NC STATE UNIVERSITY

Department of Mechanical and Aerospace Engineering

Team L.O.R.A.X.

L.O.R.A.X. Fixed Wing UAS

Aerospace Engineering Senior Design Capstone Project 2022 - 2023

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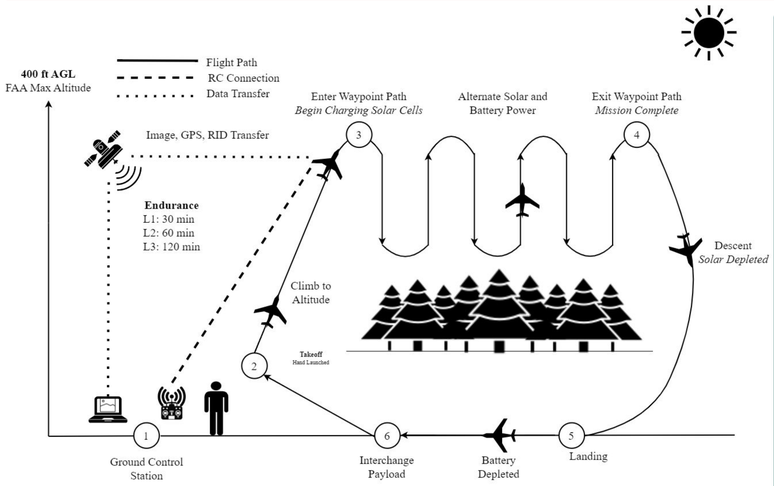
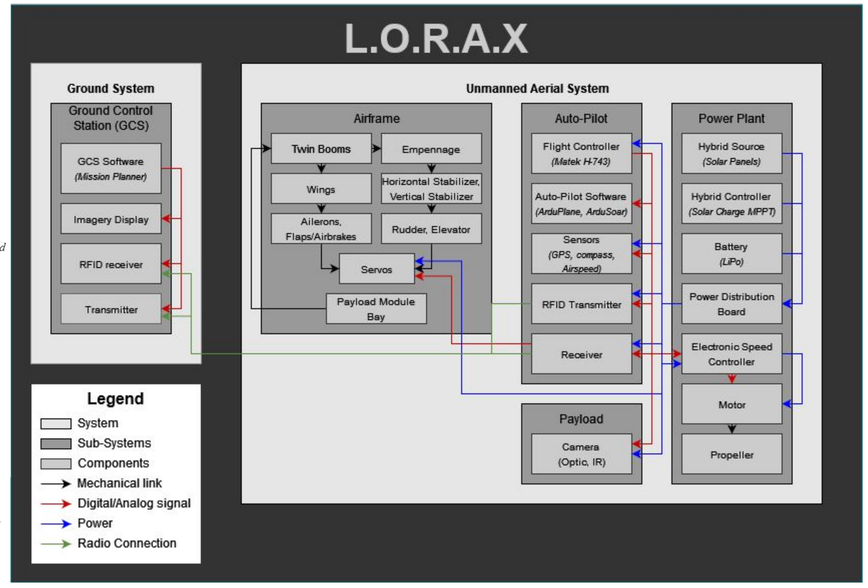
Mission Overview



The L.O.R.A.X. UAV was designed to provide the NC forest service with a cost-effective method of aerial surveillance. It is hand launched to allow for operations in remote areas and is equipped with a flight controller for autonomous missions. Solar panels are used to extend the UAV's range and endurance. If the battery is depleted or if the mission is accomplished the UAV can make a belly landing to swap batteries or payload sensors.

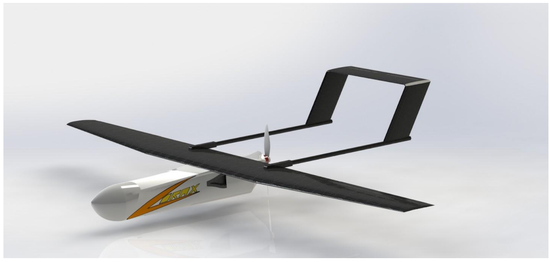
Functional Block Diagram

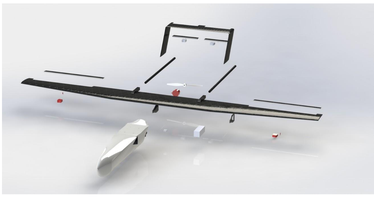


Design Solution

Design Specifications:

- Endurance: 16 mins
- Cruise Speed: 34 mph
- Weight: 10.2 lbs.
- Wingspan: 9 ft. 3 in.
- Takeoff thrust: 12 lbs.
- CG: 3.67 in. from LE
- Static Margin: 20%
- Airfoil: GOE 488





Avionics:

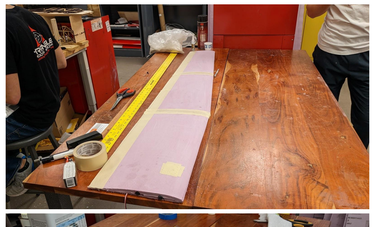
- Motor: Turnigy SK3 Aerodrive (410 Kv)
- Speed Controller: Spektrum Avian 100 A ESC
- Battery: Turnigy 6600 mAh 6S 12-24C LiPo Battery
- Charge Controller: Genasun GV-5-Li-16.7 V MPPT
- Camera: RunCam Split 4 4K Hybrid Camera
- Flight Controller: Matek H743 Wing V3
- Propeller: 14x8 Aeronaut CAM Folding Propeller

Manufacturing

The aircraft was manufactured by using a CNC mill to cut foam cores for each component. These cores acted as molds for composite layups which provide most of the strength. Carbon fiber was used for the wings and tails because of its lightness and strength. Fiberglass was used for the fuselage to allow for radio signals to pass through from the internal electronics to the ground station as the carbon fiber will block these signals.

Materials:

- Wings:
  - Foamular 150 Foam Core
  - 2x2 Twill Carbon Layup Skin
  - Kevlar Control Hinges
  - Carbon Spars
  - Resin Printed Tail Boom Boxes
- Tails:
  - Foamular 150 Foam Core
  - 2x2 Twill Carbon Layup Skin
  - Kevlar Control Hinges
  - Hexagonal Carbon Fiber Tail Booms
- Fuselage:
  - Foamular 150 Foam Core
  - Fiberglass Layup Skin
  - Plywood Electronics Mounting Plates



Final Prototype

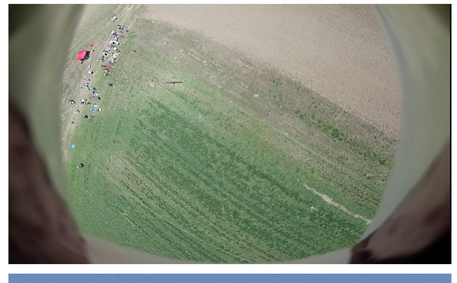
Prototype Specifications:

- Endurance: 20 mins
- Cruise Speed: 30 mph
- Landing Speed: 26 mph
- Takeoff thrust: 12 lbs.
- Propeller Diameter: 14 in.
- Weight: 12.0 lbs.
- T/W: Approx. 1
- Wingspan: 9 ft. 1 in.
- Wing Area: 1051 sq. in.
- Wing Loading: 1.64 lbs./sq. ft.
- Length: 5.9 ft.
- Fuselage Internal Dimensions: 33 in x 4 in x 4.25 in.
- Payload Volume: 561 cu. in.

Flight Testing

First Flight Test

- Aircraft was assembled in less than 30 min.
- Initial flight was completed on March 24th, 2023 with a total flight time of 2 minutes and 30 seconds.
- A flight controller was used to successfully stabilize the aircraft in 25 mph winds.
- Landing was successfully completed with minor damage to the aircraft.
- Mission successfully completed, 4k footage of surrounding area captured with real time observation capabilities.



L.O.R.A.X. CONOPS Video

L.O.R.A.X. 4K Onboard Video