

## THESIS ABSTRACT

### „Contributions regarding the use of real-time adaptive damping for the control of aviation structures”

**PhD Student: Eng. Marian P. VATAVU**

e-mail: marian.vatavu@dpa.ro, tel: 0741045629

Ph.D. Supervisor: Professor dr. eng. Vasile NĂSTĂSESCU

This thesis is related to the real-time adaptive control of vibrations in mechanical structures by using piezoelectric materials and electronic circuits in the form of RL shunt. The main objectives of the present thesis are: (1) the theoretical foundation of intelligent material concept, respectively piezoelectric materials, (2) the establishment of the physical bases followed by the presentation of modern concepts of vibration damping in the mechanical structures and (3) the theoretical development of some methodologies as support for the practical implementation, by establishing the design elements, of the adaptive systems in real time for the vibration damping by the RL shunt method.

The thesis is organized as follows:

- Chapter I presents the introductory elements of the thesis, followed by the motivation that stands behind the choice of the research topic, the proposed objectives, as well as the importance of the subject addressed.
- Chapter II presents the concept of intelligent material in particular piezoelectric materials. The physical phenomena responsible for piezoelectricity focusing on the properties of these materials are presented.
- Chapter III describes the damping methods of mechanical structures in relation to the fatigue of materials. Particular emphasis is placed on the main classical damping methods of vibration followed by the introduction of the concept of damping using piezoelectric materials by the shunt method.
- Chapter IV is dedicated to the analysis of damping methods using piezoelectric materials of mechanical structures. It is focused on several performance damping methods based on the series RL shunt and parallel.
- Chapter V is entirely dedicated to the concept of the gyrator respectively the evolution of its implementation methods. The development of the implementations is presented from the perspective of increasing the synthetic performances for an inductor.
- Chapter VI investigates the real-time amortization of structures by the resonant RL shunt method. The theoretical elements of design, simulation and experimental validation of the concept are presented. Also, an original method of multi-modal depreciation together with the simulation and experimental validation for the bi-modal case ends this chapter.
- Chapter VII contains the main conclusions derived from the doctoral thesis and the original contributions of the author. Future research directions conclude this chapter.

Among the author's original contributions are:

- Presentation for the first time of PZT piezoelectric ceramics from the perspective of their applicability in designing and making intelligent mechanical structures as key elements in the composition of modern aircraft.
- Theoretical and experimental results for two new voltage-controlled synthetic inductor circuits.
- Experimental validation for the first time in the specialized literature of bi-modal damping by using a single RL shunt by the resonance frequency hopping.