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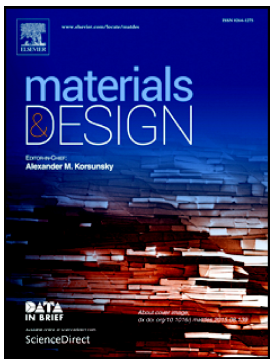

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A novel hybrid sandwich structure: viscoelastic and eddy current damping

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Abstract

A novel hybrid damping sandwich structure (VES-ED) that can attenuate structural vibration in a wide frequency bandwidth, without adding mass to the structure or significantly modifying its mechanical properties, is proposed. The hybrid sandwich combines viscoelastic and eddy current damping and consists of a thin viscoelastic sandwich and two permanent magnets without contacting the sandwich. This work has two main contributions. First, the vibrational response and dynamic properties of the hybrid sandwich are analysed by means of experimental tests in the bandwidth of 0-1 kHz. The experimental results show that the viscoelastic film of the hybrid sandwich attenuated the vibration across the entire bandwidth, and the induced eddy currents suppressed the vibration to a greater extent at low frequencies. Second, a new inverse method is developed to model the hybrid sandwich and facilitate its application. The numerical transmissibility function computed by the inverse method correlates well with that of the experiment, showing good agreement in the entire bandwidth of 0-1 kHz. In general, the hybrid sandwich constitutes a method of maximizing the performance of conventional viscoelastic sandwiches and its potential applications lies on the vibration attenuation of transport media in the stop positions.

Keywords: Hybrid damping; viscoelastic film; eddy current; lightweight structure; experimental characterisation; numerical model

1. Introduction

Vibration control is essential if mechanical structures are to achieve a desirable performance, such as low noise radiation, a long service life and high reliability. Passive damping techniques with viscoelastic materials are widely applied in structural vibration control, since they are cost-effective and easy to implement. These materials can be used in three different configurations to enhance the damping within a structure: free layer damping, constrained layer damping or sandwich, and tuned viscoelastic damping. Constrained layer damping, or sandwich, is the most effective of these and consists of restricting the viscoelastic material such that it lies between two elastic layers to form the sandwich structure. These sandwiches present high damping-to-weight, strength-to-weight and stiffness-to-weight ratios, and are therefore of particular interest to the aerospace, aeronautical, automotive and marine industries [1].

The dynamic behaviour of viscoelastic sandwich structures, together with their design, has been studied since the mid-20th century, as the performance and damping