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整体叶盘结构强度减振一体化设计方法

Integrative design method of blisk considering structure strength and resonant vibration avoidance

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英文关键词:blisk coupled vibration structure design with resonant vibration avoidance structure strength design low order resonance vibration

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中文摘要:

基于软件ANSYS,建立了整体叶盘参数化模型.结合轮盘强度设计应力标准,借助ANSYS优化模块,获得了满足强度要求的最轻整体叶盘模型.分析了整体叶盘的振动特性,研究了轮盘和叶型参数调整对整体叶盘固有频率的影响.在此基础上,研究了通过改变缘板厚度、罩量及叶型厚度等参数使整体叶盘避开低阶激振的结构设计方法.研究结果表明:对于鼓筒约束的整体叶盘,轮盘参数调整可提高整体叶盘低阶耦合振动频率与4E激振频率在最大转速的裕度为2.2%,而叶型参数调整对此裕度的影响可达8%.最终获得的整体叶盘模型在1阶振动避开5E以下激振,并与4E激振频率在最大转速的裕度达10.8%的基础上达到质量最轻,因避频质量增加4.77%,说明整体叶盘结构强度减振一体化设计方法是可行的.

英文摘要:

The parametric model of blisk was established based on the software of ANSYS. The blisk model with minimum mass and sufficient structure strength, along with stress criterion of the strength design for disk, was accomplished through optimization module of ANSYS. The vibration characteristics of blisk was analyzed, and the influence of the adjustment of disk parameters and blade profile parameters on the nature frequency of blisk were studied. On this basis, the structure design method of blisk considering avoidance of low order excitation was studied through the adjustment of different structural parameters, such as rim thickness, blade lean and blade profile thickness. According to the research statistics, the adjustment of disk parameters can increase the margin between the frequencies of low order coupled vibration and 4E excitation by 2.2% at the maximum rotation speed for the drum-constrained blisk, and the margin increase can be 8% by adjustment of blade profile parameters. The integration design method of blisk considering structure strength and resonant vibration avoidance is feasible, as the margin between the frequencies of 4E excitation and 1st vibration of the final blisk with the minimum mass is up to 10.8% with insulation from 5E excitation at the loss of 4.77% mass increase.

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