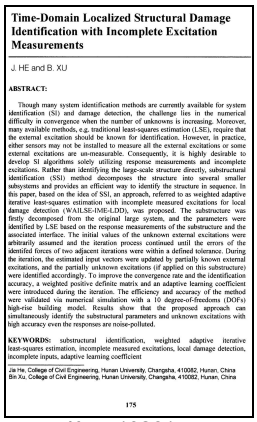

Time-Domain Localized Structural Damage Identification with Incomplete Excitation Measurements

J. HE and B. XU

ABSTRACT:

Though many system identification methods are currently available for system identification (SI) and damage detection, the challenge lies in the numerical difficulty in convergence when the number of unknowns is increasing. Moreover, many available methods, e.g. traditional least-squares estimation (LSE), require that the external excitation should be known for identification. However, in practice, either sensors may not be installed to measure all the external excitations or some external excitations are un-measurable. Consequently, it is highly desirable to develop SI algorithms solely utilizing response measurements and incomplete excitations. Rather than identifying the large-scale structure directly, substructural identification (SSI) method decomposes the structure into several smaller subsystems and provides an efficient way to identify the structure in sequence. In this paper, based on the idea of SSI, an approach, referred to as weighted adaptive iterative least-squares estimation with incomplete measured excitations for local damage detection (WAILSE-IME-LDD), was proposed. The substructure was firstly decomposed from the original large system, and the parameters were identified by LSE based on the response measurements of the substructure and the associated interface. The initial values of the unknown external excitations were arbitrarily assumed and the iteration process continued until the errors of the identifed forces of two adjacent iterations were within a defined tolerance. During the iteration, the estimated input vectors were updated by partially known external excitations, and the partially unknown excitations (if applied on this substructure) were identified accordingly. To improve the convergence rate and the identification accuracy, a weighted positive definite matrix and an adaptive learning coefficient were introduced during the iteration. The efficiency and accuracy of the method were validated via numerical simulation with a 10 degree-of-freedoms (DOFs) high-rise building model. Results show that the proposed approach can simultaneously identify the substructural parameters and unknown excitations with high accuracy even the responses are noise-polluted.

KEYWORDS: substructural identification, weighted adaptive iterative least-squares estimation, incomplete measured excitations, local damage detection, incomplete inputs, adaptive learning coefficient

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Ключевые слова:
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Содержание.