ABSTRACT

ACTIVE VIBRATION CONTROL OF SMART STRUCTURES

Ülker, Fatma Demet

M.S., Department of Aerospace Engineering

Supervisor: Prof. Dr. Yavuz Yaman

Co-Supervisor: Dr. Volkan Nalbantoğlu

September 2003, 119 page

The purpose of this thesis was to design controllers by using H_∞ and μ control strategies in order to suppress the free and forced vibrations of smart structures. The smart structures analyzed in this study were the smart beam and the smart fin. They were aluminum passive structures with surface bonded PZT (Lead-Zirconate-Titanate) patches. The structures were considered in clamped-free configuration.

The first part of this study focused on the identification of nominal system models of the smart structures from the experimental data. For the experimentally identified models the robust controllers were designed by using H_∞ and μ-synthesis strategies. In the second part, the controller implementation was carried out for the suppression of free and forced vibrations of the smart structures.

Within the framework of this study, a Smart Structures Laboratory was established in the Aerospace Engineering Department of METU. The controller implementations were carried out by considering two different experimental set-ups. In the first set-up the controller designs were based on the strain measurements. In the second approach, the displacement measurements, which were acquired through laser displacement sensor, were considered in the controller design.

The first two flexural modes of the smart beam were successfully controlled by using H_∞ method. The vibrations of the first two flexural and first torsional modes of the smart fin were suppressed through the μ-synthesis. Satisfactory attenuation levels were achieved for both strain measurement and displacement measurement applications.