



工程力学

ENGINEERING MECHANICS

ISSN 1000-4750

CN 11-2595/O3

CODEN GOLIEB

EI 收录期刊

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工程力学 » 2012, Vol. 29 » Issue (11): 360-364 DOI: 10.6052/j.issn.1000-4750.2010.09.0665

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飞行器机翼气动/结构耦合优化设计研究

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INVESTIGATION ON COUPLING AERODYNAMIC AND STRUCTURAL DESIGN OPTIMIZATION FOR AIRCRAFT AIRFOIL

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摘要

基于CFD/CSD耦合数值计算, 以升力特性为优化目标, 采用响应面算法优化光固化树脂材料的轻质F4风洞模型构型, 寻得6个优化解, 并采用光固化快速成型技术(SL)制作这6个F4风洞实验模型。实验结果表明: 6个模型升力特性与国外静气动弹性修正后的结果较接近(特别是6#模型最为接近机翼弹性变形的三维效果), 初步证明该文发展的气动/结构耦合优化设计方法基本可行, 既为基于SL技术的轻质模型高速风洞应用提供了支持, 又为多气动参数的飞行器气动/结构耦合优化和风洞试验数据静弹性修正建立了工作基础。

关键词: [气动/结构](#) [优化设计](#) [弹性模型](#) [气动特性](#) [光固化快速成型](#)

Abstract:

A coupling numerical simulation method of CFD/CSD is presented. Taking lift force characteristics as a restriction design object, the coupling aerodynamic and structural design optimization on the configurations of lightweight F4 models manufactured by Stereo-Lithography (SL) was accomplished. Six design optimization configurations of the models were conducted by utilizing the self-created program optimization of response surface methodology. The models with different wing configurations optimization were fabricated by SL technique. The results indicate that the lift force characteristics of the models are accord with the overseas results including static aero-elastic modification, especially that the experimental results of 6# model present that the wings' deformations are in three-dimensional directions, which shows the coupling aerodynamic and structural design optimization method is feasible. The method can provide some fundamentals and supports for the application of lightweight models based on SL for high-speed wind-tunnel test, also can give some suggestions and thoughts to study coupling aerodynamic and structural design optimization for aircrafts based on some aerodynamic parameters and static aero-elastic modifications on aerodynamic data obtained in the experiments.

Key words: [aerodynamics and structure](#) [design optimization](#) [elastic models](#) [aerodynamic characteristics](#) [stereo-lithography](#)

收稿日期: 2010-09-15;

PACS: [TH113](#)

基金资助:

国家自然科学基金项目(51075385); “973”计划课题项目(2009CB723802)

通讯作者: 杨党国

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