UAV FORGE

Structures Mark II

Introduction:

- AUVSI SUAS is a yearly competition utilizing a UAV and UGV
- UAV is required to do several tasks:
- Map predetermined waypoints
- Follow a course while avoiding obstacles
- Deploy UGV
- Image capture
- UGV must descent safely and drop off an object at a location

Objective

This subteam, Structures Mark II, was gathered for the purpose of creating an optimized airframe. It is tasked with closely researching structural allowables, requirements, constraints, material and design choices for a new and better frame. The team will then sketch and model a possible airframe for the rest of UAV Forge to build in the upcoming year. For now the overall design will be a prototype and can be adjusted to fit any new needs or new design choices when the time comes.

Existing Solutions:

Past years' competition placers:

Dronolab: 1st

them to be closer to the center

Octorotor

of gravity of the drone. Arms are hollow and squares

Upside Down motors to allow

- Easier to produce and bolt together
- Motors mounted directly onto

Animus Ferus: 2nd



- Hexrotor
- Bottom and top plate are carbon fiber
- Square spars
- Hexa can stay in the air even if a motor fails unlike a quad

UCAV: 4th

• Chose Octoroter that is

• X8 configuration can stay

airborne in the event of a

control to be landed safely.

motor failure and has enough

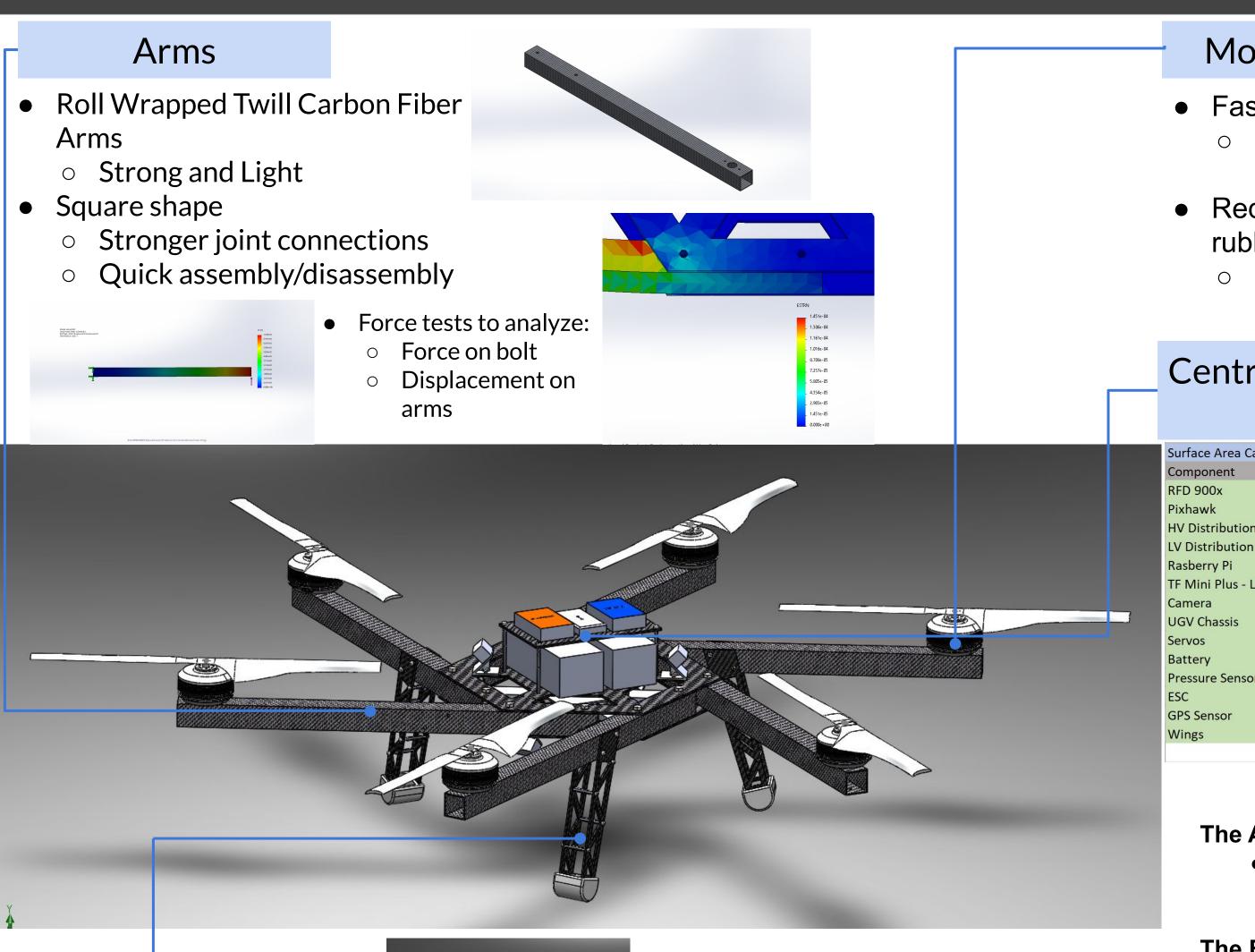
co-axial:

Says octo can consume too much battery power

Design Requirements

Temperature	Operate up to 110 Fahrenheit and not flammable
Cost	Less than \$1300
Modular	< 10 minutes for assembly and disassembly
Weight	< 25 pounds
Sturdy	Able to re-fly after a crash with minimal repairs
Easy Access	Avionic components must be easy to access
Simple	Few fasteners as possible

- Arms
- Ο



Landing Gear

- and screws
- 3D printed tip made of

Week 1-3
I Week 4-5
I Week 6-7
Veek 8-9
veek o-9
Week 10

http://projects.eng.uci.edu/projects/2020-2021/structures -mark-ii

Team: Vincent Tran, Gabriel Cruz, Kevin Luu, Allana Ilagan Sponsor: Prof. David Copp

• Pieces cut out from the same carbon fiber sheet used on the base plates, held together by spacers

TPU, glued to the bottom

Timeline

Problem Definition

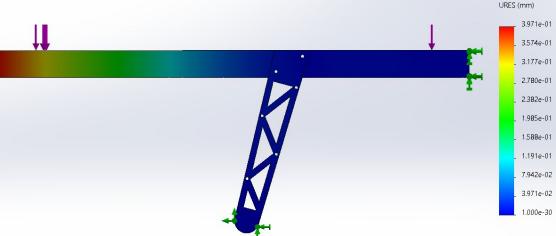
Concept Generation

Concept Selection

Solidworks Models + Assembly

Presentation

*Load of 150lb



Budget Manufacturing 14.9% Hardware 8.8% Off-the-Shelf 2.6% Materials Project Website:

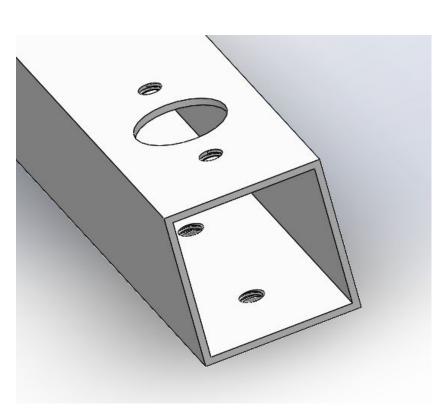


Motor Mounts

- Fastening motors directly onto arms • Reduces cost, weight, and number of fasteners
- Reduce vibration from motors with rubber washers/electrical tape
 - Clear imaging leads to better mapping

Central Hub + Avionics Placement

a Calcula	aitons (in^2)					A Avionics
	Length (in)	Width (in)	Quantity (#)	Surface Area		Avionics
	1.181103	2.244096	1	2.65050816		
	1.7322844	3.307088	1	5.72881764		
tion	3.1889781	1.968505	1	6.27751933		Avionics
ion	3.1889781	1.968505	1	6.27751933		
	3.3700806	2.224411	1	7.49644309		Avionics
s - Lidar	1.3779535	0.728347	4	4.01451236		Avionics
	1.4960638	1.496064	1	2.23820689		Avionics Avionics
s	8.7500047	6.500004	1	56.8750614		Avionics
	1.574804	0.787402	2	2.48000764		Ground Sta Ground Sta
	7.2440984	2.795277	2	40.4985247		Ground Sta
nsor	1.1417329	0.708662	4	3.23640997		Propulsion
	3.2283482	1.456694	6	28.2162869		Propulsion Propulsion Propulsion
	Diameter	2.637797	1	5.46200757		UGV
	5.86	1.38	6	48.5208		UGV
			Total Area	219.972625	in^2	



1	5./2881/64		· · · · ·					clearance?		
1	6.27751933	Avionics	RFD 900x	2	30x57x12.8 mm	15.4g		orientation of antennas? Needs to be in a place where	 2 antennas on each radio	Jordan
1	6.27751933							wires can conveniently run to all other avionics equipment minus the hv distribution board. Wires routing into Iv distribution must be in convenient location		
1	7.49644309	Avionics	LV Distribution	1	81x50x8 mm	11.33 g	Can get up to 130 C	with respect to battery Needs to be in a place where		Hieu
4	4.01451236	Avionics	HV Distribution	1		85.05 g	Can get up to 130 C	all wires going out can get to esc's. Wires routing in must be in convenient location with respect to battery		Hieu
1	2.23820689	Avionics Avionics	GPS Sensor Raspberry Pi		Diameter: 67mm Height: 15mm 85.6 x 56.5 mm	51.03 g		Can go anywhere	Cable Length: 125 mm. Cable Width 7mm	Hieu
100	56 0750644	Avionics	Pixhawk		44 x 84 x 12 mm	15.8g	Low: -40 C, High: 80 C	Can go anywhere		Hieu
1	56.8750614 2.48000764	Ground Station	Raspberry Pi High Quality Camera	2	38x38x18.4mm (height without lens)	42g (unspecified on Raspberry Pi website)	Low: -20 C, High: 60 C	Mounted front is ideal to allow for future adjustability and preventing fov from being covered.	May want to angle camera 45° forward from vertical in the future. Ground Station is deciding between 16mm C-mount lens and 6mm CS-mount lens.	
2	2.40000704	Ground Station	CS Mount Lens		Ф28×28.5mm	47g			65° FOV	
2	40.4985247	Ground Station	C Mount Lens	alternate for C Lens	φ39×50mm	133.7g			44.6°× 33.6° Maximum FOV, 21.8°× 16.4° Minimum FOV	
4	3.23640997	Propulsion	ESC	6	37 mm (W) x 82 mm (L)	78 g (114 g with Wires/Bullets) 1520g		Should be in airstream for cooling		Bevan
		Propulsion	LiPo Batt		184x71x61 mm KDE5215XF-330	1570g (longer connector)		Should be in airstream for cooling	Both batteries must be right next to each other	Jordan
6	28.2162869	Propulsion Propulsion	Brushless Motor Propeller	-	Using 20" propellers					
1	5.46200757	UGV	Servos for Decoupler			60g			Pin will connect from servo to UGV to bracket.	Jordan
	5.16230737	UGV	Bracket	1	Unknown	Unknown			 Servo arm will pull pin to release UGV	
6	48.5208	UGV	UGV	1	222.25 x 165.10 x 79.375 mm			Must be at center of mass on the bottom of the aircraft		
	210 07262E in	AD						Sensors must be in windstream. The wind will blow	https://www.sensirion.com/en/flow-sensors/differ ential-pressure-sensors/airspeed-sensor-revoluti	

Surface Area Calculations

Structures System Requirements table

The Approach:

• Began with evaluating the UAV Forge Structures team's Component placement chart and then proceeded to calculate surface area of the components to get a rough idea of the base plate size to go with.

The Build:

73.7%

- Base plate side = 8.08 inches -> which grants more than enough surface area for components and allow strategic cut outs for air flow and easier wiring
- Three stack: Two hexagonal plates (Area = 118.76 in^2) and one rectangular plate (Area = 26.69 in²).
- Priority placement:
 - HV and LV distribution -> top for best exposure to airflow and allow better natural cooling.
 - Lidar sensors on a mount with 45 degree

Conclusions

Overall, the design's priority was ease of manufacturing and quicker assembly. Square arms provide an effortless way for attachments due to its horizontal surfaces. Using the same material sheet for the base plates and landing gear provides a cost effective solution for the production of multiple parts. The base plates were made to have strategic cutouts for the fastening of components and airflow through the electronics to prevent overheating. Using simple designs and the same material for multiple parts is efficient in a time where access to machines might not be readily available.

Future Improvements:

- Connections between base plates and arms can be improved
 - Find weakness in bolt connections
 - Experiment with bolt placement and bolt sizes
- Motor mount design that allows fastening with four screws for firmer attachment and to account for torque
- Consider different forms of attachment methods for components