Active Noise Control of Honeycomb Sandwich Panels Using MFC Smart Patches

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ABSTRACT

New all-composite aircraft fuselage designs are being developed with a flexible honeycomb core sandwiched between carbon fiber reinforced composite laminate face sheets. The honeycomb sandwich panels offer potential advantages for significant weight reduction, while maintaining strength and fatigue properties. However, the excessive levels of vibration and noise of honeycomb sandwich panels have been a major cause for concern. Thus, vibration suppression and noise reduction in honeycomb sandwich panels pose major challenges for future aircraft design.

A 1m x 0.7m MFC smart patches/ honeycomb panel with CFCF configuration is utilized as a demonstrated structure in this study. The finite element analysis of the honeycomb panel is developed to predict the lowest three natural frequencies and corresponded mode shapes. The FEA results are validated experimentally by using modal analysis techniques. The vibroacoustic characteristics of the MFC smart patches/honeycomb panel are demonstrated to develop efficient and reliable vibration control mechanisms as well as sound radiation and the optimum locations of surface bonded MFC actuators. The velocity feedback control is utilized to suppress the modes of vibration and as well as sound radiation of the MFC smart patches/honeycomb sandwich panel. The experimental results show 52% vibration attenuation and 6dB noise reduction of the first mode with 149V control voltage. Similarly, the experimental results show 64% vibration attenuation and 6dB noise reduction of the second mode with 79V control voltage. For the third vibration mode, the results show 50% vibration attenuation and 4dB noise reduction with 38V control voltage. The experimental results indicate the potential of the proposed methodology to be a viable method for controlling the vibroacoustic of honeycomb sandwich panels using MFC smart patches.

Keywords : honeycomb sandwich panels、Macro Fiber Composite

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