Recently, thermal fluctuations have been introduced in the LBM for non-ideal gases [M. Gross, R. Adhikari, M. E. Cates, F. Varnik, Phys. Rev. E. 82, 056714 (2010)]. Here, we apply this method to assess the capability of LB to simulate critical phase transitions in a two-phase fluid in 2D, focusing in particular on static critical phenomena. Being based on a standard Ginzburg-Landau free energy functional, our model is expected to display Ising-type critical behavior. A finite-size scaling analysis is applied to determine the critical exponents associated with the compressibility, correlation length and order parameter. We compare our methods and results to the standard Monte-Carlo approach found in the literature. Due to the conserved nature of the order parameter, analyses become more involved in case of LB.

Finally, we give an outlook to the simulation of dynamic critical phenomena (e.g., critical critical enhancement of shear viscosity) with LB and discuss issues associated with the lack of energy conservation in the present model.