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# 压气机进气畸变数值模拟技术研究

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# Numerical Simulation of Compressor with Inlet Distortion

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摘要 发展了一种针对进气畸变条件下的风扇/压气机进行性能预估和稳定性分析的计算方法。首先研究了将叶片作用力简化为体积力源项的建模方法,在此基础上开发出一套基于体积力的三维进气畸变数值模拟程序,使用该程序对NASA Rotor 35在均匀进气、进口存在稳态总压畸变及同时存在总压和总温畸变的流场进行了模拟分析。结果表明,该程序获得的压气机特性及参数分布与雷诺平均Navier-Stokes(RANS)计算吻合得很好,同时正确地模拟出了压气机转子与上游畸变来流的耦合作用及其对压气机性能和稳定工作裕度的影响。

关键词： 航空航天推进系统 风扇/压气机 进气畸变 体积力模型 稳定性

Abstract： A numerical tool is developed to evaluate the performance and stability of fan/compressor with inlet distortion. First, the modeling method to replace the blade row forces with distributed bulk body force source terms is investigated. Then a three-dimensional computational fluid dynamics (CFD) code is developed by adding the model into an Euler solver to simulate the fan/compressor flow field with inlet distortion. A NASA Rotor 35 flow field with clean inlet, inlet steady total pressure distortion and combined total pressure total temperature distortion are simulated respectively with the code. It demonstrates that the results obtained by the code of NASA Rotor 35 with clean inlet agree well with the solutions of Reynolds average Navier-Stokes (RANS). In the case with inlet distortion, this code can obtain the key feature of the interaction of the rotor and upstream flow field, and its influence on rotor performance and stall margin.

Keywords： aerospace propulsion system fan/compressor inlet distortion body force model stability

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