Dynamic Characteristics Sandwich Plates with Embedded Electro-Rheological Fluids

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ABSTRACT

Upon the application of electric field onto an electric-rheological (ER) fluid, the fluid manifests, on the order of milliseconds, its property change from Newtonian fluid to Bingham plastic. This energized fluid, when subjected to oscillatory strain, demonstrates a dramatic change in stiffness and damping capacity. This thesis concentrates on the study of using the ER fluid contained within electrode plates as a viable tool for active vibration tuning. The governing equation of the sandwich plate with embedded ER fluid is derived by using Hamilton''s principle. In addition, the associated finite element formulation incorporating the nonlinear constitutive relationship between shear stress and shear strain of the ER fluid is also pursued. In order to verify the theoretical derivation, experimental measurement of the frequency response of a cantilevered ER sandwich plate specimen is performed. The first two modes'' resonance frequencies and damping loss factors of the sandwich plate under different electric fields and different vibration amplitudes are studied. The result shows that the resonance frequencies of the sandwich plate increase with the applied electric field. On the other hand, the damping loss factors decrease with the increase of the vibration amplitude. This decrement in damping loss factor is flattened out as the vibration amplitude is further increased. Keywords： Electro-Rheological Fluids, Sandwich Plate

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