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Optimal piezoelectric shunt dampers for non-deterministic substructure vibration control: estimation and parametric investigation

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Abstract
Piezoelectric (PZT) shunt damping is an effective method to dissipate energy from a vibrating structure; however, most of the applications focus on targeting specific modes for structures vibrating at low-frequency range, i.e. deterministic substructure (DS). To optimally attenuate structures vibrating at high-frequency range, i.e. non-deterministic substructure (Non-DS) using a PZT shunt damper, it is found that the impedance of the PZT patch's terminal needs to be the complex conjugate of its inherent capacitance paralleled with the impedance 'faced' by its non-deterministic host structure underline moment actuation. The latter was derived in terms of estimation of the effective line moment mobility of a PZT patch on a Non-DS plate by integrating the expression of driving point moment mobility of an infinite thin plate. This paper conducts a parametric investigation to study the effect of changing the size, quantity and configuration of the PZT patch to the performance of the optimal PZT shunt dampers in dissipating the energy of its non-deterministic host structure. Results are shown in terms of energy reduction ratio of the thin plate when attached with optimal PZT shunt damper(s). © 2021, The Author(s).

Index Keywords
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