6º Congresso Nacional
de Matemática Aplicada
e Computacional

A MATHEMATICAL APPROACH TO PANEL FLUTTER

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The goal of this paper is to present analytic techniques for detecting effects of the turbulent boundary layer on an elastic plate immersed in a rapidly flowing fluid. Thus we study a mathematical model of a two-degree-of-freedon non conservative mechanical system subjected to a follower force λ, to a small perturbation $\delta F(t)$, periodic in time, and to a damping force. This system is intended to be a model of the panel flutter.

The force λ being constant in the time, presents the dynamic pressure of the fluid on the plate, the small periodic perturbation simulates the fluctuations of the turbulent boundary layer, and a damping force B represents damping action of the fluid on the plate.

To ilustrate the importance of the study of non-conservative systems, we notice their presence in examples conected with the vibration of the surface of modern aircrafts emphazising the problem of the stability of equilibrium configurations.

We begin by analyzing the problem $\delta=0$ i.e. ignoring

the effects of turbulent disturbance. This gives a bifurcation problem for the equilibrium configuration $X_o(\lambda)$. We solve this problem and elucidate its mathematical structure, determinating the modes of bifurcation.

In the sequel we will consider $\delta \neq 0$ with $|\delta| << 1$. The question becomes a singular perturbation of a bifurcation. The method of matched asymptotic expansions are developed and used to analyse perturbations of bifurcations. The qualitative properties of the response enable us to conclude that there exists a smooth transition from the basic states of equilibrium to the fluttering states or bifurcated states.

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