NC STATE UNIVERSITY

AIAA Design/Build/Fly Competition

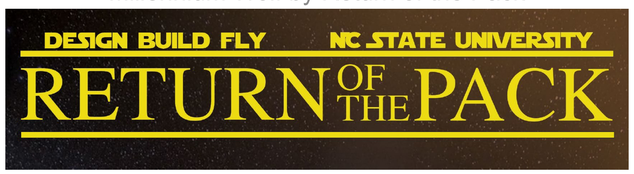
Department of Mechanical & Aerospace Engineering

Course Instructor: Dr. Felix Ewere

Faculty Advisor: Dr. Jack Edwards

Aerospace Engineering Capstone Senior Design 2021 – 2022

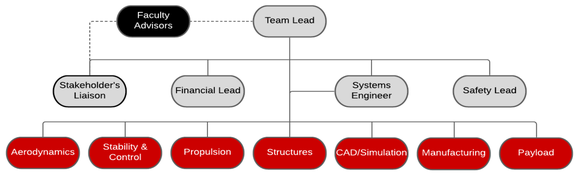
Millennium Wolf by Return of the Pack



Team Organization

Team Members: Aditya Srihari, Andrew Mistele, Brian Alonso, Josh Rusmisel, Kyle Duncan, Kyle Tharrington, Peter Simmons

7 sub-team leads, 11 underclassman, 1 pilot



Project Overview

Mission Statement: Return of the Pack will design, build, and fly an aircraft with the ability to transport syringes and deploy vaccine vial packages within the parameters of the missions given by the Design, Build, Fly Competition hosted by the American Institute of Aeronautics and Astronautics. The aircraft, designated as the Millennium Wolf, will be cost and technically efficient capable of competition success.

Objectives: The aircraft shall be remote-controlled, take off in under 25 ft, carry syringe payloads, carry and deploy vaccine vial payloads, weigh under 55 lbs, have a wingspan not exceeding 8 ft, optimize the aircraft payload carried vs. cruise speed to maximize competition score, and successfully land without damage to the aircraft

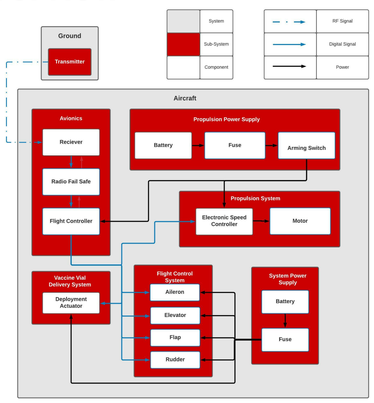
Mission Overview

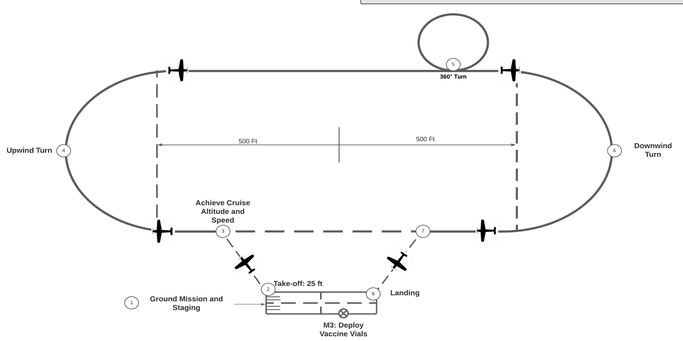
Ground Mission: Load payloads into aircraft in flight configuration while timed

Mission 1: Complete 3 laps in < 5 minutes with no payloads

Mission 2: Complete 3 laps in < 5 minutes with syringe payload

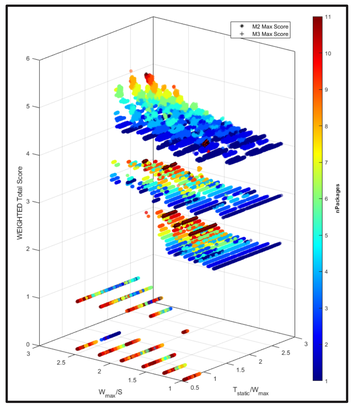
Mission 3: Complete lap, land, taxi, deploy vaccine vial payload, takeoff, repeat as many times as possible in < 10 minutes



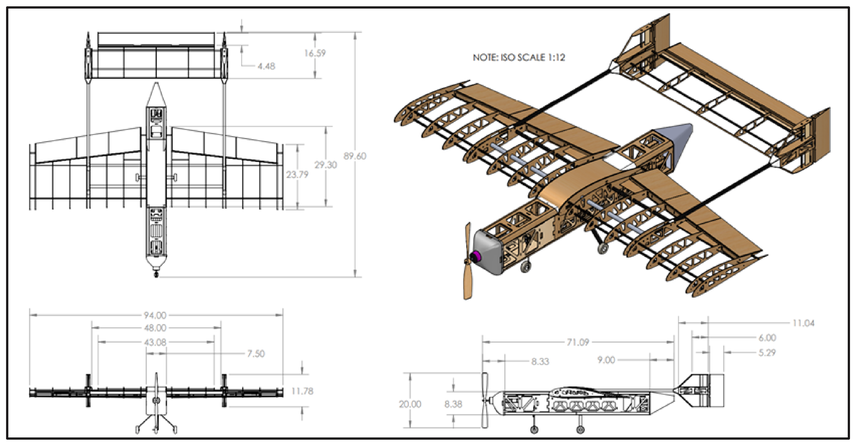


Design Solution

Design Methodology: Return of the Pack implemented a multi-disciplinary optimization and analysis (MDAO) approach to evaluate > 500,000 conceptual designs and select an optimal design point for the DBF competition. The final configuration selected maximized the Mission 2 score to place well in the competition. The aircraft features are detailed below.

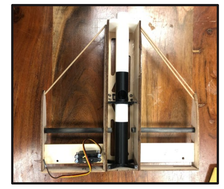


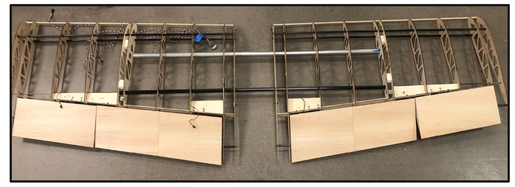
Wing		Horizontal Tail	
Airfoil	SD 7062	Airfoil	NACA 0012
Span	7.83 [ft]	Volume Coefficient	0.7
MAC	2.24 [ft]	Span	4 [ft]
Taper Ratio	0.8	Chord	1.4 [ft]
Area	17.5 [ft^2]	Area	5.6 [ft]
AR	3.7	Incidence Angle	0 [deg]
Incidence Angle	2 [deg]	**Vertical Tail**	
Fuselage		Airfoil	NACA 0012
Total Length	5.6 [ft]	Volume Coefficient	0.08
Cowling Length	0.38 [ft]	Span	0.98 [ft]
Closeout Length	0.75 [ft]	Root Chord	1.43 [ft]
Width	0.6 [ft]	Tip Chord	1.00 [ft]
Height	0.7 [ft]	Area	2.33 [ft]
Motor		**Primary Control Surfaces**	
Model	Hacker A60-6XS V4	Elevator Chord Ratio	30%
Diameter	2.36 [in]	Rudder Chord Ratio	50%
Length	4.84 [in]	Aileron Chord Ratio	30%
Propeller		Flap Chord Ratio	30%
Diameter	20 [in]	Aileron Span Ratio	35%
Pitch	13 [in]	Flap Span Ratio	50%

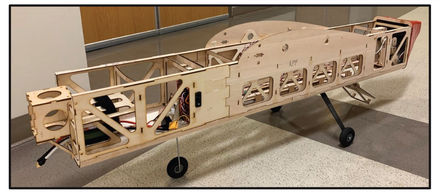


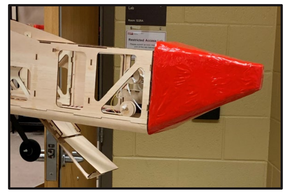
Manufacturing

Manufacturing began in January 2022 with extensive work in manufacturing modifications after completing validation testing. Composite materials were used in manufacturing the forward and aft caps, with balsa and plywood consisting of the aircraft structure.





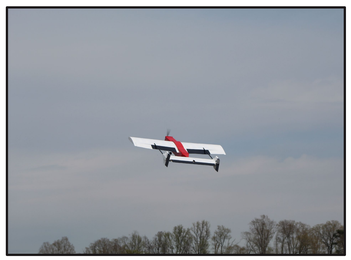




Flight Testing

Tuesday, March 29: Millennium Wolf successfully took off, flew two laps, and landed without damage. Due to electrical concerns creating risk for potential loss of elevator command ability, flight testing was cut short after 2 minutes of airtime.

Continuing Test Plan: Return of the Pack has planned continuing flight tests throughout April to verify design requirements and determine maximum payloads as a function of windspeed that can be used while meeting the 25 ft takeoff requirement.



DBF Competition Results

The DBF 2022 competition will have an in person fly off for the first time in 2 years on April 21st to 24th . The NC State team is positioned for success with a 6th place proposal out of 127 submissions. The team submitted the design report February 25th and is waiting for scores to be released.