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Title of the thesis : **THEORETICAL AND EXPERIMENTAL STUDIES OF THE DYNAMICS OF NONLINEAR ELECTROMECHANICAL SYSTEMS WITH FLEXIBLE ARMS**

Abstract:

ElectroMechanical System (EMS) are used in many applications (industry, domestic equipment, ...). In recent years, many research efforts have been done to implement nonlinear effects to improve their functioning and duration. This thesis discusses the theoretical and experimental studies of SSEMS with flexible arms. The system considered in this thesis consists of an implementation of a self-sustained electrical oscillator (of RD or VdPD type) driving a flexible arm (cantilever or hinged-hinged). It results from the modelling process that the devices are described by a set of equation consisting of an ordinary differential nonlinear equation coupled to a nonlinear pde.

We have theoretically studied these systems using the Galerkin modal approximation, the Multi times scale method, the Lyapunov exponent and bifurcation diagram. We have compared the results from the modal approach to those from finite difference simulations. This study bring out the richness of the dynamics of the system; that is bifurcation with chaotic dynamics, resonant oscillations, jump phenomena, hysteresis and quenching phenomenon. Results from finite difference simulation were corroborated with from modal approach. However, qualitatively, some differences were observed as a consequence of the one mode approximation.

Experimental simulation of the system was also tackled. After defining the constraints inherent to the experimental realization. We have realized two prototypes of SSEMS with flexible arm. The VdPD electrical system was made up of discrete components and the RD electrical oscillator with analog components (O-Ap, multiplier). Results from experiments have confirmed and complemented the theoretical predictions.