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On the stability of multi-step finite-difference-based lattice Boltzmann schemes. (English)

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- [76M28](#) Particle methods and lattice-gas methods
- [76M20](#) Finite difference methods applied to problems in fluid mechanics
- [65M06](#) Finite difference methods for initial value and initial-boundary value problems involving PDEs
- [65M12](#) Stability and convergence of numerical methods for initial value and initial-boundary value problems involving PDEs

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References:

- [1] Abe, T., Derivation of the lattice Boltzmann method by means of the discrete ordinate method for the Boltzmann equation, *J. Comput. Phys.*, 31, 1, 241-246, (1997) · [Zbl 0877.76062](#)
- [2] Bhatnagar, P. L.; Gross, E. P.; Krook, M., A model for collision processes in gases. I. Small amplitude processes in charged and neutral one-component systems, *Phys. Rev.*, 94, 3, 511-525, (1954) · [Zbl 0055.23609](#)
- [3] Biciusca, T.; Horga, A.; Sofonea, V., Simulation of liquid-vapor phase separation on GPUs using Lattice Boltzmann models with off-lattice velocity sets, *Compt. R. Mecan.*, 343, 10-11, 580-588, (2015)
- [4] Cao, N.; Chen, S.; Jin, S.; Martinez, D., Physical symmetry and lattice symmetry in the lattice Boltzmann method, *Phys. Rev. E*, 55, 1, R21-R24, (1997)
- [5] Chen, S.; Doolen, D., Lattice Boltzmann method for fluid flows, *Ann. Rev. Fluid Mech.*, 30, 329-364, (1998) · [Zbl 1398.76180](#)
- [6] Cristea, A.; Sofonea, V., Two component lattice Boltzmann model with flux limiters, *Cent. Eur. J. Phys.*, 2, 2, 382-396, (2004)
- [7] El-Amin, M. F.; Sun, S.; Salama, A., On the stability of the finite difference based lattice Boltzmann method, *Proc. Comput. Sci.*, 18, 2101-2108, (2013)
- [8] Fakhari, A.; Lee, T., Finite-difference lattice Boltzmann method with a block-structured adaptive-mesh-refinement technique, *Phys. Rev. E*, 89, 033310-1-033310-12, (2014)
- [9] Fakhari, A.; Lee, T., Numerics of the lattice Boltzmann method on non-uniform grids: Standard LBM and finite-difference LBM, *Comput. Fluids*, 107, 205-213, (2015) · [Zbl 1390.76710](#)
- [10] Guo, Z.; Zhao, T. S., Explicit finite-difference lattice Boltzmann method for curvilinear coordinates, *Phys. Rev. E*, 67, 066709-1-066709-12, (2003)
- [11] Guo, Z.; Zhao, T. S., Finite-difference-based lattice Boltzmann scheme for dense binary mixtures, *Phys. Rev. E*, 71, 026701-1-026701-12, (2005)
- [12] Guo, Z.; Zheng, C.; Zhao, T. S., A lattice BGK scheme for general propagation, *J. Sci. Comput.*, 16, 4, 569-585, (2001) · [Zbl 1039.76054](#)
- [13] Guzel, G.; Koc, I., Time-accurate flow simulations using a finite-volume based lattice Boltzmann flow solver with dual time stepping scheme, *Int. J. Comput. Methods*, 13, 6, 1650035-1-1650035-18, (2016) · [Zbl 1359.76229](#)
- [14] He, X.; Luo, L.-S., Theory of the lattice Boltzmann method: From the Boltzmann equation to the lattice Boltzmann equation, *Phys. Rev. E*, 56, 6, 6811-6817, (1997)
- [15] Hejranfar, K.; Ezzatneshan, E., Simulation of two-phase liquid-vapor flows using a high-order compact finite-difference lattice Boltzmann method, *Phys. Rev. E*, 92, 053305-1-053305-23, (2015)
- [16] Huang, J. J.; Huang, H.; Shu, C.; Chew, Y. T.; Wang, S. L., Hybrid multiple-relaxation-time lattice-Boltzmann finite-difference method for axisymmetric multiphase flows, *J. Phys. A, Math. Theor.*, 46, 055501-1-055501-27, (2013) · [Zbl 1339.76042](#)
- [17] Kandhai, D.; Soll, W.; Chen, S.; Hoekstra, A.; Sloop, P., Finite-difference lattice-BGK methods on nested grids, *Comput. Phys. Commun.*, 129, 100-109, (2000) · [Zbl 0976.76067](#)

- [18] Kefayati, G. R., FDLBM simulation of magnetic field effect on mixed convection in a two sided lid-driven cavity filled with non-Newtonian nanofluid, *Powder Technol.*, 280, 135-153, (2015)
- [19] Krivovichev, G. V., On the finite-element-based lattice Boltzmann scheme, *Appl. Math. Sci.*, 8, 33, 1605-1620, (2014)
- [20] Kupershtokh, A. L., Criterion of numerical instability of liquid state in LBE simulations, *Comput. Math. Appl.*, 59, 2235-2245, (2010) · [Zbl 1193.76111](#)
- [21] Liu, H.; Valocchi, A. J.; Zhang, Y.; Kang, Q., Phase-field-based lattice Boltzmann finite-difference model for simulating thermocapillary flows, *Phys. Rev. E*, 87, 013010-1-013010-13, (2013)
- [22] Mei, E.; Shyy, W., On the finite difference-based lattice Boltzmann method in curvilinear coordinates, *J. Comput. Phys.*, 123, 426-448, (1998) · [Zbl 0934.76074](#)
- [23] Mohammadpourfard, M.; Fallah, M., Optimized free energy-based lattice Boltzmann method for modeling micro drop dynamics, *Int. J. Comput. Methods*, 10, 3, 1350006-1-1350006-17, (2013) · [Zbl 1359.76233](#)
- [24] Nejat, A.; Abdollahi, V., A critical study of the compressible lattice Boltzmann methods for Riemann problem, *J. Sci. Comput.*, 54, 1-20, (2013) · [Zbl 1426.76610](#)
- [25] Niu, X. D.; Shu, C.; Chew, Y. T.; Wang, T. G., Investigation of stability and hydrodynamics of different lattice Boltzmann models, *J. Stat. Phys.*, 117, 3-4, 665-680, (2004) · [Zbl 1113.82044](#)
- [26] Nourgaliev, R. R.; Dinh, T. N.; Theofanous, T. G.; Joseph, D., The lattice Boltzmann equation method: Theoretical interpretation, numerics and implications, *Int. J. Multiphase Flow*, 29, 117-169, (2003) · [Zbl 1136.76594](#)
- [27] Pan, C.; Luo, L. S.; Miller, C. T., An evaluation of lattice Boltzmann schemes for porous medium flow simulation, *Comput. Fluids*, 35, 8, 898-909, (2006) · [Zbl 1177.76323](#)
- [28] Reider, M. B.; Sterling, J. D., Accuracy of discrete-velocity BGK models for the simulation of the incompressible Navier-Stokes equations, *Comput. Fluids*, 24, 4, 459-467, (1995) · [Zbl 0845.76086](#)
- [29] Richtmyer, R. D.; Morton, K. W., *Difference Methods for Initial-Value Problems*, (1994), John Wiley and Sons: John Wiley and Sons, New York · [Zbl 0824.65084](#)
- [30] Rinaldi, P. R.; Dari, E. A.; Venere, M. J.; Clause, A., A Lattice-Boltzmann solver for 3D fluid simulation on GPU, *Simul. Model. Pract. Theory*, 25, 163-171, (2012)
- [31] Schreiber, M.; Neumann, P.; Zimmer, S.; Bungartz, H. J., Free-surface lattice-Boltzmann simulation on many-core architectures, *Proc. Comput. Sci.*, 4, 984-993, (2011)
- [32] Seta, T.; Takakashi, R., Numerical stability analysis of FDLBM, *J. Stat. Phys.*, 7, 1-2, 557-572, (2002) · [Zbl 1007.82009](#)
- [33] Shan, X.; Yuan, X.-F.; Chen, H., Kinetic theory representation of hydrodynamics: A way beyond the Navier Stokes equation, *J. Fluid Mech.*, 550, 1, 413-441, (2006) · [Zbl 1097.76061](#)
- [34] Shi, Y.; Yap, Y. W.; Sader, J. E., Linearized lattice Boltzmann method for micro- and nanoscale flow and heat transfer, *Phys. Rev. E*, 92, 013307-1-013307-13, (2015)
- [35] Smith, B. T.; Boyle, J. M.; Dongarra, J. J.; Garbow, B. S.; Ikebe, Y.; Klema, V. C.; Moler, C. B., *Matrix Eigensystem Routines — EISPACK Guide*, *Lect. Notes Comput. Sci.*, 6, 1-123, (1976) · [Zbl 0325.65016](#)
- [36] Sofonea, V.; Sekerka, R. F., Viscosity of finite difference lattice Boltzmann models, *J. Comput. Phys.*, 184, 422-434, (2003) · [Zbl 1062.76556](#)
- [37] Sterling, J. D.; Chen, S., Stability analysis of lattice Boltzmann methods, *J. Comput. Phys.*, 123, 196-206, (1996) · [Zbl 0840.76078](#)
- [38] Ubertini, S.; Bella, G.; Succi, S., Lattice Boltzmann method on unstructured grids: Further developments, *Phys. Rev. E*, 68, 1, 016701-1-016701-10, (2003)
- [39] Ubertini, S.; Succi, S., Recent advances of lattice Boltzmann techniques on unstructured grids, *Progr. Comput. Fluid Dyn.*, 5, 1-2, 85-96, (2004)
- [40] Wardle, K. E.; Lee, T., Finite element lattice Boltzmann simulations of free surface flow in a concentric cylinder, *Comput. Math. Appl.*, 65, 230-238, (2013) · [Zbl 1268.76051](#)
- [41] Watari, M., Finite difference lattice Boltzmann method with arbitrary specific heat ratio applicable to supersonic flow simulations, *Phys. A*, 382, 502-522, (2007)
- [42] Watari, M.; Tsutahara, M., Supersonic flow simulations by a three-dimensional multispeed thermal model of the finite difference lattice Boltzmann method, *Phys. A*, 364, 129-144, (2006)
- [43] Wei, Y.-K.; Hu, X.-Q., Two-dimensional simulations of turbulent flow past a row of cylinders using lattice Boltzmann method, *Int. J. Comput. Methods*, 14, 1, 1750002-1-1750002-11, (2017) · [Zbl 1404.76213](#)
- [44] Worthing, R. A.; Mozer, J.; Seeley, G., Stability of lattice Boltzmann methods in hydrodynamic regimes, *Phys. Rev. E*, 56, 2, 2243-1-2243-11, (1997)
- [45] Yan, B.; Xu, A.-G.; Zhang, G.-C.; Ying, Y.-J.; Li, H., Lattice Boltzmann model for combustion and detonation, *Front. Physics*, 8, 1, 94-110, (2013)
- [46] Zhang, Y.; Pan, G.; Hung, Q., ICCM2016: The implementation of two-dimensional multi-block lattice Boltzmann method on GPU, *Int. J. Comput. Methods*, 15, 2, 1840002-1-1840002-16, (2018)

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