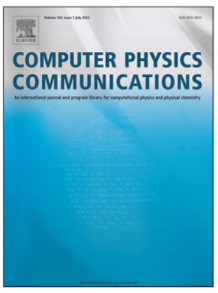

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Three-Dimensional Implementation of the Low Diffusion Method for Continuum Flow Simulations

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Abstract

Concepts of a particle-based continuum method have existed for many years. The ultimate goal is to couple such a method with the Direct Simulation Monte Carlo (DSMC) in order to bridge the gap of numerical tools in the treatment of the transitional flow regime between near-equilibrium and rarefied gas flows. For this purpose, the Low Diffusion (LD) method, introduced first by Burt and Boyd, offers a promising solution. In this paper, the LD method is revisited and the implementation in a modern particle solver named PICLas is given. The modifications of the LD routines enable three-dimensional continuum flow simulations. The implementation is successfully verified through a series of test cases: simple stationary shock, oblique shock simulation and thermal Couette flow. Additionally, the capability of this method is demonstrated by the simulation of a hypersonic nitrogen flow around a 70°-blunted cone. Overall results are in very good agreement with experimental data. Finally, the scalability of PICLas using LD on a high performance cluster is presented.

Keywords: Particle Method, Direct Simulation Monte Carlo, Low Diffusion Method, Gas Flow Simulations

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