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并列双椭圆柱绕流的格子Boltzmann-虚拟区域方法的模拟研究

Numerical investigation of flow past two elliptical cylinders in side-by-side arrangement via lattice Boltzmann-fictitious domain method

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英文关键词: [elliptical cylinder](#) [lattice Boltzmann method](#) [fictitious domain method](#) [flow past cylinder](#)

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中文摘要:

采用格子Boltzmann-虚拟区域方法对并列双椭圆柱绕流进行了模拟研究。首先, 通过与并列双圆柱的结果进行对比, 验证了数值方法的有效性。其次对雷诺数为200时两种间距($g=0.5a$ 和 $2.0a$, g 为柱体表面间距, a 为椭圆长轴)的情况进行了研究, 考察了椭圆长轴与短轴之比, 即 α 值对柱体升阻力系数及涡结构的影响。研究发现, 与圆柱相比, 对于 $g=0.5a$ 椭圆柱的升阻力系数可能出现两种变化, 一是升阻力随时间演化较规则, 接近周期性; 二是流场可能长时间偏向于其中一个椭圆柱, 这些变化与 α 的值有关。对于 $g=2.0a$, 两个椭圆柱后的某一区域内会出现四列涡街, 经过一段时间, 四列涡街又会演化成两列向两侧扩张的涡街。

英文摘要:

In this work a lattice Boltzmann-fictitious domain method has been adopted to numerically investigate flow past two elliptical cylinders in side-by-side arrangement. Firstly, the present method is validated by comparing its results with previous numerical results for flow past two circular cylinders at Reynolds number $Re=200$. Secondly, flow past two elliptical cylinders at $Re=200$ has been simulated with the spacing between two cylinder surfaces $g=0.5a$ and $2.0a$ (a is the major axes of elliptical cylinder). The effects of the ratio of major axes to minor axes α on the lift coefficients and drag coefficients of the cylinders and vortex structures have been explored. It has been found that in comparison with the results of the circular cylinders, the lift and drag coefficients of the elliptical cylinders may have two variations for $g=0.5a$. One is that the lift and drag coefficients are more regular and nearly periodic as time evolves. The other variation is that the flow between the two cylinders may deflect to one of cylinders for a long time. These two variations depend on the value of α . Furthermore, for $g=2.0a$ there exist four rows of vortex street behind the two elliptical cylinders, which will evolve into two rows of vortex street spreading to both sides after some time.

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