Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

3-D Discrete Dynamical System Based on Volumetric Lattice Boltzmann Equation .[1] X. ZHANG, Indiana University - Purdue University Indianapolis, J. MCDONOUGH, University of Kentucky, H. YU, Indiana University - Purdue University Indianapolis — We develop a 3-D discrete dynamical system (DDS) using the volumetric lattice Boltzmann equation (VLBE). After providing a brief derivation of a "poor man's VLBE" (PMVLBE) for the DDS, we study time series, power spectra, and regime maps. Of specific interest is the ability of this DDS to produce expected physical fluid flow behaviors such as steady, periodic, and subharmonic patterns and, particularly, various turbulent phenomena including intermittencies. To derive the PMVLBE, we decomposed the VLBE into large-scale and subgrid-scale (SGS), and expanded the latter using Fourier series. A single mode from the Fourier representation of the SGS part is selected, and a forward Euler numerical integrator is used to discretize the resulting equation. In this study, the D3Q19 lattice model is used, from which 20 bifurcation parameters, all of which can be calculated from physical quantities (without models), are identified. This DDS will be employed to produce SGS information for use with the volumetric lattice Boltzmann method in the context of large-eddy simulation.

[1]The research is supported by the NSF grant (1803845) and IUPUI University Fellowship. The Extreme Science and Engineering Discovery Environment (XSEDE), supported by the NSF grant (ACI-1053575), was used.

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Date submitted: 02 Aug 2020 Electronic form version 1.4