Conclusions and Recommendations

Conclusions

- This thesis presented a new concept of vibration absorber. This absorber is distributed and can be electrically actuated. It can be constructed to be lightweight, conformal and very resistant to crushing. The new concept also includes a varying resonance frequency in space. The study of the absorber has been limited to the case where the mass of the absorber is varied along the structure.
- A variational model has been developed to model a beam with arbitrary boundary conditions. This model can include piezoelectric layers, constrained layer damping, point absorbers, and distributed absorbers. This model has been validated in the simply supported case and compared to a previously developed model [13]. Experimental validation has also been performed. The matching between experimental and theoretical data is good.
- An optimization process using a genetic algorithm has been used. This optimization finds the optimal mass distribution for the absorber using simulation data. This optimization technique is validated by the very good behavior of the prototype with optimal mass distribution observed in experiments.
- Several distributed absorber prototypes have been successfully developed. Their constructions involve the use of polyvinylidene fluoride (PVDF), which is a piezoelectric material. A distributed active vibration absorber (DAVA) has been manufactured and tested.
- The passive action of the DAVA differs from the classical point absorber. It is not as efficient at reducing response at a single frequency but can provide vibration reduction on a large frequency bandwidth without creating new modes of vibration.

- The active action of the DAVA depends heavily on its mass distribution. If the mass is constant, good control of response peaks is possible but in-between the resonances, the vibration is increased. The performance of an absorber with optimal mass distribution is extremely promising. The mass distribution is optimized to reduce the radiated power of a beam with active control on. Not only are the peaks were reduced but in-between structural resonances, attenuation was also achieved. The active input to the DAVA was shown to significantly improve its passive performance.

Recommendations for future research

- Extreme care in the manufacturing of the distributed absorber has to be enforced. New manufacturing process could be use in order to improve the performance of the absorber and its reliability. Forming the PVDF film at high temperature could be investigated.
- Thinner PVDF film should be used to create light DAVA with very low resonance frequency. This type of DAVA could be applied on lighter structure. This is particularly necessary to investigate potential aerospace applications.
- The DAVA should be investigated on a plate structure. Acoustic sensors such as microphones arrays will then be useful as error sensors. The property of the DAVA to damp modally dense structure will also be investigated.
- Real disturbance like air flow or water flow should be used. The real ability of the absorber to control real disturbances with large bandwidth should therefore be determined.
- Modal sensors should be integrated in the design. A simple phase shifter associated with amplifiers could be used to modify the resonance of the absorber and enforce the anti-resonance of the structure. This type of integrated device with a sensor and an actuator is more likely to find an industrial application.
- New material should be investigated for creating the elastic layer of the DAVA. A low-density piezoelectric-rubber or a piezdoelectric rubber with cut-outs may be a solution.