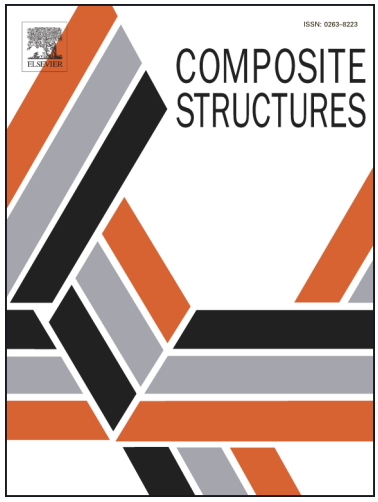

A coupling finite element model for analysis the nonlinear dynamic magneto-electric response of tri-layer laminate composites

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A coupling finite element model for analysis the nonlinear dynamic magnetoelectric response of tri-layer laminate composites

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Abstract: In this study, we investigate the nonlinear magnetoelectric (ME) response of a tri-layer ME laminate structure in a harmonic magnetic field. A coupling three dimensional (3D) finite element model of ME composite is built. Based on the Maxwell equations and a nonlinear magnetization relation proposed by Liu and Zheng, the inhomogeneous magnetic field distribution inside the layered ME composite are investigated by using the finite element method (FEM), moreover, the width of structure on magnetic field distribution and ME response are discussed in detail. Subsequently, the non-uniform distributions of stress, displacement, magnetic flux density and voltage are studied, and edge effect appears. Besides, the dynamic ME coefficient is also calculated and discussed. The results indicate that it's necessary to consider the real distribution of the magnetic field in the calculating the nonlinear ME response. The geometric size affect the ME coefficient obviously, the ME coefficient considered the width effect is smaller than analytical result and more close to the experimental data. Through analysis the stress state of the structure, the result shows that both the normal stress and shear stress in the interface are large when the laminate structure under resonance, which may lead to the interfacial debonding.

Keywords: Magnetoelectric effect, Layered composite, Finite element method, Dynamic response, Stress analysis