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VIBRATION ANALYSIS, CONTROL AND GENETIC ALGORITHM OPTIMIZATION OF A PIEZOELECTRIC ELEMENTS BONDED ROTATING SPACECRAFT APPENDAGE COMPOSITE STRUCTURE

Abstract

Vibration control of light-weight structures is of great interest of many studies and investigations. The high cost of sending heavy masses and large volumes into space has prompted the wide utilization of light-weight structures in space applications, such as antennas, robotic arms, solar panels, that are largely flexible. Vibration control of the flexible structures can be applied via passive vibration and active vibration control. With the emergence of smart materials, active vibration control of structures has been developed to deal with the light weight flexible structures. Following the development of an efficient analytical method for vibration suppression of an Euler-Bernoulli beam, a generic control system has been designed for vibration control using piezoelectric sensor and actuator. The equation of motion for the system is elaborated using energy principle and full-state observer Linear-Quadratic-Regulator. Genetic Algorithm optimization scheme has been introduced to find the optimum choice of Q and R. The accuracy of the validated method has been proved to be satisfactory, and can be utilized for more complex systems. Genetic Algorithm, GA, is an optimization and search algorithm that begins the solution from multiple different starting points. The results of the application of GA in optimizing Q and R in LQR Method in the present vibration suppression problem has been validated by comparison with the heuristic approach and has shown its plausibility, judging from its accuracy and computation time; in addition it is felt that the method is elegant. Using these techniques that have been carried out previously, the problem of Vibration Analysis, Control and Genetic Algorithm Optimization of a Piezoelectric Elements Bonded Rotating Spacecraft Appendage Composite Structure is carried out step by step following each problem category.