
Hybrid (Numerical-Experimental) Modeling of an Experimental Vehicle Model with Linear and Nonlinear Components

D. GIAGOPOULOS[1], C. THEODOSIOU[2] and S. NATSIAVAS[2]

ABSTRACT

Two systematic methodologies leading to hybrid modeling of complex mechanical systems are employed in the present work. This is done by applying numerical methods in determining the equations of motion of some of the substructures of large order mechanical systems, while the dynamic characteristics of the remaining components are determined through the application of appropriate experimental procedures. The first methodology applied has its roots in a frequency domain formulation. Such approaches are particularly suitable for systems possessing linear characteristics, which are measured experimentally, or for systems involving components with frequency dependent properties. However, these methods are usually limited by the fact that they are applicable to systems with linear and time invariant characteristics only. Therefore, when the system nonlinearities are activated and affect the response beyond a certain level, their predictions become inaccurate. For this reason, a second hybrid approach is applied here, which is based on a classical component mode synthesis method and is founded on theoretical developments in the time domain. The methodologies are applied in an experimental vehicle model. Specifically, the dynamic response of a frame structure, designed to exhibit a relatively large modal density and to involve nonlinear elements, is investigated. The composite structure is split into a frame substructure and to four support substructures. The frame substructure possesses linear properties determined through application of a finite element analysis. Also a model identification method is used to obtain the modal characteristics from a set of vibration measurements. Then the modal characteristics are used to update the finite element model of the substructure. On the other hand, the four support substructure possesses strongly nonlinear characteristics which are measured experimentally.

Keywords: Hybrid Modeling, Large Scale Structures, Substructuring, Modal Identification, Dimension Reduction, Nonlinear Supports.

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Ключевые слова:

Содержание.