유체로 연성된 두 사각평판의 고유진동수

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Natural Frequency of Two Rectangular Plates Coupled with Fluid

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Key Words : Rectangular plates, Hydroelastic, Free vibration, Finite Fourier series, Assumed modes.

Abstract: An analytical study is presented on the hydroelastic vibration of two rectangular identical plates coupled with a bounded fluid by using the finite Fourier series expansion method. It is observed that the two contrastive modes, the so called the out-of-phase and in-phase modes. All natural frequency of the in-phase modes can be predicted well by the combination of the beam modes in the air, but the natural frequency of the out-of-phase mode cannot be estimated precisely. However, the theoretical prediction for the out-of-phase mode can be improved by using the polynomials satisfying the plate boundary condition and fluid volume conservation. The proposed analytical method is verified by observing a good agreement to three dimensional finite element analysis results.

충격파 및 구조비선형성을 고려한 미사일 조종면의 유체유발 진동특성

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Flow-Induced Vibration Characteristics of a Missile Control Surface Considering Shock Wave and Structural Nonlinearity

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Key Words : structural nonlinearity, freeplay, FIV, control surface, transonic, flutter, CFD, shock wave.

Nonlinear aeroelastic characteristics of a missile control surface are investigated in this study. The wing model has freeplay structural nonlinearity at its pitch axis. Nonlinear aerodynamic flows with unsteady shock waves are also considered in high-speed flow region. To effectively consider a freeplay structural nonlinearity, the fictitious mass method (FMM) is applied to structural vibration analysis based on finite element method (FEM). A computational fluid dynamics (CFD) technique is used for computing the nonlinear unsteady aerodynamics of all-movable wings. To solve the nonlinear aeroelastic governing equations including the freeplay effect, a modal-based computational structural dynamic (CSD) analysis technique based on FMM is used in time-domain. Nonlinear aeroelastic responses with various limit cycle oscillations (LCO) are presented considering strong shock interferences.