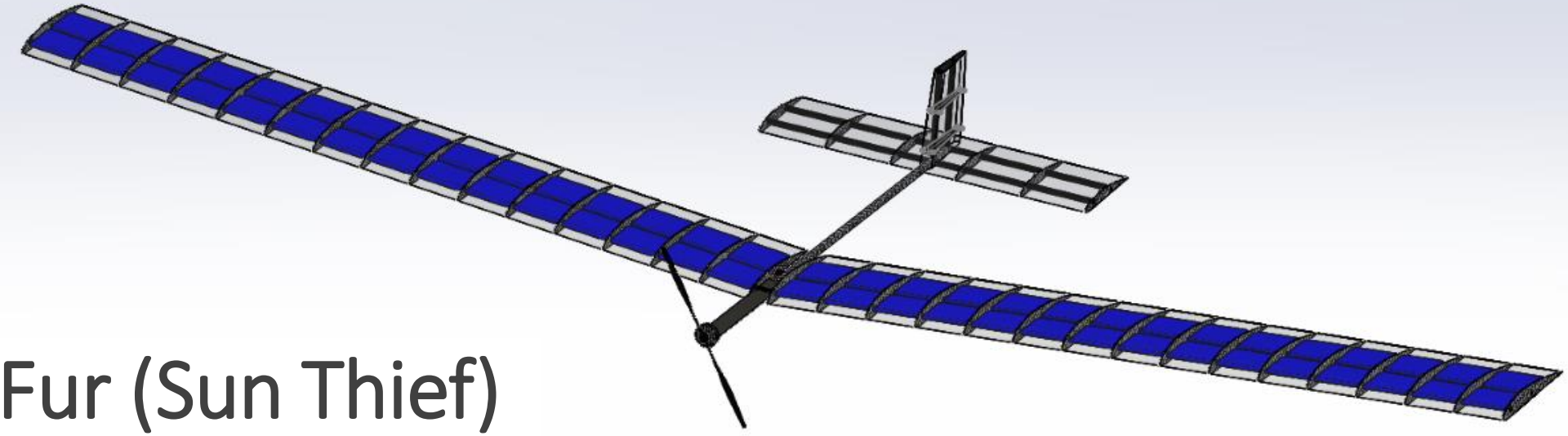
NORTHERN ARIZONA UNIVERSITY



Solis Fur (Sun Thief)

F1820 Solar Plane

The Team

Brandon Beaudoin
(Project Manager)

Michael Broyles
(Website Designer)

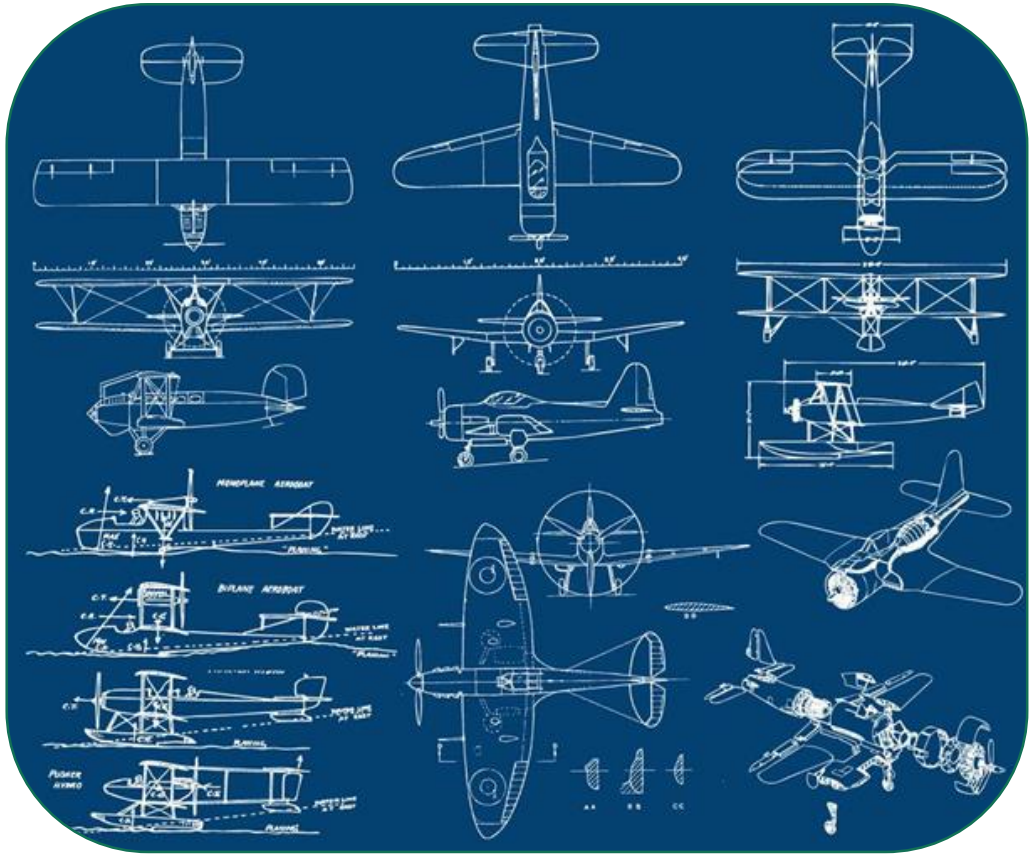
Nathan Zufelt
(Budget Manager)

Ethan Smith
(Client Contact)

Jonathan Hernandez
(Documentation Manager)

Project Concept

Explore the use of engineering principles to design and build a solar powered RC aircraft capable of sustaining indefinite flight while the sun is out.



Plane Schematic [8]

Project Sponsor / Customer

David Trevas, PhD

- Provided customer requirements.
- Crucial input for design requirements.

Sponsors

- Novakinetics AeroSystems
- Prometheus Solar
- Flagstaff Flyers

Why is this important?

- Teaches students to use engineering principles in a real life application.
- Allows the use of renewable energy to power an RC plane.

Project Review

Individual Analysis Report Conclusions

Control Surface Design:

- Control surface dimensioning used in conjunction with expected travel speeds to determine the force that is needed to actuate the surface.

Airfoil Selection:

- A Rhodes32G-il airfoil was selected based on necessary lift and ease to manufacture. The chord length will be 350 mm to accommodate two rows of solar cells.

Solar Power Input:

- Solar output for the panels will be higher than the standard testing conditions, resulting in a higher panel output than rated.

Power Usage:

- Overall energy consumption of each component within electronics in the plane, the time of discharge rate of the battery.

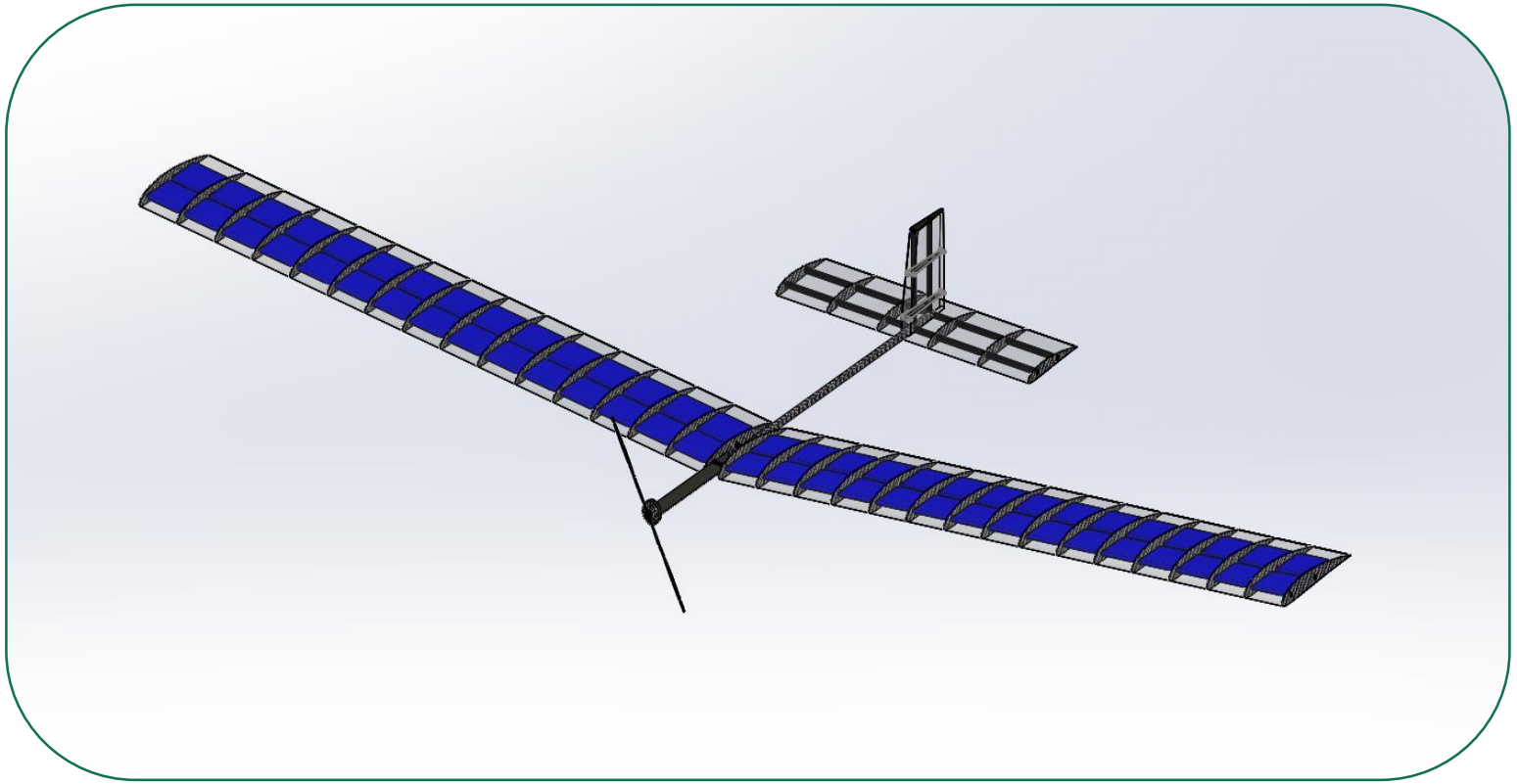
Wing Stress Analysis:

- Two 12mm Carbon Fiber spars provide the necessary strength to withstand the wing loading conditions.

Proposed Design

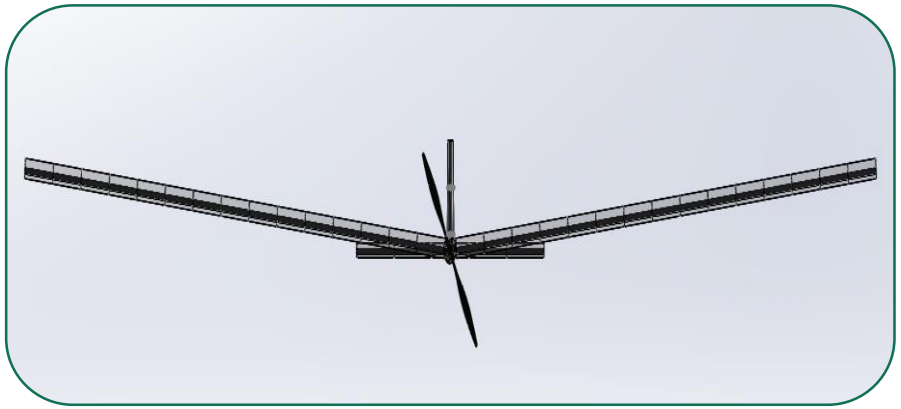
Specifications:

- Wing span: 13.25ft
- Weight: <8lbs
- Number of solar cells: 60
- Flight duration: Indefinite

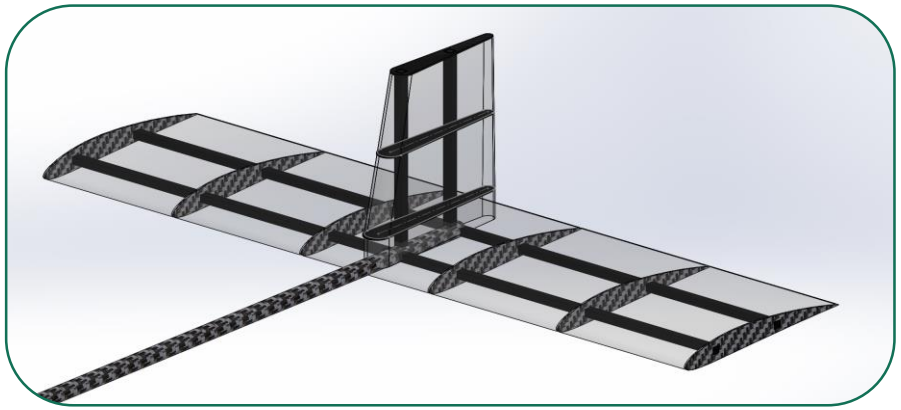


SolidWorks Rendering of Proposed Plane

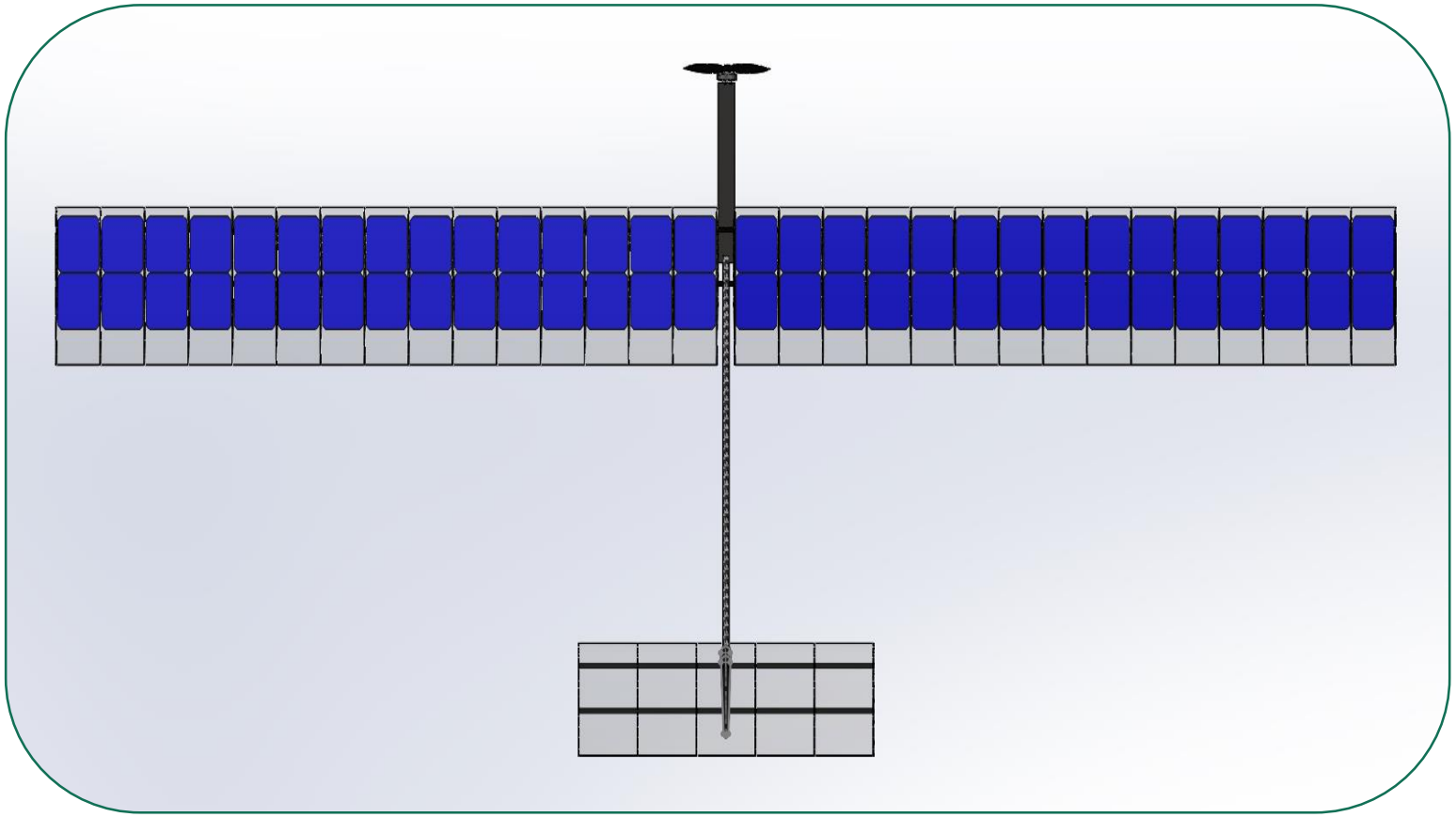
Proposed Design



5 degree Dihedral



Proposed Tail

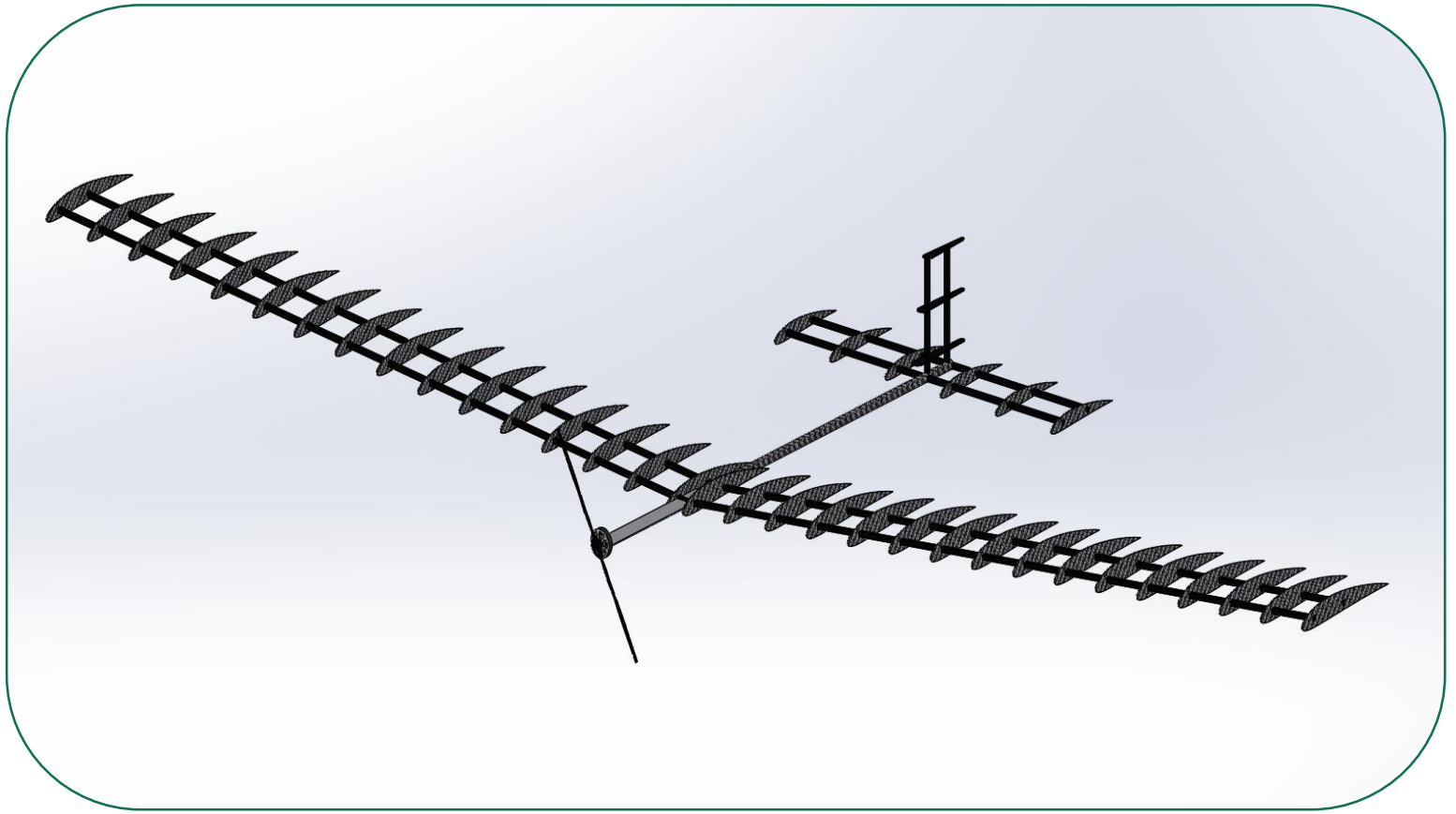


Top View

Subsystems

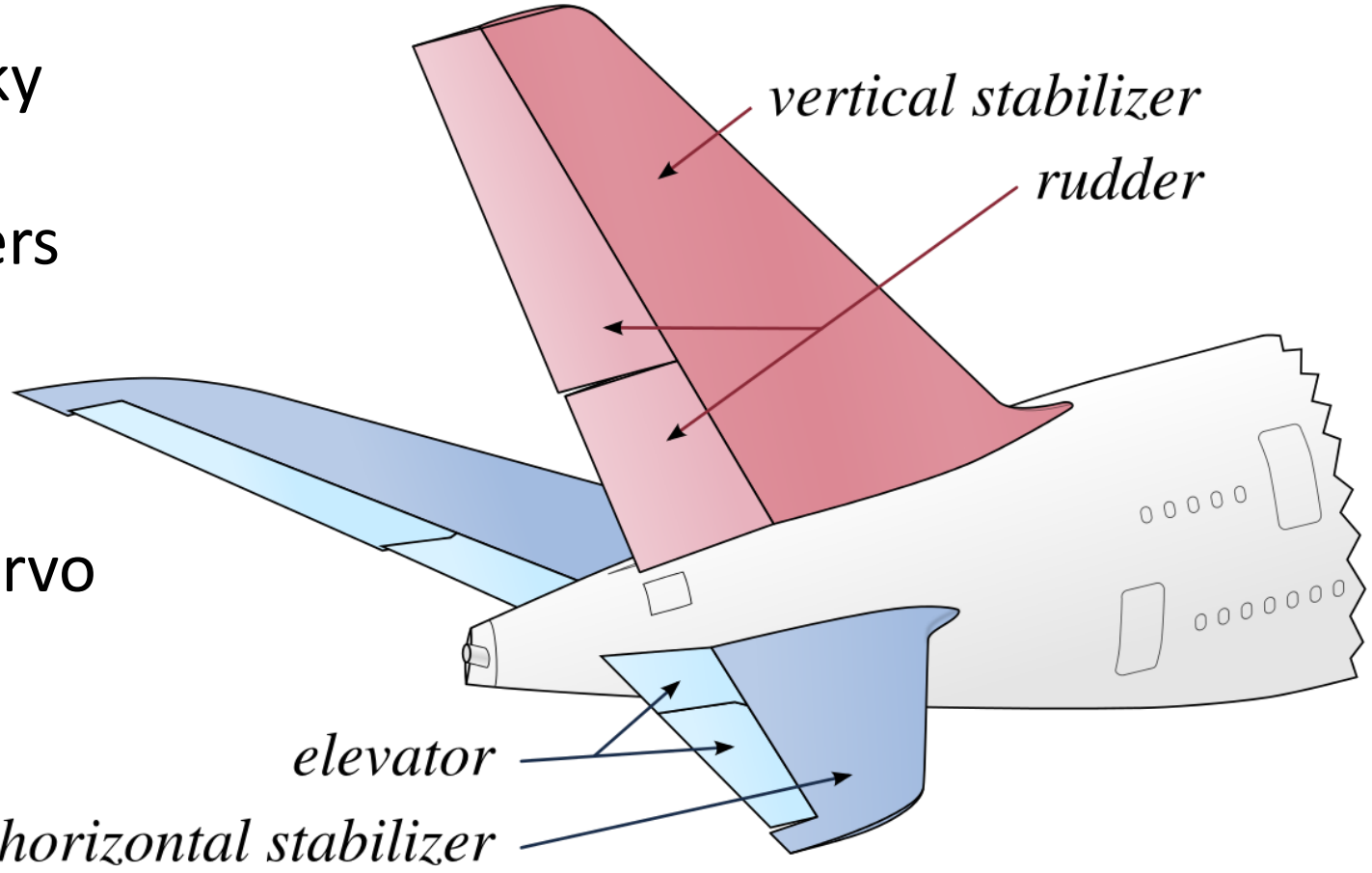
Subsystems - Structure

- Simplified Plane Design
- Two spars per wing- 12mm round carbon fiber tubes
- Tail boom- 25 mm square carbon fiber tube
- Wing profile ribs- Balsa wood 350mm x 42mm



Subsystems – Control Surfaces

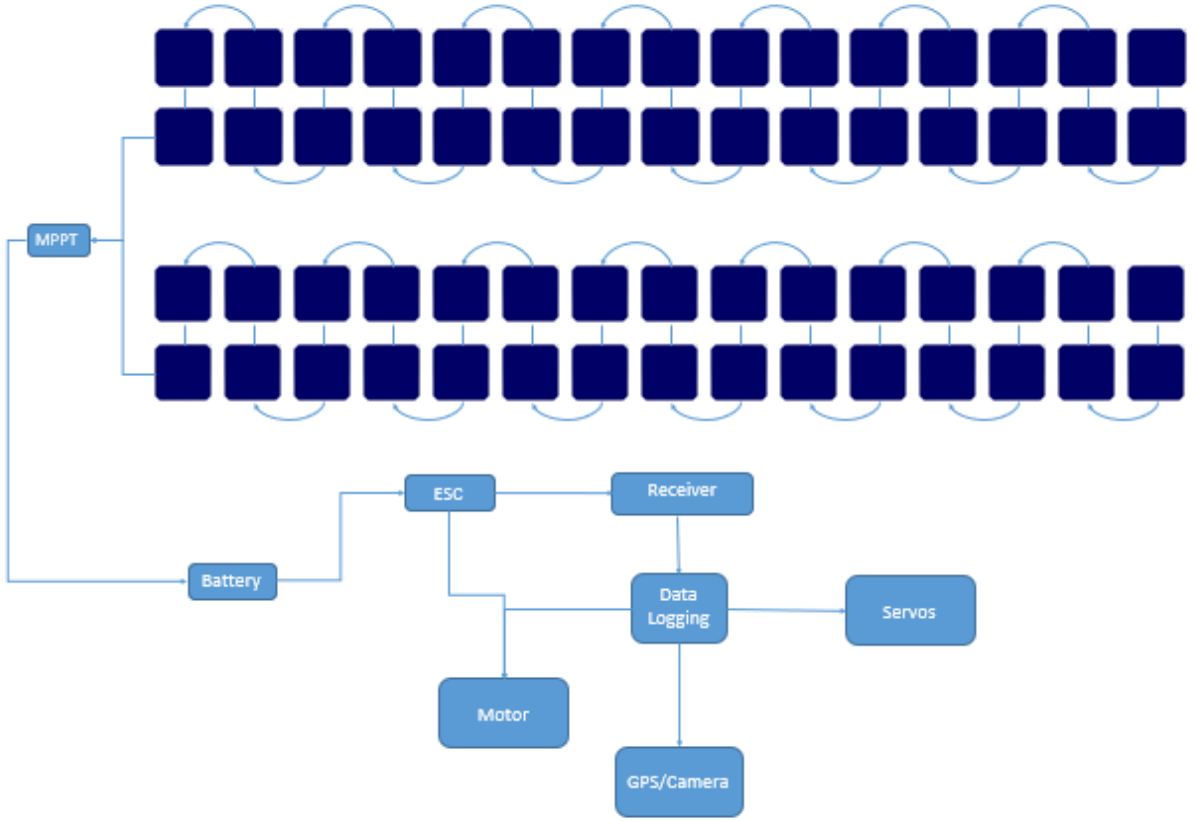
- Navigate the plane through the sky
- Work in conjunction with stabilizers
- Ensure safe flying conditions
- Sizing of control surface aids in servo selection



Tail Schematic [11]

Subsystems – Electrical System

- Manage and distribute power where needed
- Communicate with the transmitter to respond to pilot input



Subsystems – Solar Array

- Array of 30 in series per wing
  - 17.4 volts
- Each wing in parallel provides
  - 11.8 Amps
  - Each wing in parallel provides
- Harnesses energy from the sun
- Plane can endure indefinite flight

Subsystems – Propulsion

- Provide thrust as a function of propeller size and voltage applied to the motor.
- Ensure that thrust available is higher than drag experienced by the entire plane.

17X10 Folding Prop

	NO LOAD		ON LOAD			LOAD TYPE
VOLTAGE	CURRENT	SPEED	CURRENT	Pull	Power	Battery/prop
V	A	rpm	A	g	W	
11.1	0.3	3996	1.0	200	11.1	CF15x5.5 Prop
			2.5	400	27.8	
			4.3	580	47.7	
			1.0	200	11.1	CF16x5.5 Prop
			2.4	400	26.6	
			4.7	630	52.2	
			1.0	200	11.1	CF17x5.5 Prop
			2.3	400	25.5	
			5.7	760	63.3	
			1.5	300	16.7	CF18x5.5 Prop
			4.3	600	47.7	
			7.4	860	82.1	
14.8	0.3	5328	1.4	300	20.7	CF15x5.5 Prop
			3.5	600	51.8	
			6.5	910	96.2	
			1.3	300	19.2	CF16x5.5 Prop
			3.5	600	51.8	
			7.1	990	105.1	
			1.8	400	26.6	CF17x5.5 Prop
			4.7	800	69.6	
			8.5	1170	125.8	
			1.8	400	26.6	CF18x5.5 Prop
			5.1	800	75.5	
			10.8	1260	159.8	

360KV Brushless Motor

Around 1100 grams of thrust

Design Requirements

How Are We Meeting Design Requirements

Indefinite Flight

- Glider style airfoil selected to optimize lift and reduce drag.
- Weight will be kept to a minimum by using balsa wood and carbon as the primary building materials.
- Low wing aspect ratio to reduce induced drag.

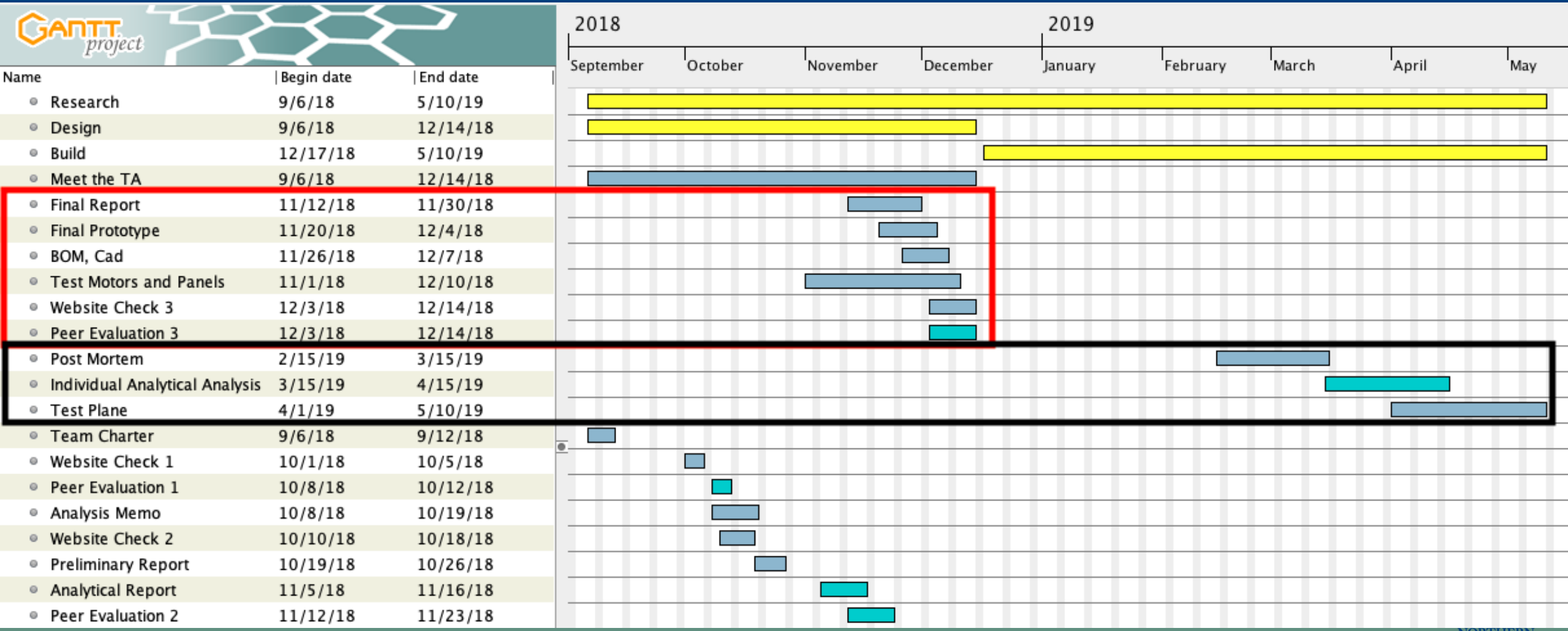
Data Logging

- eLogger V4
  - Prop RPM (optical sensor)
  - Battery Voltage
  - Voltage and Current into battery
  - 50hz ---50 samples/s

FPV or Video

- GoPro (74g)
- RunCam 2 Action Camera (49g)

Schedule



Name	Begin date	End date
Research	9/6/18	5/10/19
Design	9/6/18	12/14/18
Build	12/17/18	5/10/19
Meet the TA	9/6/18	12/14/18
Final Report	11/12/18	11/30/18
Final Prototype	11/20/18	12/4/18
BOM, Cad	11/26/18	12/7/18
Test Motors and Panels	11/1/18	12/10/18
Website Check 3	12/3/18	12/14/18
Peer Evaluation 3	12/3/18	12/14/18
Post Mortem	2/15/19	3/15/19
Individual Analytical Analysis	3/15/19	4/15/19
Test Plane	4/1/19	5/10/19
Team Charter	9/6/18	9/12/18
Website Check 1	10/1/18	10/5/18
Peer Evaluation 1	10/8/18	10/12/18
Analysis Memo	10/8/18	10/19/18
Website Check 2	10/10/18	10/18/18
Preliminary Report	10/19/18	10/26/18
Analytical Report	11/5/18	11/16/18
Peer Evaluation 2	11/12/18	11/23/18

Budget

	Price	Quantity	Units	Cost	Price per unit	Weight per unit	Units	Total Weight	Weight (lbs)
Plane Components									
Carbon Tail tubing (1.0" x 66")	$155.99	1	1	$155.99	$155.99	0.82	lbs	0.82	1.02
Carbon Wing struts (0.507" x 96")	$55.99	4	4	$223.96	$55.99	127	grams	508	1.12
Balsa Wood Sheets (1/8"x6"x48")	$6.64	5	5	$33.20	$6.64	5.9	oz	29.5	1.84
Clear UltraCote	$29.00	3	3	$87.00	$29.00	36.61821	grams	109.85463	0.24
Propeller (17x10 Folding)	$11.97	1	1	$11.97	$11.97				
Ground Equipment									
Connex ProSight HD Vision Pack	$399	1	1	$399.00	$399.00	66	grams	66	0.15
Zeee 3S Lipo Battery 11.1V 50C 5200mAh	$37	1	1	$36.99	$36.99	11.6	oz	11.6	0.73
			Total	$948.11				Total Weight	5.10

Description	Vendor	Website URL	Qty	Cost Ea	Cost
Motor	Amazon	https://www.amazon.com/Hobbysky-Brushless-MotorsDisk-Multicopter-Quadcopter/dp/B01N6HW4X0/	1	$20.80	$20.80
ESC	Amazon	https://www.amazon.com/Turnigy-Plush-30amp-Speed-Controller/dp/B00URCO7E6/	1	$19.02	$19.02
Battery	Hobbyking	https://hobbyking.com/en_us/turnigy-nano-tech-2200mah-4s-70c-lipo-pack-w-xt90-hr-tech.html	1	$33.80	$33.80
Wire	Amazon	https://www.amazon.com/EvZ-Extension-Strips-Single-Colour/dp/B009VCZ4V8/	1	$7.04	$7.04
Flux	Amazon	https://www.amazon.com/Kester-Rosin-Soldering-Bottle-Clean/dp/B01MR49JY1/	1	$12.93	$12.93
Servo	Amazon	https://www.amazon.com/ParkZone-DSV130-3-Wire-Digital-Servo/dp/B000U145LY/	2	$14.99	$29.98
Data Logging	Amazon	https://www.amazon.com/Eagle-Tree-Integrated-Connectors-MPRV4-CONN-100/dp/B00NU8EP32/	1	$69.99	$69.99
Solar Cells	Amazon	https://www.amazon.com/dp/B078K2W2TY/	1	$364.49	$364.49
Radio Transmitter	Amazon	https://www.amazon.com/FrSky-Taranis-Telemetry-Aluminum-Transmitter/dp/B073ZKFH6M/	1	$289.00	$289.00
			Total Purchased		$847.05
			Left In Budget		$1,652.95

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Questions?