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Exponential Time Integrator for Solving the Lattice Boltzmann Equations Based on a Spectral-Element Discontinuous Galerkin Approach KALU CHIBUEZE UGA, CUNY - CCNY , MISUN MIN, ANL, TAEHUN LEE, CUNY - CCNY, PAUL FISCHER, ANL, CUNY - CCNY COLLABORATION, ANL COLLABORATION — I'll present a high-order time integration method for solving lattice Boltzmann equation (LBE). We use high-order spectral-element discretization in space based on discontinuous Galerkin approach and apply a Krylov subspace approximation for time-advancing. The semi-discrete form of the spectral-element discontinuous Galerkin (SEDG) method on the LBE brings us to an ODE of the form ${}^{\partial U}/_{\partial t} = -AU$ with initial condition$U(0) = U_0$ where $U$is a solution vector. A is a large sparse matrix based on a polynomial approximation order N. The solution of the equation is $U(t) = U_0 e^{-At}$. The explicit one-step method is based on the computation of matrix functions of the type $U(t+\delta) = U(t)e^{-A\delta}$. We project the matrix exponential and the solution vector onto a finite dimensional Krylov subspace K_m of order m. We use the Arnoldi algorithm to generate an orthogonal basis V_m and an Hessenberg matrixH_m for approximating $e^{-A\delta}U(t) \approx V_m e^{-H_m \delta} V_m^T U(t)$. We will study convergence of the exponential time integrator for possible use of larger time step with high-order m.We will demonstrate its efficiency and accuracy compared to the Runge-Kutta time-stepping methods.

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