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

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IMAGE PROCESSING TECHNIQUE FOR DAMAGE DETECTION OF SPACE MEMBRANE STRUCTURES

Abstract

The damage detection techniques are significant for maintaining and controlling the navigation system of the satellites and space structural systems. The very large space structures as solar sail systems have high possibility to get the damages due to space debris because of the huge structural size and the continuous structural membrane. To detect the structural damages, many research works based on the change of the structural vibration properties in natural frequencies and vibration modes have been investigated. Also, by embedding optical fibers and piezoelectric devices into the structural elements, the smart structure systems are proposed to detect the damages for health monitoring. However, in the case of the large space membrane structures like solar sail systems, the change in the vibration properties of the structures due to the damages is quite small, and the embedded devices increase the structural mass and the performance in acceleration is decreased sensitively because of the very light weight spacecraft systems with small thrust.

In this paper, the image processing techniques are proposed for detecting damages of membrane structures using time series image data. The formulations of the damage detection analyses are derived by wavelet transformation techniques. Some numerical demonstrations are performed to examine the performances to detect the damages using the proposed technique. Finally, the effects of crack length as damage model in the membrane on the reliability of damage detection, and the differences between the active and passive images on the damage detecting performances are discussed.