

# Flapping Wing Drone Inspired by Bats



2023-2024 Mechanical Engineering Senior Design - Team 9

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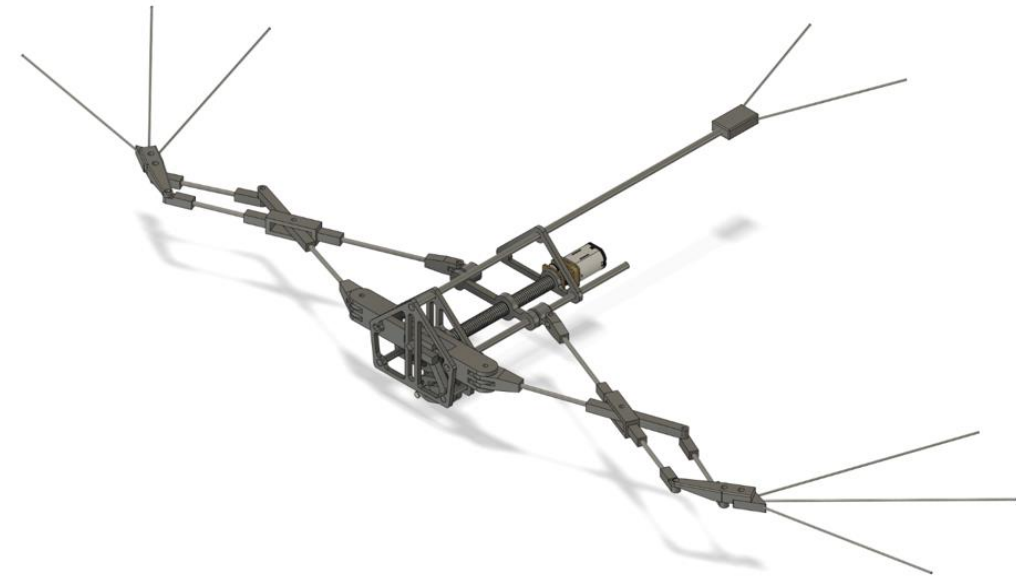
## Design Problem

Design and construct a flapping-flight drone based off the biomechanics of bats to be used for lab and field research

Design Requirements	Ideal Value	Accepted Value
Aspect ratio	3:1	1:1 - 4:1
Wingspan	50 cm	40 cm - 60 cm
Flapping Frequency	10 Hz	7 Hz
Battery Powered Flight Duration	5 minutes	3 minutes
Endurance	30 minutes	20 minutes
Flight Distance	30 m	15 m
Tethered Flight	Sustains Flight	

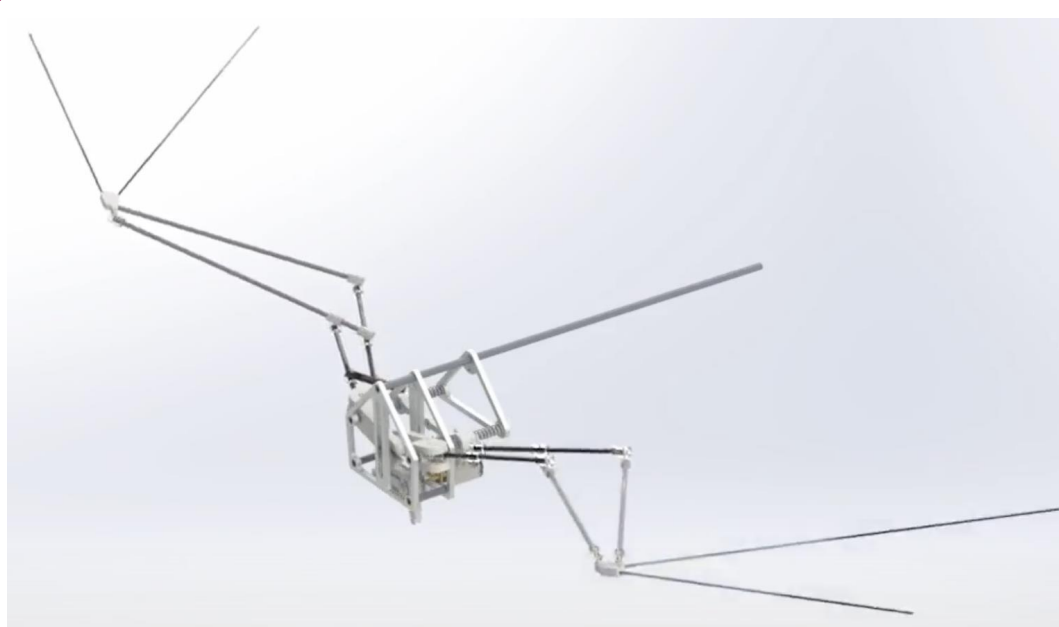
## Design Iterations

### Design Iteration I: Lead Screw Folding



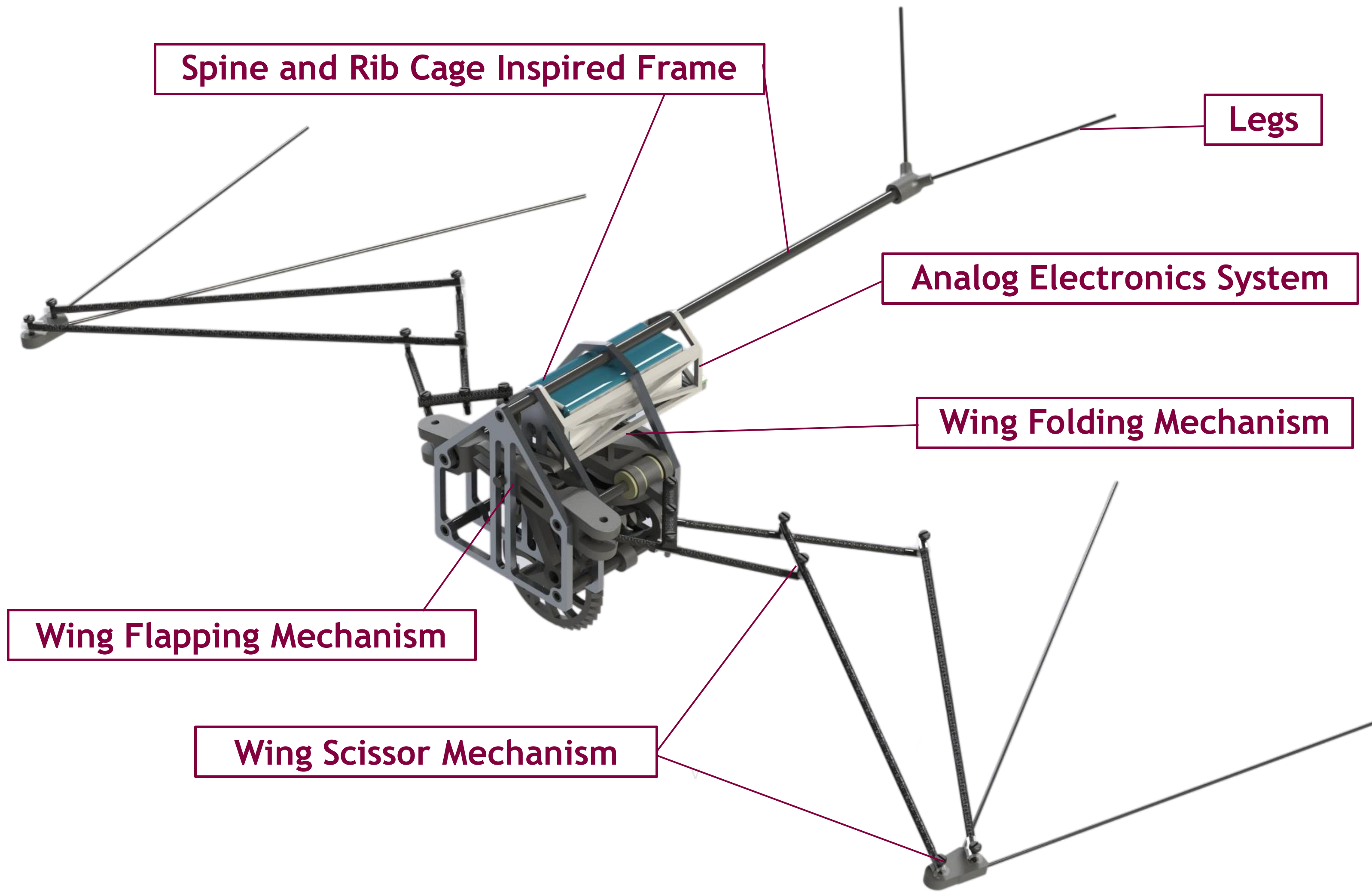
- + Active Wing Folding - Large Mass
- + Adjustable Folding - Dual Motor Synchronization

### Design Iteration II: Tendon Folding



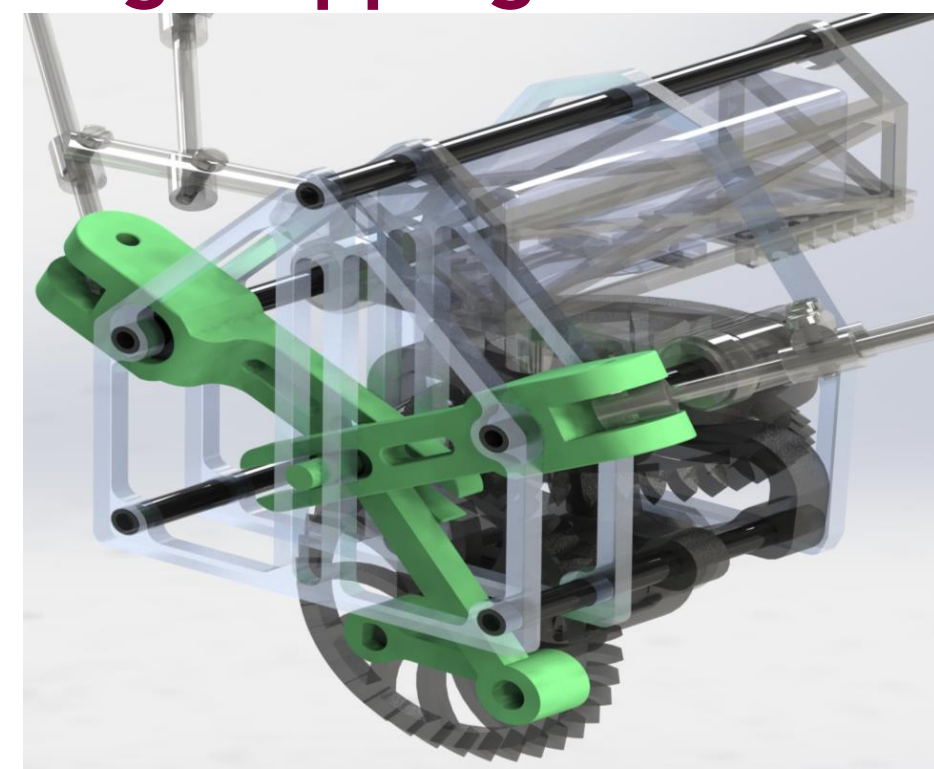
- + Reduced Mass
- + Mechanical Folding
- + Single Motor
- Unreliable Folding
- String Tensioning
- String Friction

## Final Design



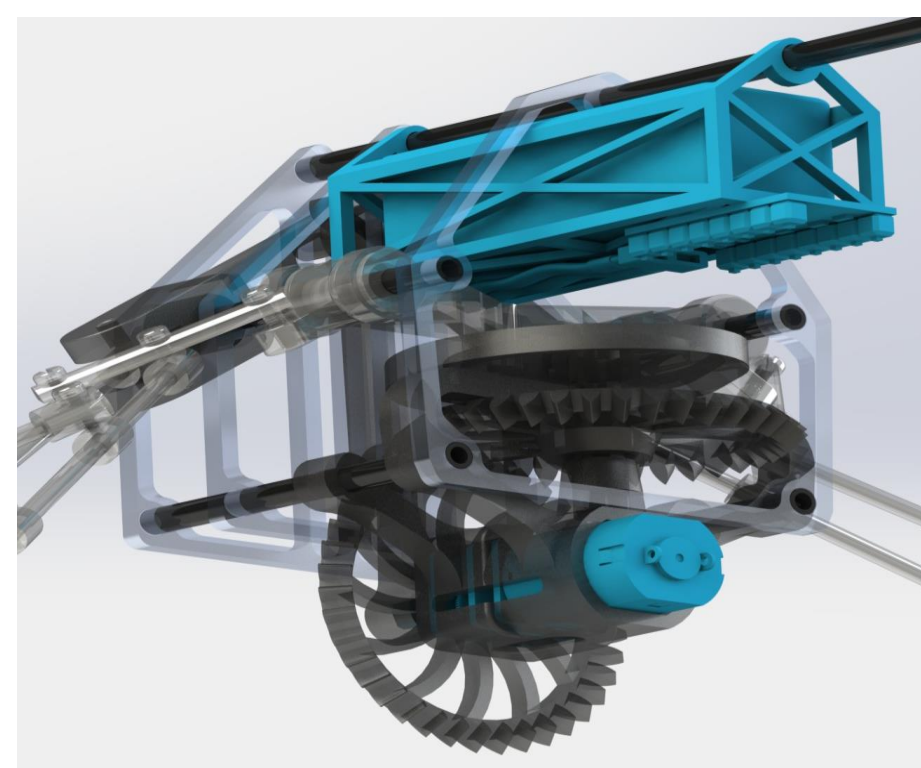
## Final Design Key Subsystems

### Wing Flapping Mechanism



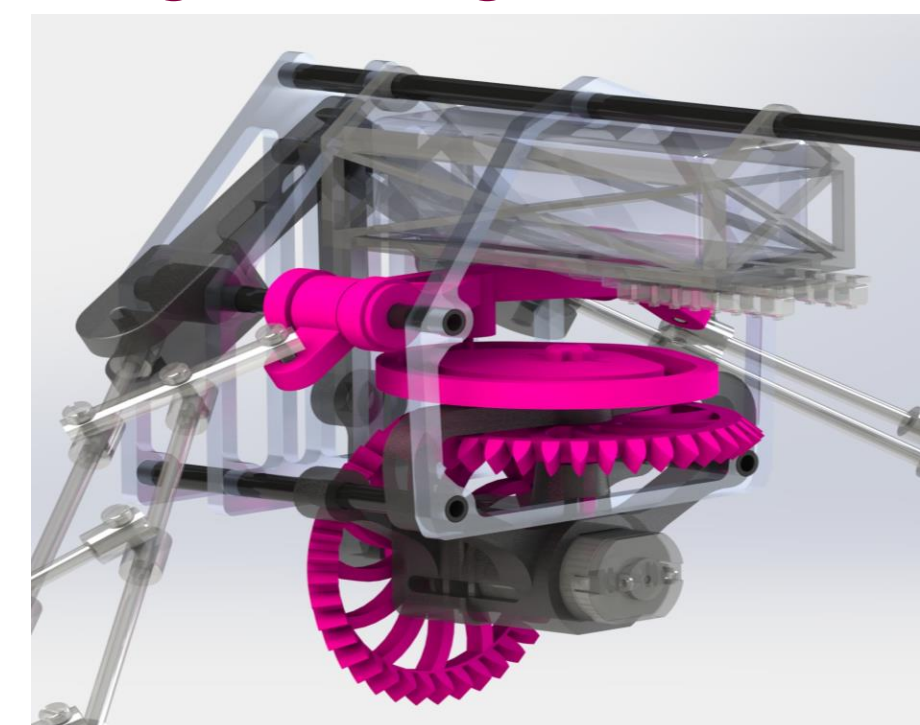
Mixture of Scotch and Yoke and Slider Crank Design

### Analog Electronics System



N20 Motor Powered by S2 Battery with Voltage Step-down via buck converter

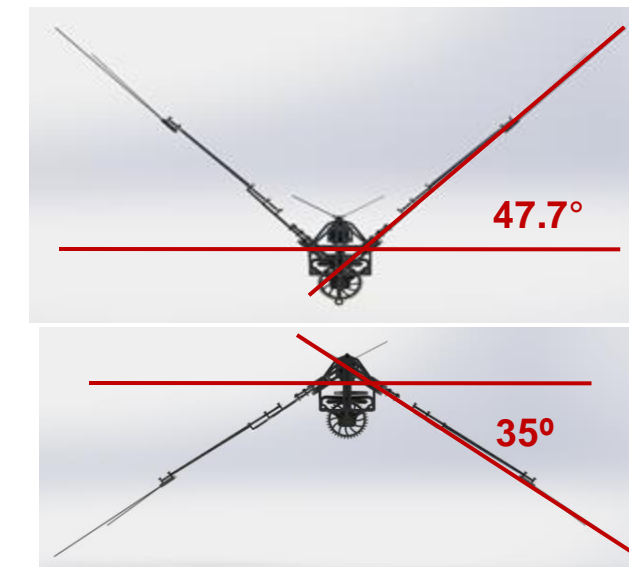
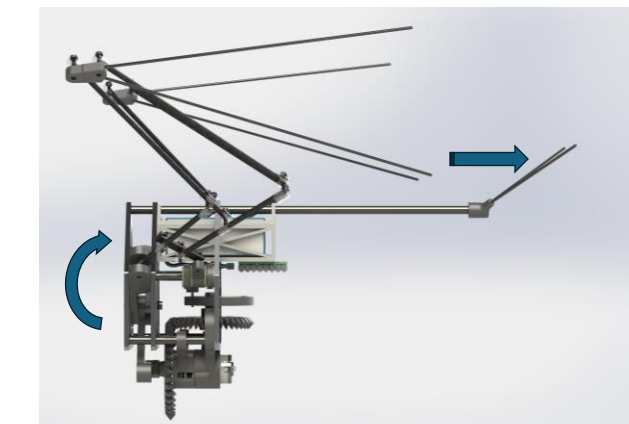
### Wing Folding Mechanism



Active Folding with Bevel Gears and Cam and Carriage System

## Design Optimizations

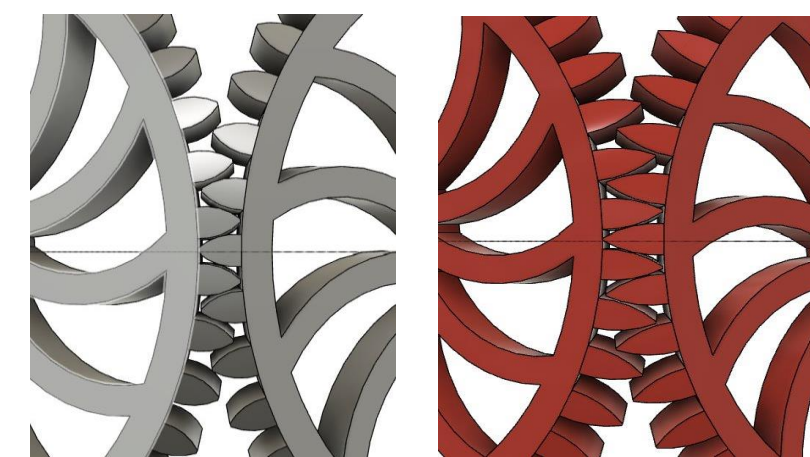
### Passive Flight Stabilization



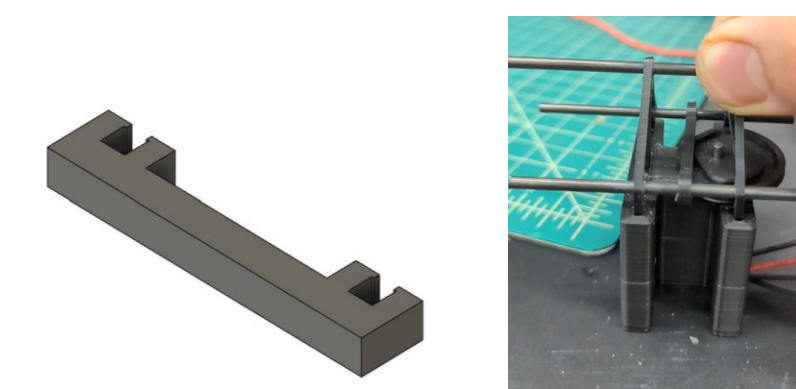
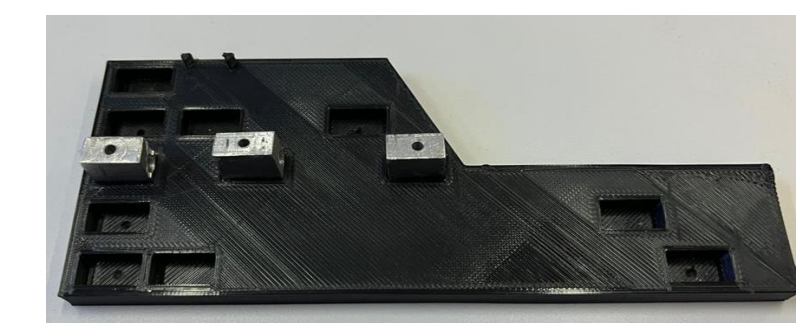
### Friction Reduction



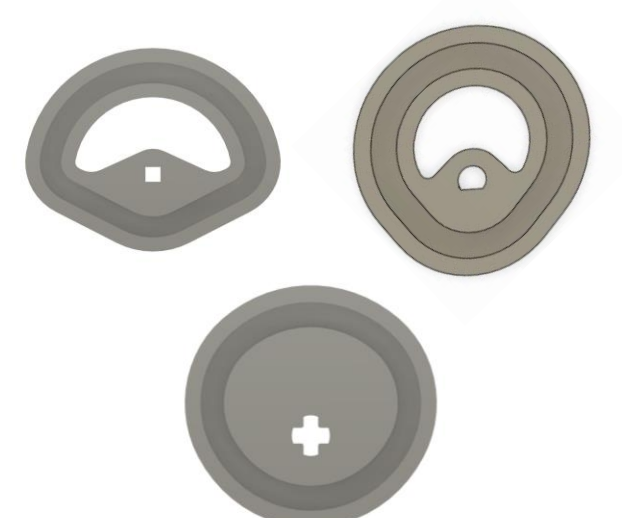
### Bevel Gear Teeth Interface



### Assembly and Testing Jigs



### Cam Design



## Conclusions

- Flapping and folding mechanisms optimized for maximum net lift generation potential, with wing folding isolated to upstroke
- Mass significantly reduced from previous years' project iterations
- Assembly jigs facilitate accurate and rapid manufacturing
- Friction reduction techniques improve endurance and efficiency of the design
- Future iterations can include flight controls, brushless motor, and further optimizations