固体力学与飞行器总体设计

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基于BLISS和PMA的多学科可靠性设计优化

刘云平[1], 张俊[2], 张冰[2], 孙瑾[3]

1. 南京信息工程大学 信息与控制学院, 江苏 南京 210044;
2. 山东水利职业学院 机电工程系, 山东 日照 276826;
3. 中信建设有限责任公司, 北京 100027

Multidisciplinary Reliability Design and Optimization Based on BLISS and PMA

LIU Yunping[1], ZHANG Jun[2], ZHANG Bing[2], SUN Jin[3]

1. College of Information and Control, Nanjing University of Information Science & Technology, Nanjing 210044, China;
2. Department of Mechanical & Electrical Engineering, Shandong Water Polytechnic, Rizhao 276826, China;
3. CITIC Construction Co., Ltd., Beijing 100027, China

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摘要

针对多学科设计优化(MDO)中考虑不确定性而带来的计算复杂性问题,采用序列优化与可靠性评估(SORA)法的解耦思想,提出了基于两级集成系统综合(BLISS)策略和性能测量法(PMA)的多学科可靠性设计优化(RBMDO)方法。该方法将传统的3层嵌套循环的RBMDO方法过程解耦为顺序执行的确定性多学科设计优化(DMDO)和多学科可靠性分析(MRA),DMDO和MRA均采用BLISS策略进行计算,避免了每次多学科设计优化对完整可靠性分析模型的反复调用。飞机起落架缓冲器算例结果表明,文中方法的计算效率较其他两种方法分别提高了52.01%和26.51%,验证了方法的有效性。

关键词： 两级集成系统综合   性能测量法   多学科可靠性设计优化   可靠性   缓冲器

Abstract：

In order to solve the computational complexity caused by the consideration of uncertainties in multidisciplinary design optimization (MDO), an efficient method for reliability-based MDO (RBMDO) based on the bi-level integrated system synthesis (BLISS) and performance measure approach (PMA) is proposed. With the decoupling idea of sequential optimization and reliability assessment (SORA) method, the conventional triple nested loop of RBMDO is decoupled into a series of sequential execution of deterministic multidisciplinary design optimization (DMDO) and multidisciplinary reliability analysis (MRA). Both the DMDO and MRA are implemented by BLISS, which avoids the total computation of the whole multidisciplinary reliability analysis model iteratively in each RBMDO cycle. Finally, a shock absorber of landing gear example has been demonstrated to verify the efficiency of the proposed method, which shows that the efficiency of the proposed method has been improved by 52.01% and 26.51% respectively compared to the other two methods.

Keywords： bi-level integrated system synthesis   performance measure approach   reliability-based multidisciplinary design optimization   reliability   absorber

Corresponding Authors: 刘云平,Tel.: 025-58731276 E-mail: liuyunping2010@163.com   Email: liuyunping2010@163.com

About author: 刘云平 男, 博士, 讲师。主要研究方向: 多学科可靠性设计, 机器人动力学与控制。 Tel: 025-58731276 E-mail:

Service

liuyunping2010@163.com;张俊 女, 学士, 讲师。主要研究方向: 机械设计与模具创新设计。 Tel: 0633-8170099 E-mail: zhangjun_dw@163.com;张冰 男, 硕士, 讲师。主要研究方向: 模具设计与优化。 Tel: 0633-8170099 E-mail: zhangbing@vip.163.com;孙瑾 女, 硕士, 工程师。主要研究方向: 结构设计与多学科优化、 自动控制。 Tel: 010-59327930 E-mail: sunjin1028@163.com

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