

Ornithopter

Peer Critique 1

What's an Ornithopter

- A mechanical bird!
- Generates thrust by flapping its wings.
- Subsystems:
 - Wings
 - Wing Flapping Mech.
 - Motor and Gearbox
 - Tail



Functional Requirements

1. Must be able to climb (this means thrust > drag)
2. Should be able to fly for at least 3 minutes on a charge.
3. Must generate its thrust by flapping its wings.
4. Should flap at a rate comparable to a similar size bird.
5. Must have wingspan ~1 meter or less.
6. Must be radio-controlled and maneuverable enough to be flown within the Olin soccer field.
7. Should be able to be re-assembled after a severe crash in 1 day or less.

Specifications

1. Wing is 1m span by 0.2 m chord
2. From testing: wing draws 20W
3. 200g weight budget
 - a. From design manual 100W/kg for climb

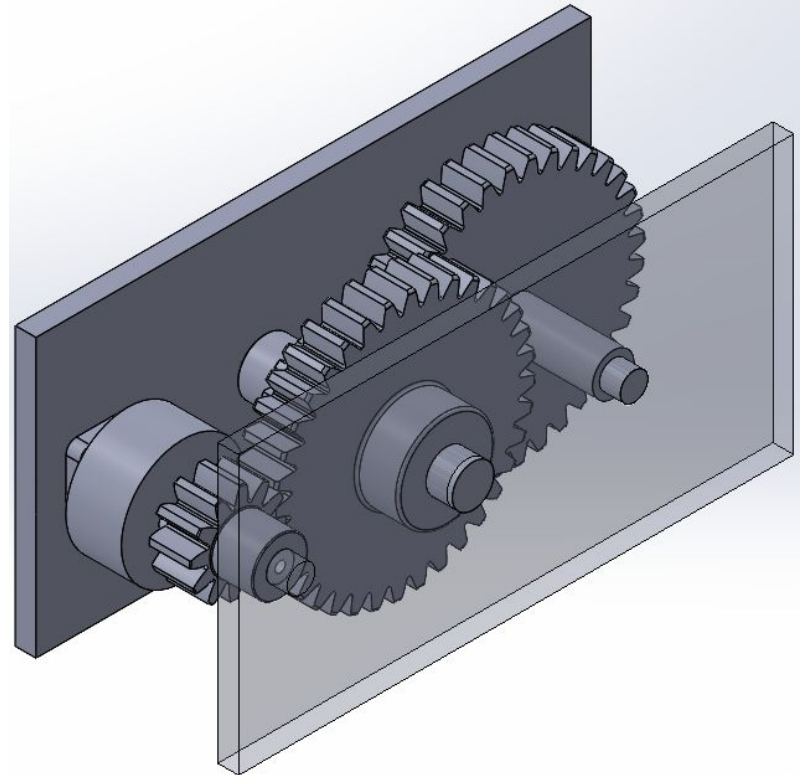
Gearbox

Requirements:

- Must output 20W at 3 flaps per second with wings attached.
- Must fit within 200g weight budget

Mechanics:

- Acts as fuselage, containing mounting points for other subsystems
- Uses a gear ratio of 9:1 determined from motor power and current calculations, in a 2x3:1 configuration to minimize weight.



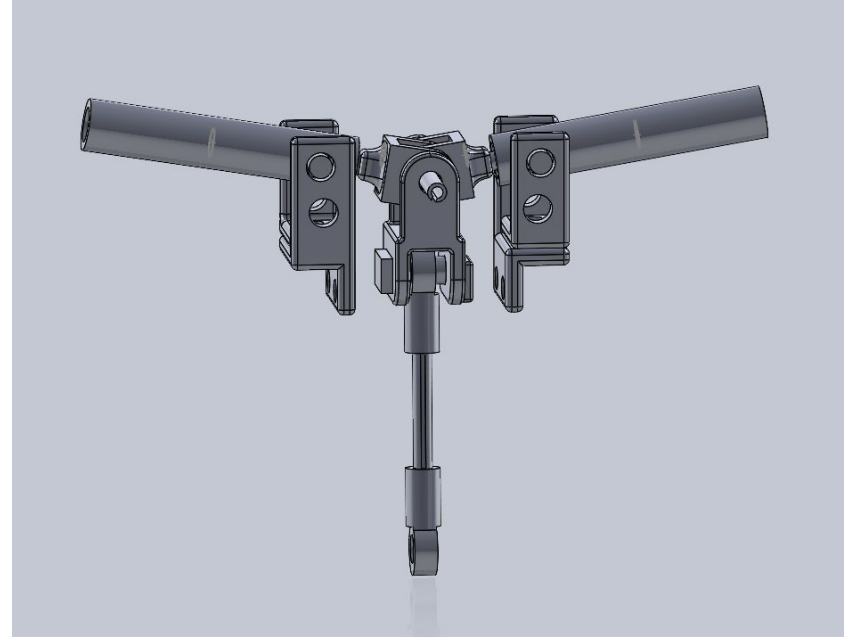
Flapping Mechanism

Requirements:

- Must output 20W at 3 flaps per second with wings attached.
- Must fit within 200g weight budget
- Must provide mostly symmetric flapping

Feedback Points:

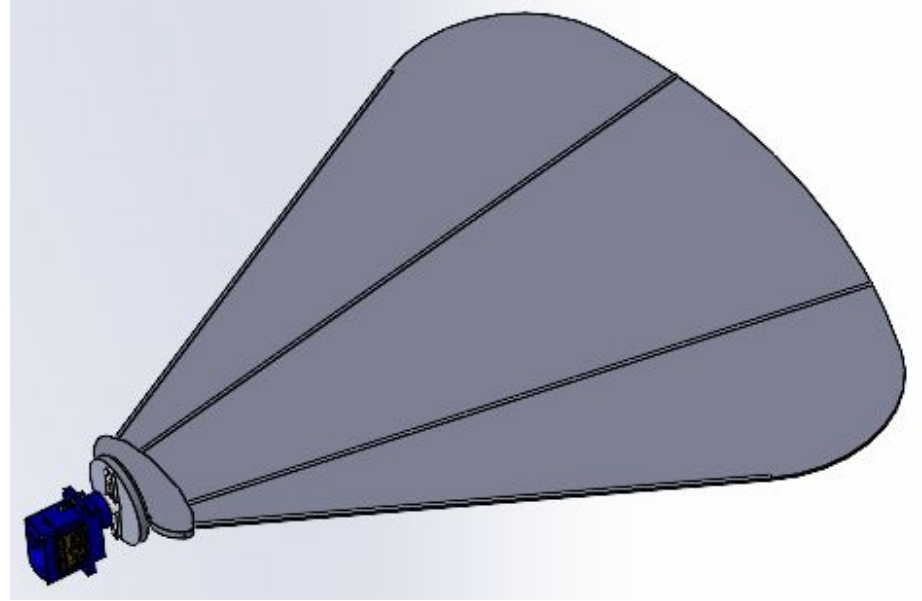
- Figuring out better materials (or whether current materials are sufficient)
- Whether heat will be an issue at high speeds
- Maintaining symmetry - is extra support needed? How to implement?



Tail

Requirements

- Must fit within 200g weight budget
- Must be able to rotate to turn
- Must provide stability to flying



Weight Budget

Calculated using recommended power-weight ratio: 200g

Subsystem	Item	Quantity	Unit Mass (g)	Unit Cost	Total Mass	Total Cost	Notes
Gear Box	Frame Plates	2	12		24	0	Based on 50x200mm piece of Lite Ply plywood
	Gears	1	21		21	0	Based on select 12 T, 1.07g 36 T, 6.73 g
	Shafts	2	1		2	0	Based on 31 x 4mm aluminum shaft
	Motor	1	9		9	0	
			Subtotal		56		
Electronics	Receiver	1	1		1	0	
	ESC	1	1		1	0	
	Battery	1	13.5		13.5	0	GNB 1s 550
	Wires	1	1.5				1 foot of 20awg wire
			Subtotal		15.5		
Flapping Mech	Brackets (small)	2	0.7	0	1.4	0	Estimate (not weighed)
	Brackets (Large)	2	1.4	0	2.8	0	
	Spar Mount	2	2.1	0	4.2	0	
	Crank-Hinge Interface	1	2.5	0	2.5	0	
	Crank Attachments	2	0.4	0	0.8	0	
	Hinge	2	0.8	0	1.6	0	
	Nylon Spacer	2	0.5	0	1	0	
	Metal Dowel (Long)	4	1.5	0	6	0	
	Metal Dowel 4.6mm	1	1.7	0	1.7	0	
	Nail	2	0.8	0	1.6	0	
			Subtotal		23.6		
Wings	Spars	2	11		22	0	
	Fabric	2	3		6	0	
			Subtotal		28		
Tail	Servo	2	9		18	0	9g micro servo (may be able to use smaller)
			Subtotal		18		
			estimate		141.1		

Timeline

- We have not yet assembled most hardware (since benchmarking), have a few prototypes made
- We plan to begin assembly next week, aiming to complete it before Thanksgiving break.