

6º Congresso Nacional de Matemática Aplicada e Computacional

A MATHEMATICAL APPROACH TO PANEL FLUTTER

G. Maranguape da Cunha

Deptº de Matemática

Universidade Federal do Ceará

Campus do Pici

60000 Fortaleza - Ceará

Brasil

nations are developed and

L. Sinay

Laboratório de Computação Científica - LCC/CNPq

Av. Wenceslau Braz, 71 - fundos

22290 Rio de Janeiro - RJ

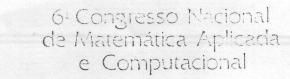
Brasil

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 $X_{0}(\lambda)$. We solve this problem and elucidate its mathematical structure, determinating the modes of bifurcation.

In the sequel we will consider $\delta \neq 0$ with $\left| \delta \right| <<1$. 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.

REFERENCES

- [1] G. HERRMANN, Dynamics and Stability of Mechanical Systems with Follower Forces, Nasa, Washington, D. C., 1971.
- [2] MATKOWSKY, B.J. and REISS, E.L., "Singular Perturbations of Bifurcations", SIAM Journal on Applied Mathematics, vol. 33, Sept. 1977, pp. 230-255.
- [3] L. SINAY and EDWARD L. REISS, Perturbed Panel Flutter: A Simple Model, American Institute of Aeronautics and Astronautics, Inc., vol. 19, no 11 Novembro 1981, New York.
- [4] MARANGUAPE DA CUNHA, G., "Efeitos de uma Força Escrava em um Pêndulo Duplo", Tese de Doutorado, USP, 1982.