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错频对叶片的气动弹性稳定性影响

Influence of frequency mistuning on aeroelastic stability of blade

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中文关键词： 气动弹性 颤振 错频 叶片间相位角 能量法

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作者	单位
郑赟	北京航空航天大学 能源与动力工程学院, 北京 100191
王静	北京航空航天大学 能源与动力工程学院, 北京 100191

中文摘要:

采用求解动网格下的非定常可压缩Navier-Stokes方程模拟了振荡叶片下的气动弹性问题,研究了叶片的频率错频对叶片气动弹性稳定性的影响.通过数值模拟平面叶栅的气动弹性第10标准算例,验证了气动弹性的数值模拟方法,计算了不同叶片间相位角和折合频率下的气动阻尼系数,研究了叶片振动频率改变对叶片气动弹性稳定性的影响.计算结果说明:频率错频是提高气动弹性稳定性的有效方法,其主要作用是减小叶片间振动的耦合效应和叶片间相位角的影响,并且随着错频量增大叶片稳定性增强;通过模拟三维环形叶栅的气动弹性第4标准算例,计算了气动阻尼系数随错频量变化的规律,验证了错频量和气动弹性稳定性增强的规律.

英文摘要:

Aeroelastic stability of oscillating blades was simulated by solving unsteady compressible Navier-Stokes equations with dynamic deforming mesh, and the effect of frequency mistuning on aero-dynamic damping was investigated. The aeroelasticity algorithm was validated by the simulation of aeroelastic behavior of the 10th aeroelastic standard configuration. The aero-dynamic damping of the oscillating cascade was calculated with different inter-blade phase angles (IBPA) and reduced frequencies. The effects of mistuning pattern and frequency of mistuning on aero-dynamic damping and the mechanism of frequency mistuning on aeroelastic stability were studied. The results indicate that frequency mistuning is an effective method in improving aeroelastic stability and the coupling of the blade vibration and the effect of IBPA were weakened by frequency mistuning; the aeroelastic stability of blade increases with the increase of frequency mistuning. 3-D aeroelstic computation of the 4th aeroelastic standard configuration was performed to examine the effects of frequency mistuning on aeroelastic stability margin, and the laws of IBPA and aeroelastic stability increasing was validated.

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