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How good is the Lattice Boltzmann method? JOSEPH KOCHEEMOOLAYIL, STC Corp. in NASA Ames Research Center, MICHAEL BARAD, CETIN KIRIS, NASA Ames Research Center — Conflicting opinions exist in literature regarding how efficient the lattice Boltzmann method is relative to high-order finite difference approximations of the Navier-Stokes equations on Cartesian meshes, especially at high Mach numbers. We address the question from the pragmatic viewpoint of a practitioner. Dispersion, dissipation and aliasing errors of various lattice Boltzmann models are systematically quantified. The number of floating point operations and memory required for a desired accuracy level are carefully compared for the two numerical methods. Turbulent kinetic energy budgets for several standard test cases such as the decaying Taylor-Green vortex problem are used to evaluate how effective the stabilization mechanisms necessary for lattice Boltzmann method at high Reynolds numbers are. Detailed comments regarding the cyclomatic complexity of the underlying software, scalability of the underlying algorithm on state-of-the-art high-performance computing platforms and wall clock times and relative accuracy for selected simulations conducted using the two approaches are also made.

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