

# **THESE DE PhD du Dr TCHOUKUEGNO (09/05/2003)**

**TITRE :** Dynamique et contrôle des vibrations des poutres modélisées par les potentiels  $\phi^6$  tristable et bistable catastrophique

## **Abstract**

In this thesis, we derive the mathematical model describing the single mode dynamics of a beam subjected to external loads.

Taking into account the geometrical nonlinearities and considering the second order approximation of the deflected length of the beam, we show in the first chapter that the single mode dynamics of a simply supported (hinge-hinged) beam can be described by  $\phi^6$  potential with various configurations. We focus our attention particularly on the three wells and the catastrophic double well  $\phi^6$  potentials.

The three wells potential is studied in this chapter II. We analyse through both harmonic balance method and the direct numerical simulation of the equation of motion, the possibilities of harmonic oscillations when the beam is subjected to parametric or additive excitation. It comes that the analytical method presents regions of 5, 3, 2 and 1 amplitudes, describing that the beam performs its motion either around one of the three wells or around all of them. Some similarities are found for the both methods. We also use the Melnikov techniques and the basins of attraction to determine the possibilities of occurrence of the Melnikov chaos. It is also found that with a well designed control device, the amplitude of vibration and the Melnikov's chaos can either be reduced or quenched.

Considering the catastrophic double well  $\phi^6$  potential, we mostly emphasise on the Melnikov criteria for the appearance of chaos as well as its control when the beam is subjected to the same type of excitation as presented above. We have also analysed for comparison the possibilities of chaotic motion with the non-catastrophic double well  $\phi^4$  potential.