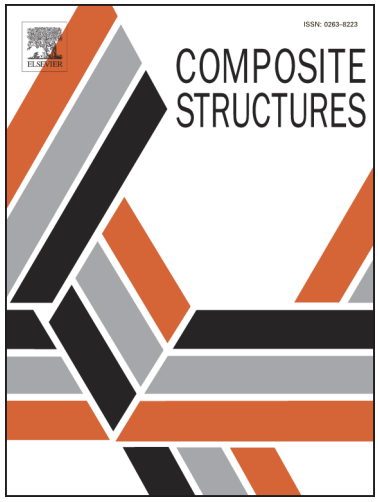

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Low-frequency sound radiation of infinite orthogonally rib-stiffened sandwich structure with periodic subwavelength arrays of shunted piezoelectric patches

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Abstract

In order to minimize the low-frequency sound radiation of an infinite orthogonally rib-stiffened sandwich structure, the periodic subwavelength arrays of shunted piezoelectric patches are introduced. Based on the piezoelectric shunt technique and effective medium method, the panels and piezoelectric patches are equivalent to two homogeneous facesheets. Then, considering all the inertia terms of the rib-stiffeners, a complete theoretical model is built for harmonic point force excitation by using Kirchhoff's thin plate theory. The vibration displacements of the facesheets in wavenumber space are solved by Fourier transform technique to complete the prediction of vibroacoustic responses. Furthermore, the correctness and effectiveness of the present model are verified by sequentially using published analytical models, simulation results and theoretical predictions in strict accordance with two prerequisites. At last, the influence laws of key influencing parameters on the research structure are investigated. All the results demonstrate that the proposed structure can effectively attenuate the structural radiation.

Keywords

Sound radiation; sandwich structure; multimode resonances; piezoelectric patch; shunt circuit

1. Introduction

With the rapid increase in the demand for sound quality and quietness of equipment, the study of vibroacoustic response of rib-stiffened sandwich structures attracts more and more researchers' attention. The classical sandwich structure consists of two parallel panels (as the facesheets) and sets of spatially periodic rib-stiffeners (as the sound bridges), and its engineering applications are very extensive, covering aerospace [1-8], submarine/ship [6-13], transportation [14-16], construction [17-21] and other fields. It is true that, from the structural point of view, there are also many cases of the introduction of poroelastic materials into the space between two facesheets [22,23], or the use of composite laminate plates to replace each facesheet [24-26], but