Finite difference and cubic interpolated profile lattice boltzmann method for prediction of two-dimensional lid-driven shallow cavity flow

Abstract

In this paper, two-dimensional lid-driven cavity flow phenomena at steady state were simulated using two different scales of numerical method: the finite difference solution to the Navier–Stokes equation and the cubic interpolated pseudo-particle lattice Boltzmann method. The aspect ratio of cavity was set at 1, 2/3, 1/2 and 1/3 and the Reynolds number of 100, 400 and 1,000 for every simulation condition. The results were presented in terms of the location of the center of main vortex, the streamline plots and the velocity profiles at vertical and horizontal midsections. In this study, it is found that at the simulation of Reynolds numbers 100 and 400, both methods demonstrate a good agreement with each other; however, small discrepancies appeared for the simulation at the Reynolds number of 1,000. We also found that the number, size and formation of vortices strongly depend on the Reynolds number. The effect of the aspect ratio on the fluid flow behavior is also presented.