MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Session on Materials and Structures (9)

Author: Mr. Shigeru Shimose
Japan Aerospace Exploration Agency (JAXA), Japan, shimose.shigeru@jaxa.jp

Prof. Kenji Minesugi
Japan Aerospace Exploration Agency (JAXA), Japan, minesugi@svs.eng.isas.jaxa.jp
Prof. Kanjuro Makihara
Tohoku University, Japan, makihara@ssl.mech.tohoku.ac.jp
Prof. Onoda Junjiro
Japan Aerospace Exploration Agency (JAXA), Japan, onoda.junjiro@jaxa.jp

INVESTIGATION OF VIBRATION SUPPRESSION CAPABILITY OF SWITCHING TECHNIQUES BY MULTIPLE PIEZOELECTRIC ACTUATORS

Abstract

This paper demonstrates, from viewpoint of electrical connection (series or parallel), comprehensive investigation of switching techniques using an electric circuit that is composed of multiple piezoelectric actuators and a selective switch. Here, switching techniques include State-switching, R-switching, and LR-switching (called Energy recycling semi-active method). We now focus on the combination of multiple piezoelectric actuators in series or/and parallel. We carried out numerical simulations and experiments by using the actual satellite structural model (Planet-A; launched by ISAS in 1985). Numerical and experimental results of piezoelectric combination in series and parallel are quite interesting and can provide a huge number of informative suggestions in designing electric circuits connecting multiple piezoelectric actuators. The comparison between numerical and experimental results appears a bit discrepancy, but it clearly shows the vibration suppression performance tendency resulting from various series and parallel combination of multiple piezoelectric actuators.

There is currently a large effort underway to effectively suppress the vibration of structures. On one hand, active vibration control method can become unstable if the control is improperly designed. Active vibration control method needs an external energy that supplies energy to the system. It is one of the defects from the point of view of restriction of power resource of practical satellites. On the other hand, since passive vibration control method dose not supply energy to the system, the passive vibration control system is always stable. However, in most cases, it does not provide satisfactory performance in vibration suppression. Therefore, we adopt an approach to solve the dilemma between active and passive vibration controls in robustness and high performance of vibration suppression. This approach, to reduce the disadvantage of active vibration control and also to keep the advantage of passive vibration control, may be semi-active vibration control, which changes the states of systems so that their inherent damping performances are enhanced. Many researches have been used piezoelectric transducers as actuators and transducers for vibration suppression by many researchers.

In this paper, we show the inference in vibration suppression performance depending on the combination of multiple piezoelectric actuators in series or/and parallel. We demonstrate numerical simulations by using mathematical models of piezoelectric actuators. Moreover, we show experimental results using the actual satellite structural model.