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VIBRO-ACOUSTIC ANALYSIS OF RANDOM VIBRATION RESPONSE OF A FLEXIBLE STRUCTURE DUE TO ACOUSTIC FORCING

Abstract

With the remarkable computing capability and the availability of sophisticated, user-friendly computer-aided analysis software, the analyst main challenge is to insure that the analysis includes all the relevant physical phenomena. However, simple fundamental principles are mandatory, in order not to lose insight on the interrelationships between relevant elements, and to device simple methods that are robust, and amenable to modifications to address various problem categories. Space borne structure must fulfill various requirements, such as to resist the loads induced by the launch environment, and meet all the functional performances required on orbit such as dimensional stability and structural integrity. Space borne structure must also interface with some other subsystems. Noise and Vibration should also be taken as critical consideration in the design of aerospace vehicles for fatigue of components arising from interior structural and acoustic pressure fluctuations due to external structural or acoustic loading. Lightweight structures for high-technology applications increasingly have to fulfill not only high demands on stiffness and strength but also on high damping and low sound radiation due to the rising comfort requirements. Here, composites offer a very high vibro-acoustic lightweight potential. The great number of design variables allows to synergetically fulfill high stiffness and acoustic standards. Hence the objective of the present paper is to describe the application of BE-FE Fluid Structure interaction on a structure subject to acoustic load and to elaborate FE formulation of the computational scheme for unified approach on acoustic-aeroelastic interaction as developed earlier. The modal representation of a mechanical structure can be determined analytically if a lumped mass-spring system is concerned. In the general case of a continuous structure, a numerical approximation by means of a Finite Element Model (FEM) is made, discretizing the structure in a finite number of physical coordinates. The present work then proceeds with the dynamic response analysis of typical and generic space shell structure subject to acoustic loading. The numerical treatment applicability is investigated and validated through application to generic cases. The analysis carried out in the work is intended to serve as a baseline in the analysis of acoustic structure interaction for lightweight composite structures by analyzing the structural-dynamic response and sound radiation of composite shells, utilizing the authors developed numerical vibro-acoustic simulation models.The work carried out thus far is focused on the formulation of the basic problem of acoustic excitation and vibration of elastic structure in a coupled fluid-elastic-structure interaction.