MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (5)

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CONTROL OF MULTI MODAL STRUCTURAL VIBRATION USING DIGITAL SELF-POWERED DEVICE

Abstract

This paper demonstrates our innovative vibration suppression method, called "Digital Self-Powered". We investigated semi-active vibration suppression method using piezoelectric actuator, and invented completely self-powered digital controlled device that does not required any external power supply unit at all. We carried out experiments of multimodal structural vibration suppression by using our novel digital controlled semi-active method. To the best of our knowledge, this performance is the first one in the world. In our experiment, we showed damping capability of our new digital self-powered technique better than damping capability analog self-powered technique. Many industries have been eagerly waiting for superior vibration suppression method. Each industry has each viewpoint, for example, suppression performance, cost, weight, size, reliability, etc. In space affiliated agency expects especially reliability. Because, it is very hard mission that vibration control parts of space structures repair in outer space. Therefore, we focused semi-active vibration suppression method that is always stable, and more effective than passive method. Many studies of semi-active vibration suppression methods have been reported. And then, they often used piezoelectric actuators for vibration suppression. Thus far, we have proposed analog self-powered systems. These do not require any external power supply, neither any external control authority. However, analog circuit systems are very awkward in practice and not programmable at all. When the parameter should be changed due to system alternation, analog systems cannot deal the request. Therefore, we invented digital self-powered systems for sophisticated vibration control. Our "Digital Self-Powered" device is composed of a programmable digital microprocessor powered, an energy harvesting section, a piezoelectric actuator, and an electric circuit made up of an inductor and selective switch. The programmable digital microprocessor changes the electrical switch automatically in synchronization of vibration phase, and accordingly unit can achieve autonomous vibration suppression. The piezoelectric actuator works not only as a semi-active vibration suppression actuator, but also as a power supplier for driving a programmable digital microprocessor. In this paper, we carried out multimodal vibration suppression experiment using our "Digital Self-Powered" system to verify its effectiveness. Our innovative "Digital Self-Powered" is a possibility of applies to not only space crafts, but also other variety industry products.