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压气机/风扇二维叶型自动优化设计

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Automatic Optimization Design of Compressor/Fan 2D Blade Profiles

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摘要 通过压气机叶片自动优化设计关键技术研究,提出采用并行遗传算法以实现全局寻优和并行优化缩短优化耗时;采用基于修改量参数化方法,达到优化过程生成叶型的可控性和合理性;提出兼顾非设计点性能的目标函数设置方法,实现全工况优化;并进一步研制出二维平面和任意回转面叶型自动优化设计软件。软件中流场计算模块与商用软件相比一致性较好,表明流场计算模块的可靠性。应用所研制的优化设计软件设计的高亚声叶栅叶片表面等熵马赫数分布呈控制扩散规律,超声叶栅通道内势流区流动近于呈等熵压缩,实现了给定压比下低总压损失系数和较大的低总压损失系数工作范围。

关键词: 压气机 风扇 叶片 数值优化 遗传算法

Abstract: In this paper, the key techniques of automatic compressor blade optimization are investigated. A parallel genetic algorithm is adopted as the numerical optimization method for its global and parallel optimization ability. The blade profile parameterization is based on geometry modification to generate controllable and reasonable blade profiles in the process of optimization. To realize the optimization in the whole work range, an objective function is set which also taken into consideration the performance at non-design positions. A software is developed, which could design 2D blade profiles of plane and arbitrary rotating surfaces. The software is used to design high subsonic and supersonic blade profiles of plane and arbitrary rotating surfaces. The constant entropy Mach number distribution of the designed subsonic blade profiles is in good accord with controlled diffusion regularity; the flows are compressed nearly in constant entropy in the potential regions of designed supersonic cascades. Therefore, the designed blade profiles are of low total pressure loss coefficient and large low total pressure loss coefficient range.

Keywords: compressor fan blade numerical optimization genetic algorithm

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