# Introduction

The recent technological advances made in materials used in aerospace and in the transportation industry has in general led to the design of light and stiff structures. The dynamics of these structures have to be considered at an early stage of the design process in order to avoid the disastrous effect of vibration and/or acoustic resonances. However, annoying resonances may remain for these structures especially in the low frequency range (100-1000 Hz). Passive techniques have been used but their efficiency is not always sufficient when weight is limited and the disturbances' varies in time. Active control approaches have been developed and validated to reduce vibration and acoustic levels. Nevertheless, the price of these control systems is still very high in terms of electronics and power consumption. New hybrid approaches combining active and passive treatments are under development to broaden active control benefits. The general trend is to distribute an array of such devices in order to control large structures. Distributed actuators and sensors have also been developed using mainly piezoelectric materials. Another distributed treatment is the constrained layer damping. Mostly used in the aerospace industry, it remains a purely passive treatment. Attempts to actively enhance constraining layers have not yet been totally conclusive [48]. The idea of having a similar treatment in the form of added layers on radiating plates is the starting point to this research. The device therefore investigated is a distributed active dynamic absorber. The first task undertaken was to model such absorber. The model has been extrapolated from a former beam model based on Hamilton's principle [13], which used polynomial functions as trial functions. The numerical behavior of these trial functions was unsatisfactory. New functions based on the trigonometric set was therefore experimented and successfully implemented. A fully distributed active TVA (DAVA) could then be simulated and optimized using a genetic algorithm. A simultaneous attempt to develop a real DAVA was successful using curved Polyvinylidene Fluoride (PVDF) film and a mass distribution made of thin sheets of lead. As a passive device the DAVA is more efficient than a conventional point TVA or a distributed constrained layer. The DAVA also demonstrated its active ability. Active control experiments showed that additional sound or vibration reduction could be achieved.

The following thesis is arranged as follow. The first chapter is a literature review of the passive and active techniques available today with a historical emphasis on tunable vibration absorbers.The second chapter concerns different theoretical principles used in this research such as the principles underlying the use of TVAs, the variational approach used for the model and the genetic algorithm used for the optimization process. The third chapter presents the different models developed for the virtual testing and optimization of the DAVA. The fourth chapter presents the experimental investigation of an example DAVA. The thesis finishes with conclusions and recommendation for future work.