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振荡扰流片非定常流场的N-S方程数值模拟

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NUMERICAL SOLUTION OF NAVIER-STOKES EQUATION OF UNSTEADY SEPARATED FLOWS DUE TO A SPOILERS OSCILLATION

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摘要

通过有限差分法求解不可压缩流体的二维非定常Navier-Stokes方程,研究扰流片作振荡运动引起的强迫非定常分离流特性。着重研究了雷诺数、缩减频率等因素的影响。得到涡在扰流片上生成、发展、脱落以及脱落后的演化过程;并给出扰流片和平板表面的压力分布。计算结果和实验结果符合良好。

关键词： N-S方程 扰流片 非定常流 分离流 数值计算

Abstract：

The finite difference method （FDM） is applied in the present paper to solving the unsteady N-S equations for incompressible fluids. ADI and SLOR methods are served for the vorticity equation and the Poisson equation for , respectively. The upwind scheme is used for the convective terms in order to speed up the convergence. The moving boundary conditions are specially treated, and the effects of outlet conditions on the flow field are also examined. Numerical results obtained show the followingss The spoiler's oscillation induces forming, growing and shedding of vortices. The shedding frequency of vortices is equal to that of the spoiler's oscillation. The growing and shedding of vortices. The shedding frequency of vortices is equal to that of the spoiler's oscillation. The forced unsteady separated flows under the present investigation depend mainly on the reduced frequencies, At low reduced frequencies, the vortices shed from the spoiler interact weakly, with each other, and move downstream with an almost uniform speed of $0.38V\infty$. At high reduced frequencies, the interaction between the adjacent vortices strengthens. They close to and rotate around each other, and eventually, merge into a single vortex.

Keywords： N-S equations   spoilers   unsteady flow   separated numerical calculation

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