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Entropic Lattice Boltzmann Methods for Fluid Mechanics[1]
SHYAM CHIKATAMARLA, FABIAN BOESCH, DAVID SICHAU, ILYA KARLIN, ETH Zurich — With its roots in statistical mechanics and kinetic theory, the lattice Boltzmann method (LBM) is a paradigm-changing innovation, offering for the first time an intrinsically parallel CFD algorithm. Over the past two decades, LBM has achieved numerous results in the field of CFD and is now in a position to challenge state-of-the art CFD techniques. Our major restyling of LBM resulted in an unconditionally stable entropic LBM which restored Second Law (Boltzmann H theorem) in the LBM kinetics and thus enabled affordable direct simulations of fluid turbulence [2]. We review here recent advances in ELBM as a practical, modeling-free tool for simulation of turbulent flows in complex geometries. We shall present recent simulations including turbulent channel flow, flow past a circular cylinder, knotted vortex tubes, and flow past a surface mounted cube. ELBM listed all admissible lattices supporting a discrete entropy function and has classified them in hierarchically increasing order of accuracy[3]. Applications of these higher-order lattices to simulations of turbulence and thermal flows shall also be presented.

[1] Chikatamarla et al, J. Fluid. Mech, 656 (2010); Physica. A, 392 (2013)
[2] Chikatamarla and Karlin, Phys. Rev. Lett., 010201 (2006); Phys. Rev. Lett, 19060

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