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圆柱绕流三维不稳定性的低维Galerkin法分析

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摘要　利用低维Ｇａｌｅｒｋｉｎ方法及Ｆｌｏｑｕｅｔ稳定性分析理论，计算分析了圆柱绕流的三维线性不稳定性．分析中构造了能较好描述尾迹区流动的周向基函数，建立了完备的合理的基函数组，改进了计算机算法．结果证实圆柱二维周期流对展向小扰动为不稳定的，正确地预计了出现三维长波不稳定性的临界雷诺数Ｒｅｃ＝１９０；扰动展向波长为λｃ一３．６ｄ．对雷诺数Ｒｅ为１８０，１９０两种工况下的圆柱三维绕流流场的计算进一步证实了这种流动的整体不稳定性．本文所预计的临界值比Ｎｏａｃｋ等人的结果更为精确，与Ｂａｒｋｌｅｙ等人的ＤＮＳ解一致，与Ｗｉｌｌｉａｍｓｏｎ的实验相符．

关键词　圆柱绕流　三维线性不稳定性　Galerkin方法　Floquet稳定性

分类号

THREE-DIMENSIONAL STABILITY ANALYSIS OF THEPERIODIC WAKE BEHIND A CIRCULAR CYLINDERBY LOW-DIMENSIONAL GALERKIN METHOD

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Abstract

Three-dimensional linear instability of flow past a circular cylinder is analyzed bymeans of a low-dimensional Galerkin method and Floquet instability theory. Some improvementson the construction of the azimuthal modes and calculation algorithm in the present analysisare made. The present results show that the ideal two-dimensional periodic flow around thecylinder is unstable with respect to a small spanwise disturbance. It has long-wavelength instabilityand the critical Reynolds number predicted is Re_c =1...

Key words　three-dimensional stability　cylinder wake　Galerkin method　Floquet stability

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