Milestone Review Flysheet 2019-2020

Institution	Auburn University

Milestone	FRR

Vehicle Properties

Total Length (in)	132.75
Diameter (in)	6.2
Gross Lift Off Weigh (lb)	55
Airframe Material(s)	Carbon Fiber, Fiberglass
Fin Material and Thickness (in)	Carbon Fiber, 0.1
Coupler Length(s)/Shoulder Length(s) (in)	14in/6.2in

Motor Properties

Motor Brand/Designation	AeroTech L2200G
Max/Average Thrust (lb)	697/504
Total Impulse (lbf-s)	1147
Mass Before/After Burn (lb)	10.5/5.55
Liftoff Thrust (lb)	557.55
Motor Retention Method	Aeropack motor retention system

Stability Analysis

Center of Pressure (in. from nose)	104
Center of Gravity (in. from nose)	78.606
Static Stability Margin (on pad)	4.11
Static Stability Margin (at rail exit)	4.16
Thrust-to-Weight Ratio	10.3-1
Rail Size/Type and Length (in)	15 - 15 rail / 96
Rail Exit Velocity (ft/s)	84.9

Ascent Analysis

Maximum Velocity (ft/s)	596
Maximum Mach Number	0.53
Maximum Acceleration (ft/s^2)	383
Target Apogee (ft)	5000
Predicted Apogee (From Sim.) (ft)	4726

Recovery System Properties - Overall

Total Descent Time (s)	88.9
Total Drift in 20 mph winds (ft)	2,609

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2.5
	Backup	3
Energetics Mass - Main Chute (grams)	Primary	8
	Backup	8.5
Energetics Mass - Other (grams) - If Applicable	Primary	
	Backup	

Payload Deployment

Location: Air or Ground (if applicable)	Ground
Altitude of Deployment (if applicable)	N/A

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Perfectflite Stratologger
Secondary Altimeter Make/Model	Perfectflite Stratologger
Other Altimeters (if applicable)	
Rocket Locator (Make/Model)	Featherweight GPS Tracker
Additional Locators (if applicable)	
Transmitting Frequencies (all - vehicle and payload)	919.8 MHz
Pad Stay Time (Launch Configuration)	4 hrs
Describe Redundancy Plan (batteries, switches, etc.)	Redundant recovery system including backup altimeters and black powder charges.

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Auburn University/Circular	
Size or Diameter (in or ft)			30 in	
Main Altimeter Deployment Setting			apogee	
Backup Altimeter Deployment Setting			apogee + 1sec	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			97.1	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 inch Tubular Nylon	
Recovery Harness Length (ft)			15ft and 10 ft	
Harness/Airframe Interfaces		(2x) Quick Link to U-Bolt mounted in bulk plate		
Kinetic Energy (Ft-lbs)	Section 1	Section 2	Section 3	Section 4

Recovery System Properties - Main Parachute

Manufacturer/Model			Auburn University/Hemispherical	
Size or Diameter (in or ft)			10.5ft	
Main Altimeter Deployment Setting (ft)			550	
Backup Altimeter Deployment Setting (ft)			500	
Velocity at Deployment (ft/s)			97.1	
Terminal Velocity (ft/s)			12.75	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 inch Tubular Nylon	
Recovery Harness Length (ft)			20ft and 15ft	
Harness/Airframe Interfaces		(2x) Quick Link to U-Bolt mounted in bulk plate		
Kinetic Energy	Section 1	Section 2	Section 3	Section 4

	(Ft-lbs)	49.8	17.2	43.9	

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Payload

	Overview
Payload 1 (official payload)	The payload will be broken down into three subsystems. The main payload will be a remote controlled aerial vehicle deployed on the ground. The vehicle will be manually flown to a sample site and will extract the sample with a auger-like mechanism. The ejection system will be an active lead-screw driven system that is remotely activated by the team once the launch vehicle lands. The orientation and retention system will be an active system that will be locked during flight. After the flight is complete, the orientation system will actuate, orienting the payload. Once the payload is deployed, the retention system will actuate, releasing the payload from the orientation system.
Payload 2 (non-scored payload)	The altitude control system is a variable drag system that is designed to deploy a set of 4 grid fins to control the apogee of the vehicle. Because the mass of the vehicle will be too heavy to reach the target apogee, and because the fins did not deploy at the verification flight, the system will remain static and only collect data. The flight will be used as an opportunity to test algorithms and find any bugs in the software.

Test Plans, Status, and Results

Ejection Charge Tests	Ejection testing for the subscale rocket was completed on October 19 in Huntsville, AL. The test was successful for both drogue and main separations, proving that the subscale rocket was prepared for a successful launch and recovery. Full scale ejection tests was performed on January 29 at an Auburn University research facility located just off campus in Auburn, AL. Though the test was initially considered successful, a full vehicle flight on February 15 resulted in a main ejection event at apogee, making a second ejection charge test necessary. This test was performed in Auburn, AL, on February 19, prior to the vehicle demonstration flight on February 22. This second test was successful, proving that a slightly smaller volume of black powder was adequate, which was further validated during the vehicle demonstration flight on February 22.
Sub-scale Test Flights	A 2:3 scale rocket was manufactured with scaled-down but otherwise similar layouts, compartments, and materials as the full scale rocket has. In the place of payloads, a small electronics package was flown to collect flight data so that accurate payload simulations could be performed after the launch. This simulated the weight and volume of the full scale payloads. This subscale launch was completed on November 9 in Samson, Alabama. The flight was nominal, reaching an altitude of 4,529 feet. The recovery, altitude control, and payload systems each collected independent flight data so that the flight could be analyzed and used for design of the full scale systems.
Vehicle Demon-stration Flights	The vehicle demonstration flight was completed on February 22, 2020, in Samson, AL. The vehicle reached an altitude of 4,665 feet with all payload systems, including the altitude control system, active. Because the altitude control system alters the trajectory of the vehicle, it was included in the vehicle demonstration flight even in the event that the payload was not ready for a demonstration flight at the same time. An Aerotech L2200G motor was used, the same motor which will fly at the competition. After a straight and stable flight, all parachutes deployed at the appropriate altitudes, allowing for a successful recovery of the vehicle and the internal payloads.
Payload Demon-stration Flights	The payload was successfully demonstrated during the same launch as the vehicle on February 22, 2020. The UAVES system successfully retained and deployed the paylaod during and after launch. The AOS/ARS system operated successfully and oriented the payload after deployment and released the locking clamps for BRIC properly. The BRIC auxiliary systems performed successfully and the BRIC performed successful flight tests after deployment. The payload was also stowed in the payload bay with all systems powered on for four hours before launch. This validates the battery system's factor of safety of 2 for a full scale demonstration flight. The payload will not need a second demonstraton flight.

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Transmitter #1			
Location of transmitter:	Nose Cone		
Purpose of transmitter:	Tracking of Rocket		
Brand	Featherweight Altimeters	RF Output Power (mW)	250
Model	Featherweight GPS Tracker	Specific Frequency used by team (MHz)	919.8
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)	23in		
Description of shielding plan:	he GPS has a carbon fiber bulkplate between it and the nearest e-match which shields its signa		

Transmitter #2			
Location of transmitter:	Altitude Control		
Purpose of transmitter:	Telemetry & GPS Tracking		
Brand	Adafruit LoRa Featherweight	RF Output Power (mW)	100
Model	RFM95	Specific Frequency used by team (MHz)	915
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)	30		
Description of shielding plan:	Carbon fiber bulkplate between it and the nearest e-match		

Transmitter #3			
Location of transmitter:	UAVES Bay		
Purpose of transmitter:	Receives commands for the UAVES system and transmits status data		
Brand	Reyax	RF Output Power (mW)	31.62mW
Model	RYLR896	Specific Frequency used by team (MHz)	915MHz
Handshake or frequency hopping? (explain)	Handshake - The transmitter prefaces its transmission with the address and network of the target receiver		
Distance to closest e-match or altimeter (in)	6 in		
Description of shielding plan:	A carbon fiber bulkhead is placed between the transmitter and the altimeter		

Transmitter #4			
Location of transmitter:	AOS/ARS Plate		
Purpose of transmitter:	Receives commands for the AOS and ARS systems and transmits telemetry and status data		
Brand	Reyax	RF Output Power (mW)	31.62mW
Model	RYLR896	Specific Frequency used by team (MHz)	915MHz
Handshake or frequency hopping? (explain)	Handshake - The transmitter prefaces its transmission with the address and network of the target receiver		
Distance to closest e-match or altimeter (in)	12 in		
Description of shielding plan:	A carbon fiber bulkhead is placed between the transmitter and the altimeter		

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Transmitter #5

Location of transmitter:	Ground Station		
Purpose of transmitter:	Transmit instructions to the UAV		
Brand	FrSky	RF Output Power (mW)	100mW
Model	QX7	Specific Frequency used by team (MHz)	2400 MHz
Handshake or frequency hopping? (explain)	Frequency hopping - Uses the FrSky ACCST protocol to pair with a receiver		
Distance to closest e-match or altimeter (in)	Ground based		
Description of shielding plan:	The carbon fiber body tube shields the altimeters from ground based transmissions		

Transmitter #6

Location of transmitter:	BRIC Top Plate		
Purpose of transmitter:	Transmits video signal to the ground station		
Brand	Holybro	RF Output Power (mW)	500mW
Model	Atlatl HV v2	Specific Frequency used by team (MHz)	5800MHz
Handshake or frequency hopping? (explain)	N/A		
Distance to closest e-match or altimeter (in)	12 in		
Description of shielding plan:	A carbon fiber bulkhead is placed between the transmitter and the altimeter		

Additional Comments