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Modeling and Simulation of Vibratory Behavior of Hybrid Smart Composite Plate

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Abstract : This study presents the behavior of a hybrid smart sandwich plate with a magnetorheological elastomer core. In order to improve the vibrational behavior of the plate, the pseudo-fibers formed by the effect of the magnetic field on the elastomer charged by the ferromagnetic particles are oriented at 45° with respect to the direction of the magnetic field at 0°. Ritz's approach is taken to solve the physical problem. In order to verify and compare the results obtained by the Ritz approach, an analysis using the finite element method was carried out. The rheological property of the MRE material at 0° and at 45° are determined experimentally, The studied elastomer is prepared by a mixture of silicone oil, RTV141A polymer, and 30% of iron particles of total mixture, the mixture obtained is mixed for about 15 minutes to obtain an elastomer paste with good homogenization. In order to develop a magnetorheological elastomer (MRE), this paste is injected into an aluminum mold and subjected to a magnetic field. In our work, we have chosen an ideal percentage of filling of 30%, to obtain the best characteristics of the MRE. The mechanical characteristics obtained by dynamic mechanical viscoanalyzer (DMA) are used in the two numerical approaches. The natural frequencies and the modal damping of the sandwich plate are calculated and discussed for various magnetic field intensities. The results obtained by the two methods are compared. These off-axis anisotropic MRE structures could open up new opportunities in various fields of aeronautics, aerospace, mechanical engineering and civil engineering.

Keywords : hybrid smart sandwich plate, vibratory behavior, FEM, Ritz approach, MRE
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