



航空学报 » 2012, Vol. » Issue (3) :470-478 DOI: CNKI:11-1929/V.20111202.1031.001

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基于非线性阻尼的航空发动机高压转子拉杆结构装配检测方法

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Assembly Variation Detection for Rod Fastening Rotor of High Pressure Spool in Aero-engine Based on Nonlinear Damping Identification

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摘要

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摘要 为了提高航空发动机高压转子拉杆结构的装配质量,提出了基于非线性阻尼的装配检测方法。该方法运用组合阻尼模型描述拉杆结构的非线性接触特性,并通过能量方程推导出基于Hilbert-Huang变换(HHT)方法的非线性阻尼的识别公式。在拉杆结构正常装配、单个螺栓松动和2个不相邻螺栓松动的3种情况下,采用非线性阻尼识别法进行实验,将3种情况得到的实验结果进行对比,发现基于组合阻尼模型得到的非线性阻尼与装配情况具有强烈的相关性,从而验证了基于非线性阻尼的装配检测方法的有效性。

关键词: 非线性阻尼 装配检测 Hilbert-Huang变换 高压转子 拉杆结构

Abstract: In order to improve the quality of the assembly operation for rod fastening rotors of high pressure spool in an aero-engine, this paper presents an assembly variation detection method based on nonlinear damping identification. A combined damping model is applied to describe the nonlinear contact in a rod fastening rotor, and the equation for nonlinear damping identification based on Hilbert-Huang transform (HHT) is found by a step-by-step integration of the energy dissipation equation. Then, dynamic experiments are carried out in three different scenarios, including a normal assembly, preload changes of a single bolted joint and two separate bolted joints. The dynamic response data are processed using the proposed nonlinear damping identification method. A strong correlation is observed between the changes of the preload and the nonlinear damping which represents the amount of nonlinear energy dissipation. In this way, the validity of the proposed assembly variation detection method is confirmed.

Keywords: nonlinear damping assembly variation detection Hilbert-Huang transform high pressure spool rod fastening

Received 2011-06-09;

Fund:

中国博士后科学基金(20100481498)

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引用本文:

张子阳, 谢寿生, 彭靖波, 滕健, 翟旭升. 基于非线性阻尼的航空发动机高压转子拉杆结构装配检测方法[J]. 航空学报, 2012, (3): 470-478.

ZHANG Ziyang, XIE Shousheng, PENG Jingbo, TENG Jian, ZHAI Xusheng. Assembly Variation Detection for Rod Fastening Rotor of High Pressure Spool in Aero-engine Based on Nonlinear Damping Identification[J]. Acta Aeronautica et Astronautica Sinica, 2012, (3): 470-478.

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