

## **Aeroelastic vibration control of hybrid airships using regenerative actuators**

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As in this era the key requirements for a product is high efficiency, well designed, characterised quality, smaller and lighter device with trimmed power. In Aerospace/ Aeronautical Engineering these requirements are clearly marking evident with more compact and lighter aircraft. Lighter the structure the more flexible the structure is, which means more flexible structures tends to vibrate and these bring challenges for the dynamic control. To reduce the vibrations, it is essential to develop an accurate model for the characteristic structure. The use of piezoelectric material as regenerative actuators for vibration control of wing (the main component of airship which vibrates the most compare to larger component which vibrates least) is well developed in this field with research being done in past few decades.

This paper presents the use of regenerative actuators to damp the vibration without using any external power source. The concept of energy harvesting from vibration of airships offers the opportunity of designing novel and energy efficient device as self-powered systems. The limited energy harvested is used to run small electric components. However this limited energy plays a vital role; the electric energy which is harvested from the vibration (fluttering) of the flexible wing can be used for dampening this vibration. On the other side there is no need to take external source of energy to dampen the vibration of the wing. This also eliminates the use of batteries as the external power source for vibration control. The use of batteries is not desirable due to the extra weight that they add to air vehicles and also their maintenance demand of replacing them as a battery is limited to a finite life.

Regenerative actuators possess the ability to act as sensors as well as actuators to assemble a collocated controller. Regenerative actuators work throughout the circuit and can distinguish between actuating signal and sensing signal applied to piezoelectric material, in which the circuit will cancel out the applied voltage in an actuating signal and will only return the sensing signal. During this process circuit allows one piezoelectric patch to sense and at the same time to actuate the structure (wing).

Macro fibre composite (MFC) is a piezoelectric element which was recently researched and developed by NASA research centre. It was developed in such a way that it can act as a sensor and actuator to harvest energy and control vibration. This element is flexible to bond in the curved surface. As in research it was found MFC is an accurate regenerative actuator and it is able to dampen 80% of vibration at its second resonant frequency. Energy harvesting using regenerative actuators is

investigated by theoretical approach. Experimental investigation is carried out for energy harvesting using piezoelectric cantilevers, which represent air vehicles wings, in a wind tunnel.