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Adaptive Feedforward Controller for Active Vibration Control of a Cylindrical Shell Using Piezoelectric Patches

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Abstract

Active vibration control of a cylindrical shell using piezoelectric patches is studied both theoretically and experimentally in this paper. Hamilton's principle is used for deriving dynamic equations of motion. The equations are discretised by Rayleigh-Ritz method. An adaptive feedforward controller based on steepest descent method is implemented on a PC to control the modal vibration. It is shown that the proposed controller is effective in reducing vibration and radiated acoustic noise.

Keywords: Active vibration control, Feedforward, Piezoelectric

1. Introduction

Nowadays, acoustic and vibration noise control are essential issues in many applications and industries. Existing high level of vibrations and acoustic noises in human beings environments may lead to many problems such as audition disease, heart disease, increasing stress and precocious exhaustion [1]. Reducing the noise of household appliances, noise reduction of fancoils in libraries, hospitals and conference rooms, active noise and vibration control in car cabins in order to increase passengers comfort level, decreasing noise in incubators and decreasing urban noise are examples of using this technology in different applications and industries.

In many appliances, vibration of the structure produces acoustic noise due to interaction between the structure and acoustic fluid. This noise is called structural noise. In structural noise, the normal vibration of the structure moves the fluid in its vicinity and produces pressure field in the environment. Consequently, reducing the vibration of the structure leads to reduction of noise in the environment [2].