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GLOBAL DAMPING CONFIGURATION OF LARGE SPACE TRUSS STRUCTURE BASED ON ENERGY FINITE ELEMENT ANALYSIS

Abstract

Multi-function and high-power are the trends of modern spacecraft, of which structures indicate the characteristics of large size, weak stiffness and low damping, such as the large space truss structure. When these structures working on the orbit are disturbed, vibration with low frequency and high amplitude is easily stirred. Because of its low damping character, the vibration is difficult to self-attenuation, and will obstruct the normal operation of the spacecraft if there is not control. Moreover, the traditional structural finite element method is usually complex and inefficient, and it even makes matter worse that the element size and the vibration wavelength do not match with each other. Therefore, for the purpose of simplifying the damping configuration of large space truss structure, this article adopts the energy finite element analysis method to study the ability of dampers which absorb and dissipate vibration energy in different locations, and optimizes the configuration with the dissipation energy factor. In order to control vibration, the role of damping control is to absorb and consume the energy by setting damping material in the transfer path of vibration energy. Based on the theory that the system energy will be dissipated by damping coefficient, we study the longitudinal and bending vibration control equation with variables of energy density. Considering the main variables of traditional energy finite element are not continuous and the structural junction model is complex, energy error is introduced with considering the junction as a whole. And then energy solution of the vibration of the truss structure is derived. For optimizing the global damping configuration of the structure, the modal dissipation energy factor is amended using the idea of the optimal control theory. And then the amended modal dissipation energy factor is used to evaluate the effect of damping element with different size and different locations, which is also the performance index of optimizing the structure configuration. Moreover, the finite element optimization function is created, and the discrete optimization problem of the damping configuration in truss structure vibration control is then studied. Finally, several numerical simulations accompany the theoretical developments are carried out and the results demonstrate that the energy finite element analysis method has a good effect in a wide frequency range.