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VIBRATION SUPPRESSION USING TARGETED ENERGY TRANSFER IN A TWO-DEGREE-OF-FREEDOM UNEQUAL MASS NONLINEAR VIBRATION ABSORBER

Abstract

Lots of papers have been devoted to vibration suppression which is a challenging problem. The vibration environment during launch or landing could do damage to sensitive equipments on spacecraft, vibration of large space structure can also cause serious problems. Active control can always offer the best performance especially during the low frequency vibration, but with the development of nonlinear science, passive nonlinear vibration absorber can also represent an alternative.

Targeted energy transfer refers to one-way energy flow from the main structure to the nonlinear attachment, in which energy can be dissipated and do not flow back, and unlike linear vibration absorber, it has a broad suppression bandwidth and for a wide range of initial forcing amplitude the energy transfer is effective. Compared with active control, targeted energy transfer has many advantages such as more robust and no additional actuator or energy is required.

We study the dynamics of a two-DOF unequal-mass nonlinear attachment coupled with a main structure, the capacity of vibration absorption of the attachment is shown numerically, and a comparison with the same-mass one-DOF nonlinear vibration absorber is included. It is shown that targeted energy transfer can be achieved using the two-DOF nonlinear attachment, the process of energy dissipation is efficient and broadband. To study the dynamics of the two-DOF absorber, an analytical study by applying complex-averaging method is carried out, and an approximate slow dynamics is obtained.

This study focuses on realizing a more efficient targeted energy transfer contrast to one-DOF nonlinear vibration absorber, and it also gives an alternative for vibration suppression of large space structure and sensitive equipments.