Abstract

This dissertation deals with the analysis of the active control of geometrically nonlinear vibrations of the homogenous magneto-electro-elastic (**MEE**), functionally graded magneto-electro-elastic (**FGMEE**) and the piezoelectric fiber reinforced magneto-electro-elastic (**FRMEE**) plates and doubly curved shells using the active constrained layer damping (**ACLD)** treatment. The vertically/obliquely reinforced 1-3 piezoelectric composite (**PZC)** is considered as the candidate material for the constraining layer of the **ACLD** treatment. The constrained viscoelastic layer of the **ACLD** treatment is modeled by using the Golla–Hughes–McTavish (**GHM**) method in time domain. Based on a layer-wise higher order shear deformation theory, three-dimensional finite element models of the overall smart **MEE** plates and doubly curved shells integrated with the patches of the **ACLD** treatment has been developed taking into account the effects of coupling among elastic, electric and magnetic fields. The von Kármán type nonlinear strain displacement relations have been incorporated for the geometric nonlinearity. A negative velocity feedback control law is employed to incorporate the active damping. The backbone curves are derived to identify the magnitudes of the maximum non-dimensional displacements which induce substantial nonlinearity in the uncontrolled responses. Particular emphasis has been placed on the investigation of the effects of the coupled fields, **MEE** stacking sequence, boundary conditions and the variation of the piezoelectric fiber orientation angle in the 1-3 **PZC** constraining layer of the **ACLD** treatment on the damping characteristics of the overall **MEE, FGMEE** and **FRMEE** plates and doubly curved shells.

The investigations reveal that if the constraining layer of the **ACLD** patches is made of the vertically reinforced 1–3**PZC**, the control authority of the patches becomes maximum for active damping of geometrically nonlinear vibrations of the **MEE**, **FGMEE** and **FRMEE** plates and shells. The volume fraction and the orientation of the piezoelectric fibers embedded in the **FRMEE** substrate have considerable influence on the control of the geometrically nonlinear transient vibrations of the **FRMEE** plates and the **FRMEE** doubly curved shells.

Finally, an innovative attempt has been made on the smart control of geometrically nonlinear vibrations of the **MEE** plates and shells without using the **ACLD** treatment. The results reveal that the electric and the magnetic fields exhibit significant influence on the control of nonlinear transient vibrations of the **MEE** plates and shells.