MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (5)

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AN OPTIMIZATION OF SSDI SYSTEM FOR A BEAM STRUCTURE

Abstract

The vibration suppression technique called LR-switching or SSDI (synchronized switch damping on inductor) has attracted considerable interest because of its simplicity, robustness, and high performance. Previously, the authors have experimentally demonstrated that this method can reduce the vibration amplitude of 140kg satellite by 50 percent by using 80grams piezoelectric transducers. This vibration suppression method converts structural vibration energy into electrical energy as a charge in the capacitance of the piezoelectric transducers. Then the polarity of this charge or voltage is inverted according to the phase of structural vibration by a switched inductive shunt circuit, so that the piezoelectric transducer generates the right polarity of force to suppress the structural vibration effectively. Although the loss of the electric energy at this voltage inversion dominates the performance of the technique, it was difficult to estimate this loss from design parameters of the transducer and inductor. Recently, the authors established a mathematical model of this energy loss based on experimental data obtained by using various piezoelectric transducers and inductors (eg. IAC-14 C2.P1X22859). This model enables us to estimate the performance of SSDI technique from design parameters. This paper proposes a method of optimization of SSDI system using this model, and demonstrates the benefit brought by the optimization. The optimization maximizes the energy dissipated by the SSDI technique per a cycle of steady state vibration. As an example, a clamped beam is considered, and a SSDI system is optimized to suppress the vibration of the beam. Results of the optimization demonstrate significant enhancement of the damping of the beam due to this optimization.