Title of the thesis: Dynamics and active control with delay of the dynamics of unbounded monostable mechanical structures with φ^6 potential

Abstract: Dynamics and active control with delay of the dynamics of unbounded monostable mechanical structures with φ^6 potentials, that is the main purpose of this work. It may be viewed as a contribution to the study of the control of the dynamics of physical systems in which the potential have a catastrophic single well φ^6 configuration. Active structural enhancement consists of the use of active control to modify the structural behavior.

We present in chapter I, some important physical systems related to the non-linear mechanical structures with catastrophic single well φ6 potential. It is shown that, the mathematical model of various non-linear structures (inverted pendulum, articulated beam, elastic beam fixed at its base and free at the top) is that of a particle moving in a catastrophic single well φ6 potential. The condition for escape from a potential well are obtained and the criteria for the appearance of horseshoes chaos are derived using the Melnikov theory. Numerical simulation of the original equation is carried out to complement our analysis and metamorphism of the basin of attraction is observed.

Chapter II is devoted to the control by sandwich and with piezoelectric absorber of the dynamics of mechanical structures as presented in chapter I. The first control strategy consists of coupling the non-linear beam by a linear one. The linear one serves as control element used to reduce the amplitude of vibration of the non-linear beam. The effects of the control parameters on the dynamical behaviour of the system is analysed and the conditions for the effectiveness of the control as well are obtained. Approximate criterion for the appearance of Melnikov in the control model is derived and the effects of control gain parameters are analysed.

In chapter III, we consider the effect of time-delay between the detection of the structure's motion and the restoring action of the control system. The stability of the control system under control is studied using the Lyapunov concept and the domain subdivision method. The effect of time delays in the critical force leading to the reduction of amplitude and escape from a potential well is obtained analytically and verified numerically. The effects of the control strategy and time-delays in the onset of Melnikov chaos is presented. Our study ends with a general conclusion summarising the most important results obtained and listing some other problems encountered. We also present the other perspectives open by this work.