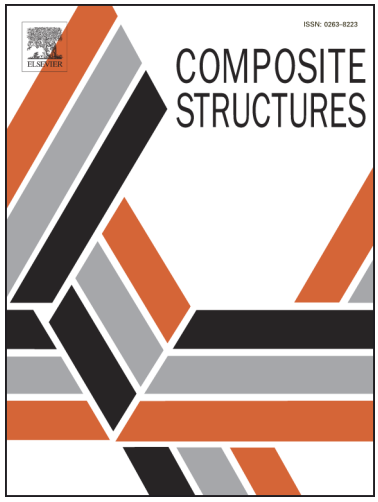

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Abstract

This paper deals with the finite element analysis of active constrained layer damping (ACLD) of laminated composite plates using fractional order derivative constitutive relations for viscoelastic material. The constraining layer of the ACLD treatment is composed of the vertically/obliquely reinforced 1–3 piezoelectric composites (PZCs). The novelty of the present analysis is that the three dimensional fractional derivative model (FDM) of the constrained viscoelastic layer has been derived in time domain. A three-dimensional finite element model has been developed based on the FDM of the viscoelastic layer. Thin laminated plates with various boundary conditions and stacking sequences are emphatically analyzed to investigate the effectiveness of the three-dimensional FDM for both the passive and active control authority of the ACLD patch.

1. Introduction

The use of piezoelectric materials has been extensively investigated by several researchers [1-10] for active control of vibration of high-performance light weight smart structures. The inherent properties of direct and converse piezoelectric effects present in the piezoelectric materials are exploited to use them as distributed actuators and sensors, respectively, either mounting them on or embedding them into the host flexible light weight structures. When they are activated properly with the suitable control voltage, the resulting structures attain self-controlling and self-sensing capabilities. Such flexible structures are customarily known as smart structures. Further investigation on reliable and efficient control of smart structures led to the development and increased use of active constrained layer damping (ACLD) treatment [11–17]. The flexural vibration control by the constrained layer damping treatment is attributed to the dissipation of energy in the constrained viscoelastic layer. Such dissipation is mostly due to the transverse shear deformations of the constrained viscoelastic layer. With proper control strategy, the smart piezoelectric constraining layer of the activated ACLD treatment can be exploited to increase the transverse shear deformations