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扩展特征系统实现算法在结构模态参数识别中的应用

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THE APPLICATION OF THE EXTENDED EIGENSYSTEM REALIZATION ALGORITHM FOR STRUCTURAL MODAL PARAMETER IDENTIFICATION

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摘要 特征系统实现算法(ERA)需要以自由响应或脉冲数据作为前提，而实际工程中，随机荷载作用下的响应较为常见。该文在ERA算法的基础上进行扩展，引入观测马科夫(Observer Markov)参数，推导并提出扩展特征系统实现算法(EERA)，使其可以应用于随机荷载下的强迫振动响应，提高计算精度。该文首先引入3个自由度数值模拟试验，利用EERA进行模态参数识别，与精确解比较表明该文算法有效可靠，与ERA结果比较表明该文算法可以提高精度，然后在实验室环境下对一个4层框架结构进行了振动台实验，利用无线传感技术获得El Centrol地震波激振下的结构加速度响应，利用EERA识别此框架结构的模态参数，结果有效可靠，为实际工程应用提供了一定的可能性。

关键词： 模态参数识别 特征系统实现算法(ERA) 马科夫算子 无线传感技术 强迫振动响应

Abstract: The eigensystem realization algorithm is one of the global time domain methods for modal parameter identification, and it is widely used recently for its high accuracy and fast speed. The essence of ERA is using the measured impulse response or free response to perform identification; however, the forced vibration response is more commonly desired in the real project. Based on ERA, the paper presents the extended eigensystem realization algorithm (EERA) which could be used along with the measured forced response, and improve the accuracy by the observer Markov parameter. The identification of a 3-NDOF numerical simulation via EERA demonstrates the proposed method’s validity and accuracy through the comparison among exact results, EERA results, and ERA results. Then a laboratorial shaking table test of a four-story frame structure was conducted under the excitation of El Central earthquake wave, and acceleration responses were recorded by the wireless sensing technology. The modal parameters of the four-story frame structure were identified accurately by the EERA method, showing the possibility of its application in real projects.

Key words: modal parameter identification eigensystem realization algorithm Markov parameter wireless sensing technology forced vibration response

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