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Research Article

Effect of a Bonded Patch on Aeroelastic Behavior of Cantilevered Plates

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In recent years, many researchers have studied vibration suppression of fluttering plates using piezoelectric actuators. Lots of these researchers have focused on optimal placement of piezoelectric patches to obtain maximum controllability. Although mass and stiffness characteristics of bonded patches can alter aeroelastic behavior of fluttering plates, few of them considered the effect of the mentioned parameters in optimization process. This paper investigates effect of a bonded patch on aeroelastic behavior of cantilevered plates in supersonic flow. For this purpose, critical dynamic pressure and limit-cycle oscillations of the system are studied. Von Karman plate theory along with first order piston theory is employed for mathematical simulation of the system. Obtained results reveal that a bonded patch with a small mass ratio can change the system critical dynamic pressure significantly, where the main part of the variations is resulted from the added mass of the bonded patch. The maximum raise of dynamic pressure is acquired when the patch is placed on the plate's leading edge. The results show that mass and stiffness characteristics of bonded piezoelectric patches can have a great impact on aeroelastic performance of fluttering plates. Therefore, these parameters must be considered as effective factors for optimal placement of piezo-actuators.

1. Introduction

Recently, performance optimization of smart materials and structures has attracted many researchers. Lots of them focused on the optimal vibration suppression of fluttering plates and panels which are ideal models for wings and membrane elements of airplanes and missiles. For this aim, one of challenges was to obtain optimal location of piezoelectric actuators. Therefore lots of works were devoted to optimal placement of the bonded actuators. Most of researchers used controllability-based optimization methods for maximizing system controllability index (e.g., see [1–4]). Although, in specific patch positions, mass and stiffness