On the Optimal Placement of Piezoelectric Elements for Active Flutter Suppression

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Abstract

The optimal placement of PZT elements for the active flutter suppression of a real wing is discussed. The motion equations of wing bending and torsion are considered. The modal shapes are calculated with the Galerkin method, projecting the real wing modal shapes on those of an approximated model with an exponential stiffness and mass distribution similar to the real wing, having a closed form analytical solution. A non-stationary aerodynamic flow has been considered. A closed loop feedback control has been applied on the vibration amplitudes through the minimisation of a quadratic objective function. To this aim, a "tensor-distance" function is defined, in analogy with the distance between two points. It has been demonstrated that the minimisation of the "tensor-distance" between the quadratic form of the integrand of the objective function and a 90° rotation tensor is equivalent to the minimisation of the objective function. A modified version of the Price's algorithm for functions minimisation has been applied the for global optimisation.

Keywords

Piezoelectric, Flutter, Optimisation, Aeroelasticity