



Smart Morphing Structures With Full Shape Control

Summary

An innovative smart morphing technology has been developed by engineers in the Department of Aeronautics at Imperial College that consists of a smart core fabricated from many layers of piezoceramic material, forming a honeycomb structure. Actuators of the walls, which can be performed independently for each cell, will ultimately morph the core shape.

This technology could provide performance advantage through the reduced structural requirements and the improved handling while reducing power consumption due to the optimised drag characteristics of the morphing wing.

Background

Variable geometries can offer significant advantages to many products and applications as their shape can be gradually and continuously controlled, with less mechanical complexity, than their standard 'on/off' counterparts.

Morphing Geometry Technology (MGT) is a changeable geometry structure containing an active "smart" core and a passive flexible outer skin. The morphing wing is an aerofoil member that has a "smart" core made of either an array of piezoelectric actuators or shape memory alloys (SMA), depending on the application requirements, together with a glass or carbon fibre reinforced polyurethane composite skin and tailored to any required stiffness. The skin is a passive element, fitting perfectly around the core and remaining attached during the deformation.

Technology

The piezoelectric material or the SMA honeycomb structure can change shape when heat or an electric field is applied, changing the overall shape of the aerofoil core. The passive flexible skin will move with the outer layer of the core to change the profile of the aerofoil.

The application of different electric fields or temperatures to the core structure can then generate different geometries in the aerofoil.

The piezoelectric actuators can change shape within milliseconds while the SMA core will change in a matter of seconds. The honeycomb structure of the core allows high strength at relatively low weight. With the application of piezoelectric actuators, the geometric change is virtually instantaneous, making the technology applicable to high speed applications as well as conventional low-speed usage.

Intellectual property information

This technology is patented in Europe (EP2097314) and in the US (US8186631)

Benefits

- Manipulates the whole control surface.
- Reduced complexity of variable systems by eliminating movable parts and associated equipment.
- Significant performance advantage through optimised geometry, thus reduced power consumption.
- Virtually instantaneous transformations.

Applications

- **Wing/fin:** Fixed wing drones, UAV, UUV, cruise-missiles, and commercial & military aircraft.
- **Energy Generation:** Wind and water turbines.
- **Motorsport:** Active aero appendices, body components.
- **Construction:** Smart panels for climate control, light control, aesthetic elements.
- **Consumer products:** Morphing snowboards, high-performance bicycles.

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