

Optimization of piezoelectric patches with passive shunted damping for noise reduction in sandwich panels

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ABSTRACT

This paper addresses vibration and noise reduction in laminated sandwich plates using both viscoelastic and piezoelectric elements. In the low frequency range, noise and vibration damping is accomplished through applied passive RL damping circuits to piezoelectric patches bonded to the surfaces of the sandwich panels. For higher frequency ranges, damping is obtained from viscoelastic materials that are used as the core of the sandwich panels. The sound transmission characteristics of the panels are evaluated by computing their radiated sound power, using the Rayleigh integral method [1].

The numerical model is based on a *layerwise* sandwich plate model [2] with viscoelastic core, composite laminated face layers and surface bonded piezoelectric patches. A multiobjective approach is implemented for obtaining the optimal distribution of surface bonded piezoelectric patches in the composite laminated panels. The objective is to obtain designs that simultaneously minimize weight and maximize damping using the minimum number of damping circuits. A topological optimization approach is used along with the DMS (Direct MultiSearch) solver [3].

Results are presented to illustrate the performance of the optimized panels in terms of weight and noise reduction efficiency and a comparison is established between the RL damping circuits approach and the active co-located control strategy using negative control feedback.

REFERENCES

- [1] Fahy F. and Gardonio P. *Sound and Structural Vibration: Radiation, Transmission and Response*. Academic Press, 2nd Edition (2006).
- [2] Araújo, A.L., Carvalho, V.S., Mota Soares, C.M., Belinha, J. and Ferreira, A.J.M. Vibration analysis of laminated soft core sandwich plates with piezoelectric sensors and actuators. *Composite Structures* (2016) **151**:91–98.
- [3] Custódio, A.L., Madeira, J.F.A., Vaz, A.I.F. and Vicente, L.N. Direct multisearch for multiobjective optimization. *SIAM Journal of Optimization* (2011) **21**:1109–1140.