A HYBRID APPROACH FOR SOLVING THE STRUCTURAL DAMAGE IDENTIFICATION PROBLEM

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Abstract

Considerable research and effort over the last few decades has taken place in the field of system identification problem for different reasons. One of the most interesting applications involves the monitoring of structural integrity through the identification of damage [1]. The basic idea remains that measured modal parameters (notably frequencies, mode shapes, and modal damping) are functions of the physical properties of the structure (mass, damping, and stiffness). Therefore, changes in the physical properties, such as reductions in stiffness resulting from the onset of cracks, loosening of a connection or more in general due to the aging of material, will cause detectable changes in these modal properties. Because changes in modal properties or properties derived from these quantities are being used as indicators of damage, the process of vibration-based damage detection eventually reduces to some form of a pattern recognition problem.

A variety of experimental, numerical and analytical techniques has already been proposed to solve the damage identification problem, and have received notable attention due to its practical applications [2]. These methods are usually classified under several categories, such as frequency and time domain methods, parametric and non-parametric models, deterministic and stochastic approaches [3].

The present investigation is focused on the solution of a dynamic inverse problem which is concerned with the assessment of damage in structures by means of measured vibration data. This inverse problem has been presented as an optimization problem which has been solved through the use of a hybrid approach where the Conjugate Gradient Method with the adjoint equation, also called variational method, is employed coupled with the Genetic Algorithm Method. Moreover, a general formulation for the application of the variational method is presented, which allows the use of experimental data in both time and frequency domains. The solution for the damage estimation problem has been obtained using synthetic experimental data, and the reported results are concerned with lumped and continuous parameter systems modeled through the finite element technique.

References

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