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Optimal Design of Unconstrained Damping Layer on Beams

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The optimum layout of unconstrained damping layer on beams is obtained using an equivalent stiffness approach and finite element formulation. The Ross, Ungar and Kerwin's (RUK) formula is introduced to represent the equivalent complex modulus of the damping layer and beam. The fractional derivative model describes the dynamic characteristics of viscoelastic materials in order to include the non-linearities of real materials with respect to frequency and temperature. Using the equivalent stiffness, a finite beam element is developed and a nonlinear eigenvalue problem is solved for a beam with the unconstrained damping layer on it. The objective of optimization problem is to maximize the product of loss factor and eigenfrequency of a specified mode. Optimum coverage is obtained by combining an analytic design sensitivity analysis and a gradient-based numerical search algorithm.

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