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Structural Damage Identification Based on Substructure Sensitivity and l_1 Sparse Regularization

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Sparsity constraints are now very popular to regularize inverse problems in the field of applied mathematics. Structural damage identification is a typical inverse problem of structural dynamics and Structural damage is a spatial sparse phenomenon, i.e., structural damage occurs, only part of elements or substructures are damaged. In this paper, a structural damage identification method based on the substructure-based sensitivity analysis and the sparse constraints regularization is proposed. Substructure sensitivity analysis, the establishment of structural damage stiffness parameter variation and change of modal parameters of linear equations between the measured degrees of freedom is limited, the equations for a morbid equation. The introduction of structural damage sparsity conditions, to minimize the l_1 norm optimization solution. The numerical example of the 20 bay-trass structure with considering measurement noise, incomplete of measurements and multi-damage cases are carried out. The effects of number sensor and layout to the identification results are also investigated. The results indicated that the damage locations and extents can be effectively identified by the proposed method. Additionally, the sensor location can be random arrangement, which has great significance to the sensor placement of the actual structural health monitoring because robust structural damage identification also can be obtained even a few of sensor are failure.

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Ключевые слова:

Содержание