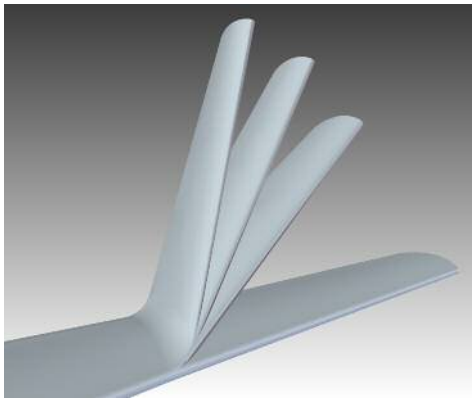
The Centre for Power Transmission and Motion Control

UNIVERSITY OF BATH

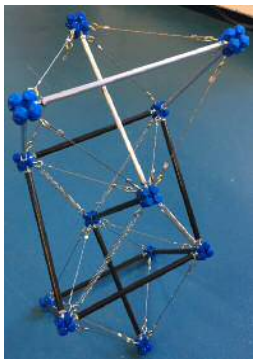
Research Project

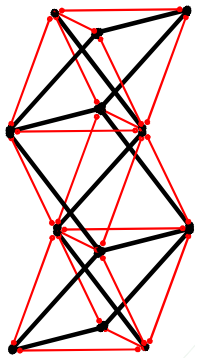
DISTRIBUTED ACTUATION FOR FUTURE AEROSTRUCTURES



Motivation

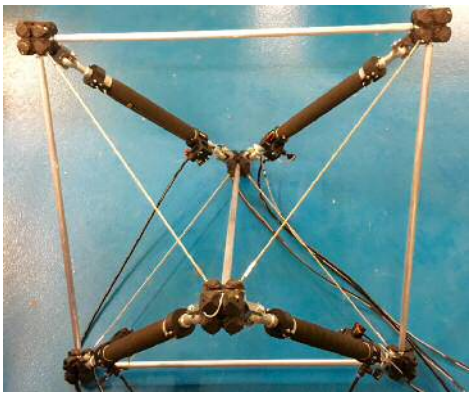
Future machines will require distributed actuation integrated with load-bearing structures, so that they are lighter, move faster, use less energy, and are more adaptable. Good examples are shape-changing aircraft wings which can adapt precisely to the ideal aerodynamic form for current flying conditions, and light but powerful robotic manipulators which can interact safely with human co-workers. A 'tensegrity structure' is a good candidate for this application due to its excellent stiffness and strength-to-weight ratio and a multi-element structure into which actuators could be embedded. The project aims to produce a tensegrity structure with 3 degrees of freedom, i.e. bending, shear and twist, suitable as the basis for winglet or tailplane morphing.





Tensegrity structure

A tensegrity structure is a multi-element structure with rigid members (struts) always in compression and flexible members (cables) always in tension. As its name suggests, the whole structure is required for 'integrity', and can only be stabilised by the tensile member forces acting on the compressive struts. There is no bending moment in any member or torque at any joint.



Progress

An iterative approach has been used to facilitate the design of a tensegrity model. A physical prototype with 1 unit cell of the tensegrity model has been built. The unit cell is actuated by pneumatic artificial muscles (PAMs) produced by FESTO. The PAM is a type of pneumatic actuator which is frictionless and has a high force to weight ratio. To help understand the dynamic behaviour of the prototype, a detailed simulation study has been conducted.

Future work

Two additional cells will be added to the prototype to fully replicate the tensegrity model. The simulation will be extended in order to study dynamic behaviour and closed loop control.

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