UCL Flapping Wing Drone Project

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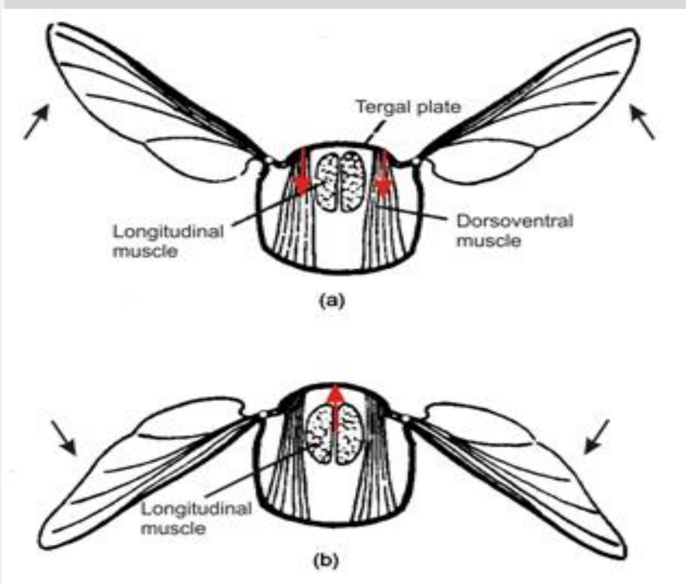
Why are we doing it ?

Natural mechanics of insects have inspired technological innovation over the past decades, with scientists and engineers placing greater emphasis on uncovering and mastering the complex unsteady aerodynamics which give rise to extraordinary lift forces, generated by their flapping wings. Considering insects' flying mechanism gives them amazing maneuverability in mid-air, an evolutionary advantage over the state-of-the-art man-made flying structures today, it is easy to appreciate why a great deal of bio-inspired robots are being excogitated. As a group, we want to make progress towards creating an insect-size flapping wing drone.



Caption
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What are we doing ?

Unmanned Aerial Vehicles (UAVs) was initially developed due to military interest, which required high precision technology. Nowadays, UAVs have become increasingly involved in our daily life. For example, it is viable to equip a camera on a drone for recording purposes. Currently, there are an abundance of potential drones, and this project is focusing on flapping drones in micro dimension..

Design

How can we do it ?

A flapping wing MAV design can be categorized into 4 parts: Transmission, Hinge, and Wing.

Transmission Design-
1.Rock Slider
Rock slider mechanism can be divided to stage where the first stage covert rotational motion to linear motion and second stage amplify the amplitude. Figure 2 and 3 shown two protype build using this mechanism.

2.Compliance
Compliant structures provide an exciting opportunity for generating even more complex designs and (wing) motions with the capability to contract and expand the whole structure using a single beam, which emulates the asynchronous mode of flight in which insects' thorax vibrate on meeting the resonance condition with internal flight muscles, enhancing lift generation. Additionally, structures to store energy or damp motion at various points during the flapping cycle could be designed to replicate certain aerodynamic motions – such as absorbing energy during the 'clap' stage of the stroke and releasing this on the 'fling' occurring.

Hinge Design
One of the major aspects contributes to the insects' superior flying ability is their multi degree of freedom wings. Flexure hinge can mimic such ability to a degree.

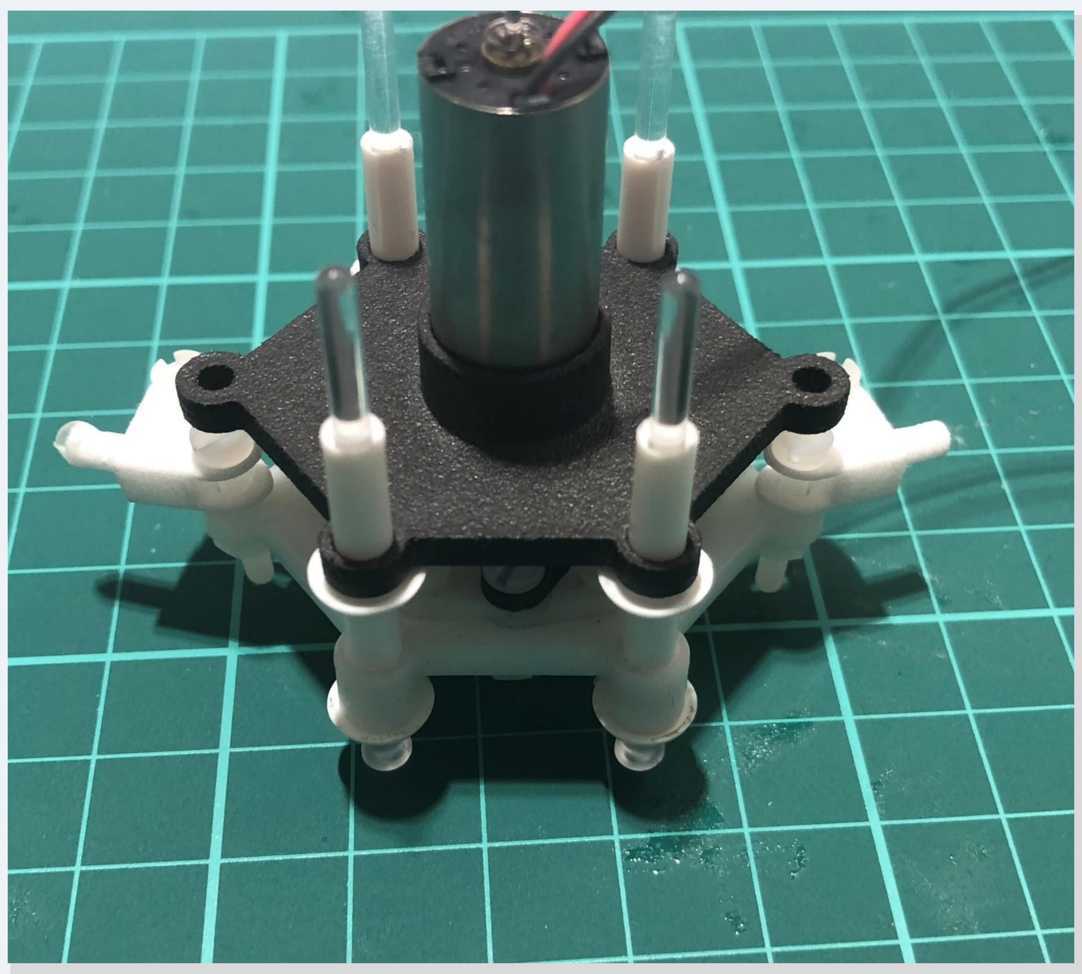

Figure 2, Two-stage rock slider prototype .c

Figure 3, One-stage rock slider prototype.

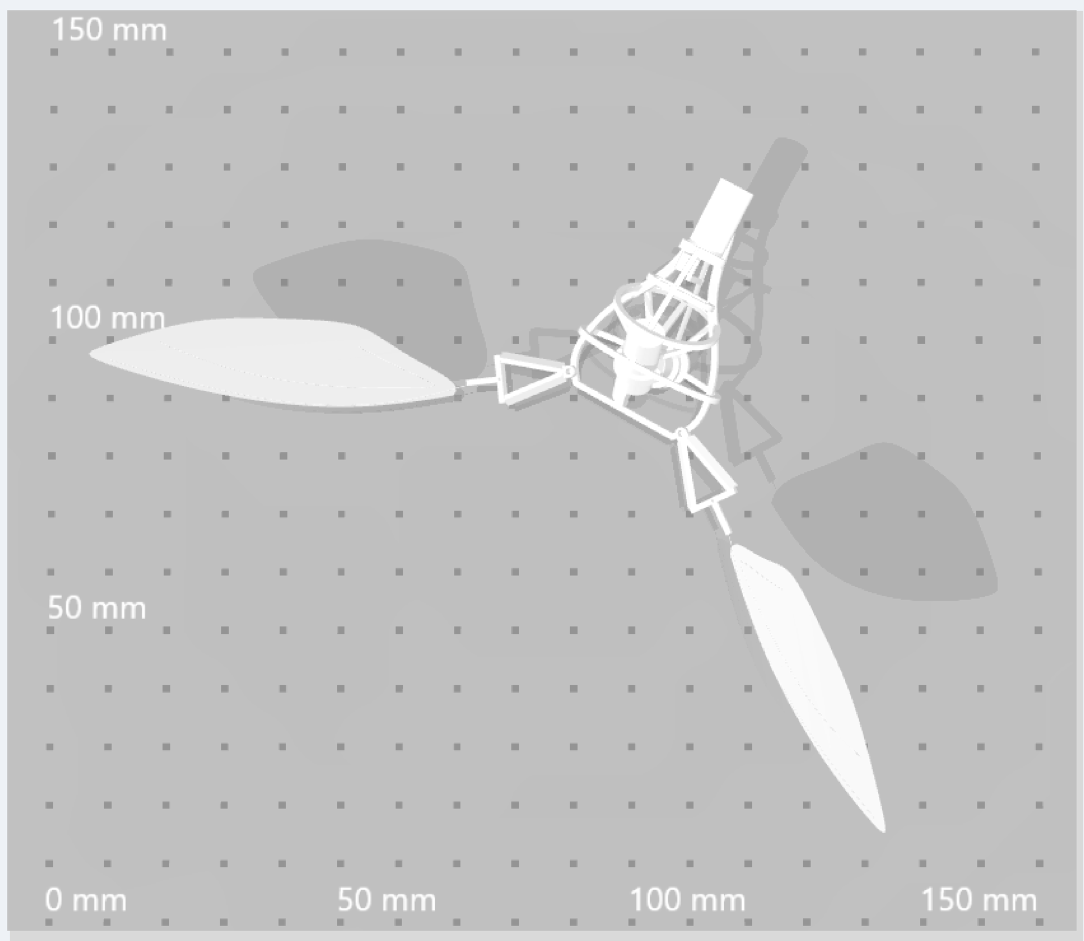

Figure 4, Compliance Structure Design Top view.

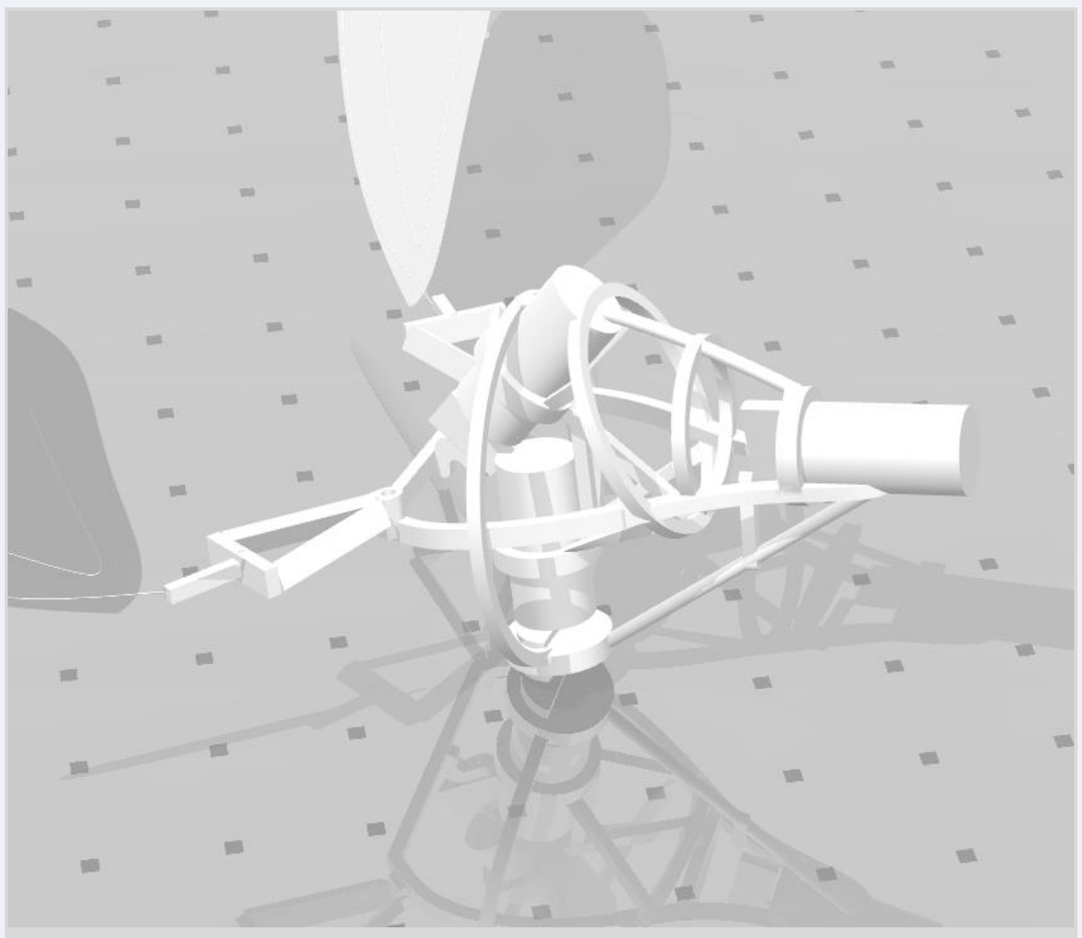

Figure 4, Compliance Structure Design Side view

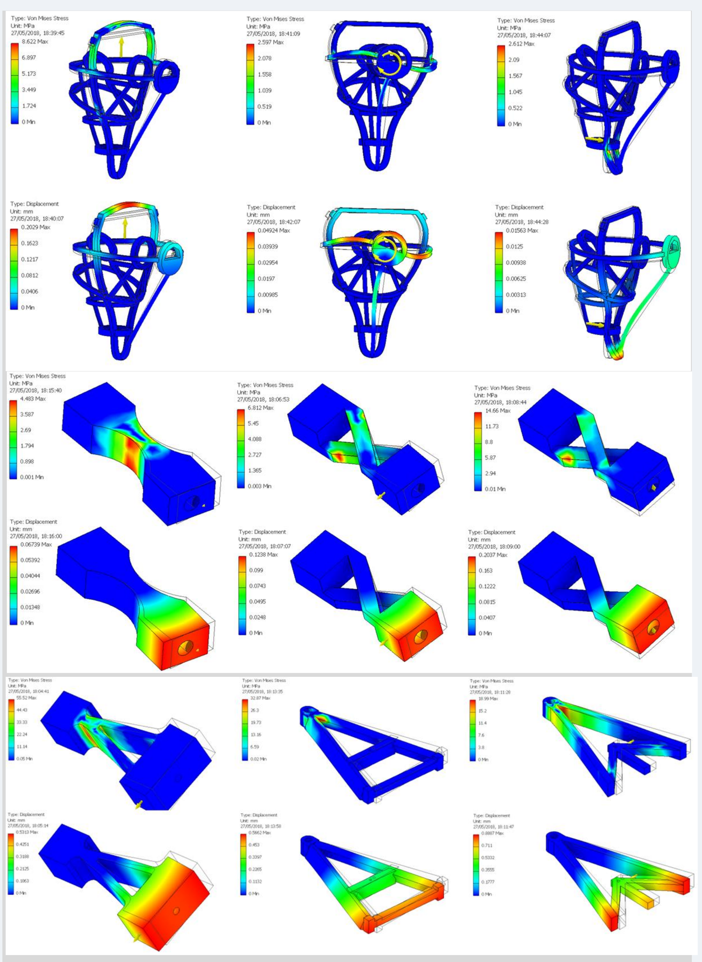

Figure 6, FEA Analysis for some compliance and hinge design.

Future and Potentials

Currently, the designs are too stiff at the central and tail sections. Some links could be cut (and replaced elsewhere) to improve flexibility, (however it is important to ensure that one plane remains undistorted in flight to attach the accelerometer). Next stages of design could also incorporate the passive actuation of wing rotation by the structure, building on the work which was done simultaneously on lone development of the flapping segment..