Vibration and Flutter Control of Wing-Plate Structures Using Macro-Fiber-Composites

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ABSTRACT

The purpose of this thesis is to study characteristics of vibration and flutter control wing-plate structures, actuated by utilizing Macro-Fiber-Composite actuators. The major advantages of the piezoelectric fiber composite actuators are their high performance, flexibility and durability when compared with the traditional piezoceramic (PZT) actuators. Optimum placement of Macro-Fiber-Composite actuators is determined with its structural cantilever plate using finite element numerical analytical methods. The structural frequency response is due to the combination of acoustic radiation actuation and structural characteristics. On the basis of a velocity feedback control experimentation, a general method of active structural vibration control is adapted. Since the piezoelectric materials exhibit elastic deformation in proportion to the magnitude of an applied electric field which can transfer forces to the structure, piezoelectric materials that are bonded at proper locations of a base structure can be used as actuators. Experimental tests are conducted and compared to numerical analytical results. Anisotropic piezoceramic actuators exhibit enhanced performance when compared to traditional isotropic piezocceramic actuators. As a result of the inherent isotropy, these advanced actuators develop strain along the principal material axis. The orientation of anisotropic actuators is investigated with the effect of structural vibration control of plate panels under consideration. A fully coupled square plate finite element formulation is hence developed to include anisotropic piezoceramic actuators for plate structures.

Keywords : macro fiber composites ; actuator ; vibration reduction

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