SAE Aero Design

Mid-point Review

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Introduction

- Build an airplane that adheres to SAE requirements
- Constraints include a maximum combined dimensions of 175 in, specific payload bay area volume, and must have a 1000 W power limiter
- The design and construction phases have concluded
- A final design will be presented

Need Statement

Northern Arizona University does not have an airplane design to compete in the SAE Aero design competition, so the team is tasked with the design and construction of the airplane.

Project Goals

- Design and build an aircraft that adheres to the SAE Aero competition requirements
- Gain valuable knowledge in the mechanical engineering design and manufacturing processes, specifically in airplane design
- Compile an excellent report detailing the design and manufacturing processes and orally present the final design
- Win the SAE Aero Regular class competition

Objectives

Objective	Measurement	Units of Measurement
Carry max payload	Weight	Pounds Force (lbf)
Carry a payload from point A to B	Distance	Feet (ft)
Small turning radius	Distance	Feet (ft)

Constraints

- Freestanding aircraft must not exceed a combined length, width and height of 175 in
- Aircraft must be powered by a commercially available lithium-polymer battery pack
- Must use a new 2015 version 1000 W power limiter provided by Neumotors.com
- Interior payload bay must be smooth and dimensions must be 10"x4" x4" (length, width, height) with a tolerance of +0.125"

Constraints

- Payload must be secured to an airframe, with payload plates
- Airplane must land and take off within 200 ft
- Must complete all tasks within 180 s







Fabrication - Wing





Fabrication - Fuselage



Fabrication - Fuselage







Fabrication - Fuselage

• Pieces were notched out to connect them efficiently

• Tape to make sure the pieces remained in tact while glue dried

• Payload bay and tail end of the plane are access points

Fabrication - Tail

Twin tail





Fabrication - Tail









Fabrication - Tail









Functional Diagram



Fabrication - Electronics











Fabrication Difficulties

- Monokote
- Miscellaneous essential parts

- Final Dimensions-99" Width x 55" Length x 19" Height
- 173" Total Linear Dimension
- Heavy Duty Tricycle Landing Gear
 - 4" Wheels
- Stabilator Vertical and Horizontal Control Surfaces
- 22.2V DC Motor
- 18x12 Propeller







Future Modifications

- Cowling
- Vertical Stabilizers support bar on top
- Adjust center of gravity



Bill of Materials

tems	Quantity	Description					
Motor	1	AXI 5325/16 GOLD LINE	\$299.99				
Motor mount	1	N/A					
Propeller	1	APC 18x12WE	\$11.72				
Nose gear	1	Nose Gear with Nose Gear Mount Block (HAN1306)	\$4.99				
Landing gear	1	Constructing at machine shop					
ESC/BEC	1	CASTLE CREATIONS Phoenix Edge 75	\$101.96				
Battery	1	Eflight 3200mAh 6S 22.2V 30C LiPo, 12AWG EC3	\$99.99				
Arming plug	1	SAE 2016 Arming Safety Harness	\$30.00				
Power limiter	1	SAE Limiter V2 2016	\$50.00				
Receiver	1	AR610 6-Channel DSMX Aircraft Receiver (SPMAR610)	\$49.99				
Servos	5	Extra High Torque Servo (SPMS601H)	\$44.99				
Y-harness	2	Y-Harness: Telemetry (SPM1516)	\$5.99				
Wheels (2 orders)	4	Big Wheels, 4" (DUB400RV)	\$15.49				
Balsa dowels	10	3/16" x 3' balsa dowels	\$57.80				
Balsa sheeting	6	Balsa Sheet 3/16 x 12 x 36	\$112.59				
Pine spar	2	2in.x4in.x10ft Kiln-Dried Heat Treated Spruce-Pine-Fir Lumber (161659)	\$4.05				
Aluminum tubing	1	36 in. x 1/2 in. x 1/16 in. Aluminum Round Tube	\$10.67				
Aluminum sheeting	n/a	3/16" Aluminum Scraps	Donated				
1/32-in nylon-coated cable	1	Loos Galvanized Steel Wire Rope, Nylon Coated, 7x7 Strand Core	\$12.16				
ABS	29.58in^3	\$250/52in^3	\$142.22				
TOTAL			\$1,054.60				

Project Plan

Task	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14	W 15	W 16
Fuselage design																
Wing construction																
Tail design																
Parts for Fuselage and Tail																
Fuselage construction																
Tail construction																
Landing gear design																
Fabricate airplane parts																
Airplane construction																
Finalize airplane construction																
Test/modify airplane																
Hardware review 1																
Hardware review 2																
Hardware review 3																
Hardware review 4																
Midpoint presentation																
Hardware review 5																
Walkthrough Presentation																
UGRADS Presentations															29	

Conclusions

- Fabrication of the airplane has been completed
- Minor modifications will be made to the final design
- Testing will begin shortly

References

[1] What-When-How, "Tail design", Conventional Tail, T-tail, Dual Tail, Triple Tail and Twin Tail. Available: whatwhen-how.com.

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[5] "Airfoil Tools," Airfoil Tools. [Online]. Available at: http://airfoiltools.com/. [Accessed: 2015].

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