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Discrete dynamical system approximation to the Boltzmann equation for eddy-viscosity-free LES modeling of transitional flow J. M. MCDONOUGH, University of Kentucky, HUIDAN (WHITNEY) YU, Indiana University Purdue University at Indianapolis — A discrete dynamical system (DDS) representation of the Boltzmann equation with the BGK approximation is derived. The density distribution function is constructed through a single-mode Fourier–Galerkin approximation with basis functions in coordinate space but Fourier coefficients depending on time and molecular velocity. The resulting DDS contains numerous bifurcation parameters related to various physical quantities, and effects of varying these parameters on temporal behavior of distribution function Fourier coefficients are studied through time series and power spectra by means of which types of dynamical behavior are identified. It is found that the DDS can produce all of steady, periodic, sub-harmonic, quasi-periodic, phase-locked and chaotic time series as bifurcation parameters are changed; in addition, the chaotic regimes exhibit various forms of intermittency. An approach to employing this DDS as part of a subgrid-scale model for eddy-viscosity-free, multi-scale large-eddy simulation employing the lattice Boltzmann equation is described.

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