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基于PEM的结构二阶参数识别法的试验研究

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EXPERIMENTAL STUDY ON PREDICTION ERROR METHOD-BASED SECOND-ORDER STRUCTURE IDENTIFICATION ALGORITHM

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摘要 汶川和玉树地震给人民的生命财产造成重大损失。震后的结构物鉴定是震后安置工作的重要内容。基于振动测试分析建筑物震后整体性能的是结构表面病害鉴定方法的必要补充。该文通过3层楼的结构模型试验研究基于最小预测误差法(PEM)的结构二阶参数识别法的表现。该系统识别方法通过将结构动力学中的状态空间模型展开为线性的ARMAX/ARMA模型,再利用PEM方法识别模型参数,可直接从结构动力响应中识别出结构质量、刚度、阻尼比等二阶参数。该方法有助于结构的重要参数鉴定,也有助于结构健康监测系统中的损伤识别。

关键词: 损伤识别 随机子空间法 结构安全 系统识别 时程分析 振动响应

Abstract: A seismic Disaster causes serious lose of people' s life and properties. Building assessment is then one of the important works to rebuild the effected area. The globe property identification based on vibration data could be a critical supplement to the assessment technical only based on local damage identification. This paper studies the performance of the prediction error method (PEM)-based second order structural identification algorithms through a 3-storey model structure vibration test. By applying PEM method to identify the ARMAX/ARMA model derived from state space model, this identification method can identify second order model parameters such as mass, stiffness, damping ratios directly from measured vibration data. This system identification method can be used for investigating the structural properties and has potentials to be applied as a damage detection algorithm on structural health monitoring systems. To study the performance of this method, a 3-storey model structure is built. The identification results from measurements of vibration tests on this model structure including top story excitation tests and ground motion tests show that the PEM based second order structural system identification technique is capable of accurately identifying the second order parameters and locating and quantifying damages reasonably well in the context of real vibration test data.

Key words: damage assessment stochastic subspace methods structural safety system identification time series analysis vibration response

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