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自由-自由运行体系动态载荷反演问题研究

Study of dynamic force identification for free-free structural system

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中文摘要：

　　对自由-自由运行体系动态载荷识别问题进行深入研究,将自由-自由运行体系振动积分方程时域离散化,建立了体系动态载荷反演的力学模型。在动态载荷反演模型求解过程中,由于结构矩阵的病态特性以及测量噪声的影响,常规最小二乘法往往失效;通过对载荷反演模型进行奇异值分解,指出该病态问题的本质,并提出相应的正则化求解方法。数值仿真表明了本文方法能够得到满足工程要求的稳定近似解。本文研究对于实际飞行器运行过程所受动态载荷评估具有一定的意义。

英文摘要：

　　A discrete formulation of force identification method in time domain is proposed, which is mainly for reconstructing the dynamics force applied on free-free structural system. The inverse problem of force identification is always ill-posed due to the inverse process of structural matrix and measurement noise in practical engineering and the ordinary least square method always obtains the meaningless solution. This paper further discloses the essence of ill-posedness of force identification problem in detail through the singular valued decomposition technique, and the corresponding regularization technique is presented to single out a stable and useful solution to force identification problem. Finally two forces exerting on a free-free plane frame structure are successfully identified by regularization technique with different measurement noise, at the same time the force identification results obtained by regularization technique are compared with the results gained by ordinary least square method. The numerical simulation shows that the regularized solution to identification of load exerting on the free-free structural system is valid. The proposed method is meaningful in the application to dynamic force identification for flying vehicles.

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