APPLICATION OF LATTICE BOLTZMANN METHOD AND FIELD SYNERGY PRINCIPLE TO THE HEAT TRANSFER ANALYSIS OF CHANNEL FLOW WITH OBSTACLES INSIDE

by

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In this paper the lattice Boltzmann method and field synergy principle are applied to simulate two-dimensional incompressible steady channel flow under low Reynolds number, and analyze the local influence on velocity field and temperature field caused by inserting cylinder obstacles of different cross-section. Furthermore, field synergy principle of elliptic flow type is applied to demonstrate that the increased interruption within the fluid increases the synergistic level between the velocity field and temperature gradient field. As the intersection angle between the velocity vector and the temperature gradient vector decreases by inserting cylinder obstacles to fluid field, the results of heat transfer will improve significantly.

Key words: lattice Boltzmann method, field synergy principle, intersection angle

Introduction

Lattice Boltzmann method (LBM), which belongs to the explicit method, primarily solves the distribution function of the particles first, and therefore could skip the iterative computations. Furthermore, the stability of the method has nothing to do with the sizes of the lattices and the length of time step. As a result, the algorithms of the method are much simpler and steadier, which makes the method superior to its conventional counterparts. In addition to the simplicity of the equations, LBM is able to concretely demonstrate the ability of microscopic interaction as well. This method, hence, has been successfully applied to the simulation and calculation of a series of problems ranging from ordinary hydrodynamic problems [1] to the complex flowing phenomena such as two-phase flows [2] and porous flows [3].

Guo [4] proposed a novel concept concerning boundary layer flows when he studied on convective heat transfer. He pointed out that the intersection angle formed by

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