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Semi-Lagrangian Lattice Boltzmann Method for Compressible Flows DOMINIK WILDE, University of Siegen, ANDREAS KRAEMER, National Heart, Blood and Lung Institute, National Institutes of Health, HOLGER FOYSI, University of Siegen — The lattice Boltzmann method (LBM) is an established tool for the simulation of weakly compressible flows. However, in the field of compressible flows the LBM is still lacking a widely accepted framework, which is why it is an active field of research. On the one hand, traditional LBM solvers with an exact propagation of the distribution function values usually require large velocity sets. On the other hand, Eulerian solvers like finite volume or finite difference LBMs suffer from high computation costs. We propose a semi-Lagrangian streaming step allowing for unstructured grids and for non-integer-based velocity sets. This procedure effects small numerical dissipation, while the spatial order of convergence can be increased by the use of high-order interpolation polynomials in combination with an appropriate choice of support points. The semi-Lagrangian LBM circumvents the costly application of explicit time integration in Eulerian schemes. Instead, from an algorithmic point of view, the semi-Lagrangian LBM is still close to the original LBM formulation. Simulations of a Sod shock tube, a 2D Riemann problem, a shock-vortex interaction, and a 2D airfoil confirm the newly introduced semi-Lagrangian LBM to be appropriate for the calculation of compressible flows.

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