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预测轴流压气机叶栅通道端壁附面层及叶片力亏损

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A NEW METHOD FOR PREDICTING THE END WALL BOUNDARY LAYERS AND THE BLADE FORCE DEFECTS iNSIDE THE PASSAGE OF AXIAL COMPRESSOR CASCADES

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摘要 本文将二次流理论与端壁附面层理论相关联,提出一种用于预测轴流压气机叶栅通道内的端壁附面层及叶片力亏损的新方法。附面层主流流动采用包含叶片力亏损的动量积分方程,横流流动采用双层速度分布模型,使用二次流分析和有限差分计算方法预测横流外层速度分布,主流流动和横流流动交替计算。用于两种高负荷压气机叶栅的预测结果表明,不仅端壁附面层发展的预测结果与实验结果吻合较好,而且叶片力亏损发展的预测值也与实验值一致性较好;此外,该方法不仅自动,而且还能较准确地预测S形横向流动的发展。

关键词： 轴流压气机 叶栅 端壁附面层 叶片力亏损 二次流

Abstract： A new method is presented for calculating the ena-wan (?) lay(?) and the blade force defects inside the passage of axial compressor cascades based on associating boundary layer theory with secondary flow analysis in this paper. An integral equation of the boundary layer is used to calculate the longitudinal flow. Two layers of velocity modes are established to predict the transverse flow. An elliptic outer layer transverse flow associated with the secondary vorticity is computed by using differential method. The calculation is performed inside cascade passage, and conducted alternatively between the longitudinal flow and the transverse flow. The S-type transverse flow profiles are predicted automatically and accurately. Compared with experimental results, the predictions by this method show better agreement for two examples of heavily loaded cascades. It is apparent that this method is both practical and reliable. The bases are established for predicting the end wall boundary layers in multistage axial compressors in this paper.

Keywords： axial compressor cascades end-wall boundary layer blade force defect secondary flow

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