Active Vibration Control of Piezoelectric Laminated Beam Under Clamped Conditions

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Abstract

Vibration suppression of piezoelectric laminated beam is presented in the present work. A one-dimensional finite element model for the dynamic analysis and control of a hybrid beam with surface mounted piezo-layers is developed. The coupled efficient layer-wise (zigzag) theory is used for making the model. Piezoelectric layers are used as sensing and actuating elements. Each node of beam element has four mechanical degrees of freedom and a variable number of electrical degrees of freedom. Cubic Hermite interpolation is used for the deflection and electric potentials. Linear interpolation is used for the axial displacement and the shear rotation. Eigen Value problem using subspace iteration method is solved for a beam with clamped-clamped end conditions to obtain the natural frequencies. Based on the structure responses determined by finite element method, a state space model of the system is developed by converting the equations in modal model. The linear quadratic Gaussian (LQG) algorithm is employed for controller design. The control model assumes that the upper layer acts as sensor and the bottom layer as actuator, and the signal generated through is used as a feedback reference in the closed loop control system. The formulation is validated by comparing the results with the 2D-FE results, obtained using ABAQUS, for a beam with clamped-clamped end conditions.

Keywords: Zigzag Theory, FEM, Smart Beam, ABAQUS, LQG controller

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