Active Vibration Suppression of an elastic piezoelectric sensor and actuator fitted cantilevered beam configurations as a generic smart composite structure

ABSTRACT

An efficient analytical method for vibration analysis of a Euler–Bernoulli beam with Spring Loading at the Tip has been developed as a baseline for treating flexible beam attached to central-body space structure, followed by the development of MATLAB© finite element method computational routine. Extension of this work is carried out for the generic problem of Active Vibration Suppression of a cantilevered Euler–Bernoulli beam with piezoelectric sensor and actuator attached as appropriate along the beam. Such generic example can be further extended for tackling light-weight structures in space applications, such as antennas, robot's arms and solar panels. For comparative study, three generic configurations of the combined beam and piezoelectric elements are solved. The equation of motion of the beam is expressed using Hamilton's principle, and the baseline problem is solved using Galerkin based finite element method. The robustness of the approach is assessed.

Keywords: Euler–Bernoulli theory; Finite element method; Hamiltonian mechanics; Piezoelectric material; Active vibration control; Structural dynamics