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New iterative method for model updating based on model reduction

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ABSTRACT

Model reduction technique is usually employed in model updating process. Here, a new iterative method associating the model updating method with the model reduction technique is investigated. Using the traditional iterative method, the errors resulted from replacing the reduction matrix of the experimental model with that of the finite element (FE) model are not fully considered, which needs more iterations and computing time. In order to reduce the errors produced in the replacement, a new iterative method is proposed based on the traditional method, in which the correction term related to the errors is added. The comparisons between the traditional iterative method and the proposed iterative method are shown by model updating examples of solar panels and both of these two iterative methods combine the cross-model cross-mode (CMCM) method and the succession-level approximate reduction (SAR) technique. The results indicate that the convergence rate and the computing time of the new method are significantly superior to those of the traditional iterative method with or without noise.

1. Introduction

Accurate finite element (FE) models of engineering structures are needed in order to predict their dynamic characteristics. Nowadays, the appearances of high precision aircrafts and spacecrafts, large-scale bridges and other new engineering structures impose higher demands on the reliability and accuracy of their FE models. However, a FE model may be inaccurate especially in the case of complex structures due to difficulties in the modeling of joints, boundary conditions and structural damping. So the development of model updating method which has the ability of correcting the numerical values of individual parameters in a FE model using the data obtained from an associated experimental model is necessary. The updated model can more correctly describes the dynamic properties of the subject structure [1]. Ever since Gravitz [2] first used the experimental data to update the flexibility matrix of an aircraft structure, extensive studies have been conducted. FE model updating techniques mainly can be categorized into two types: direct methods [3,4] and parametric methods [5–12]. Because the updating results have clear physical meaning and can be more conveniently utilized by commercial structural analysis software, parametric methods have got more attention.

Generally speaking, it is unpractical and even impossible to obtain all the mode information in experiment and the degrees of freedom (DOFs) of the FE model usually greatly exceed those of the experimental measurement. One critical reason is the rotational DOFs are difficult to be measured and some FE nodes in the internal structure also cannot be measured. Meanwhile, the number of the sensors is restricted by the experimental conditions. Therefore, in order to solve

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