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Hybrid lattice Boltzmann-direct simulation Monte Carlo approach for flows in three-dimensional geometries

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Highlights

- A hybrid method combining the Direct Simulation Monte Carlo with the Lattice Boltzmann Method is here extended to the case of a three-dimensional complex flow, characterized by a large range of non-equilibrium and rarefaction effects.
- The hybrid model is based on a domain decomposition technique and the switching criteria between the two methods is based both on the rarefaction conditions, defined according to the macroscopic flow characteristic scale, as well as on non-equilibrium conditions as determined by the local velocity gradient
- This study demonstrates that the hybrid model can provide results in terms of pressure and velocity comparable to those given by the DSMC but at a fraction of the computational cost.
- The demonstrated very good parallel scaling properties of the developed algorithms remain valid also when thousands of processors are used, this contributing to the possibility to study with high accuracy the physics of realistic complex flows.

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