Identification of damping and complex modes in structural vibrations

A sufficiently accurate mathematical representation of the viscous damping matrix from modal parameters is often limited to structures with light damping or an assumed structure of the damping matrix. These limitations are now circumvented by a novel expression, which reconstructs the damping matrix from the complex-valued eigenvectors and eigenvalues of a non-classically damped structure with an assumed mass distribution. The accuracy of this expression is demonstrated by both numerical simulations and experimental measurements of a model-scale five-story shear building, with damping introduced locally by a single eddy current damper. The spatial distribution of the damping is estimated by integrating the proposed expression for the damping matrix in a covariance driven output-only system identification technique. The reproducibility of the mode shape estimates and their convergence with respect to measurement duration validate the proposed approach and demonstrate that complex modes are achievable from vibration measurements.

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