AeroVironment: Swarm Test System

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Introduction

Problem Statement: Create a novel system that allows a single person to quickly prepare, launch, and recover a collaborative aircraft swarm

Motivation: Demonstrate one system
- Build one launcher and one aircraft
- Designed so that a single person can operate a dozen at a time
- Generic payload allowing for wide range of missions

Budget: $5600

Mission Objective

MO.1 - Develop, within 20 weeks, a low cost, modular, reusable, platform for aircraft swarming that is easily and **quickly** assembled to set up, **deploy**, run a mission, **recover**, and re-use by building and demonstrating one system that is designed so that a **single person** could operate a dozen at a time while operating within standard everyday wind conditions and temperatures, and standard mission altitudes and range.

MO.2 - A **nominal SWAP** is specified to **modularly** support many kinds of (small) payloads, including some combination of intelligence, surveillance, and reconnaissance (ISR).

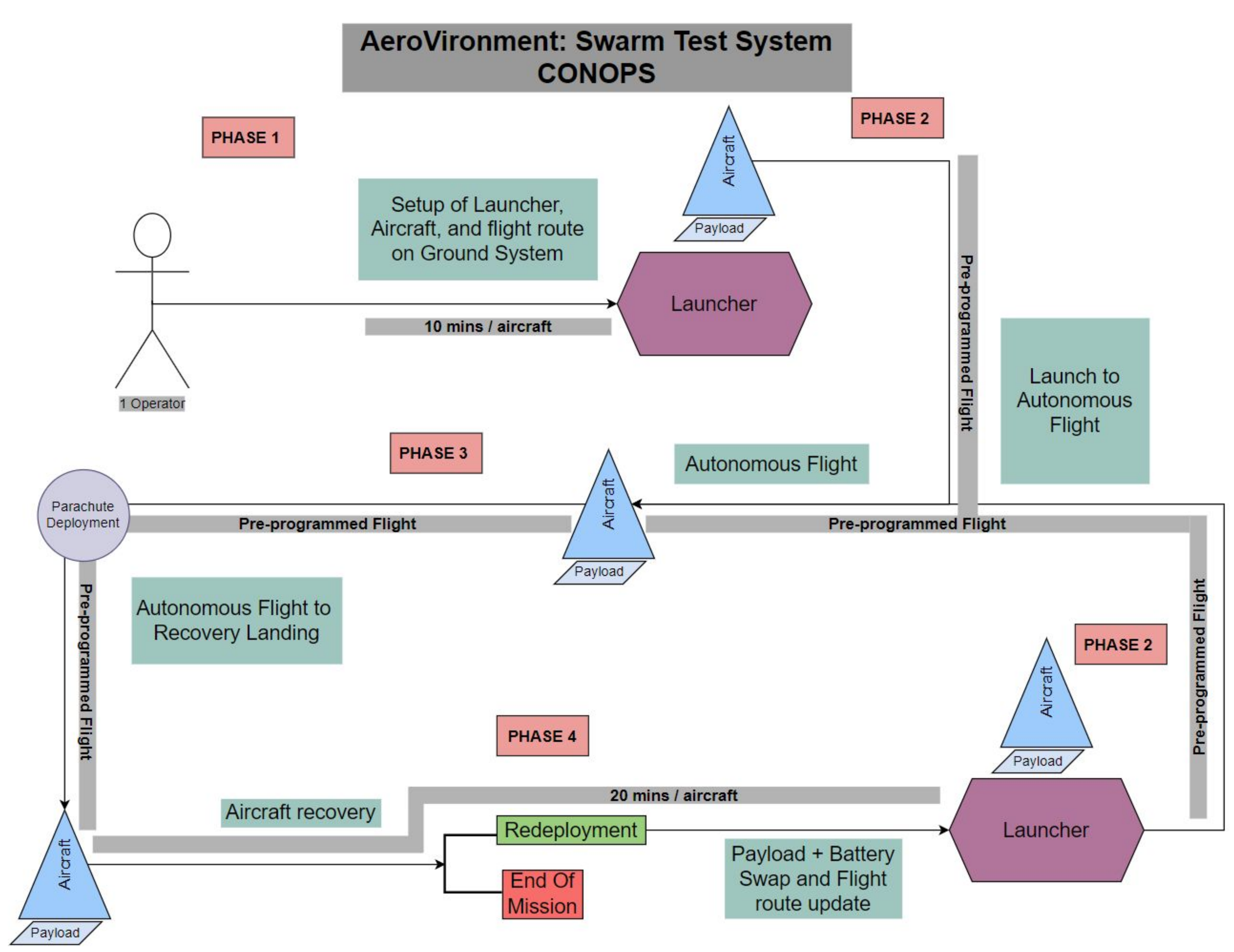

Figure 1: CONOPS showing all stages of a sample mission

Aircraft

Dimensions:
- Length: 1.5m
- Wingspan: 2m
- Tail Span (non-projected): 1 m
- Tail Dihedral: 40 deg
- Mass: 6kg

Aerodynamics:
A V-tail was selected to protect the parachute lines during deployment. This leads to mixing of rudder and elevator control action (Fig 3). These are called ruddervators

Flight Performance:
- Cruise speed: 20 m/s
- Thrust: 14 N
- Range: 20km

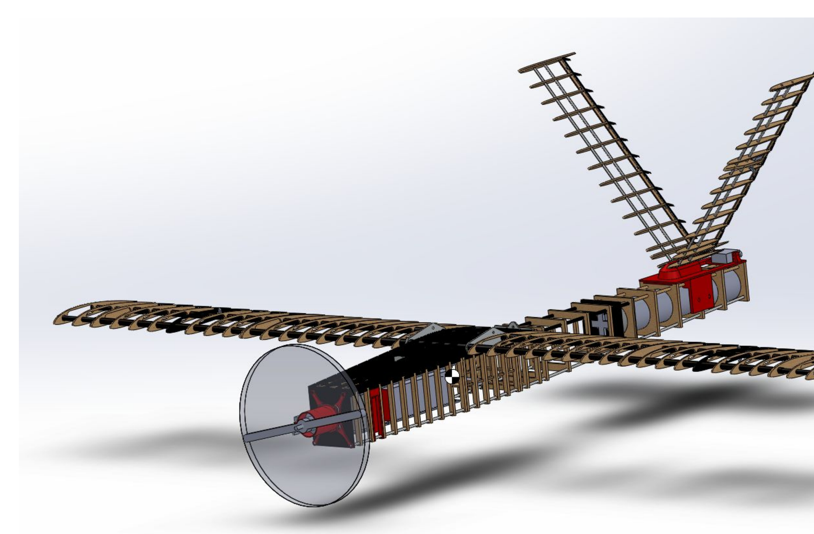

Figure 2: CAD model of full aircraft structure

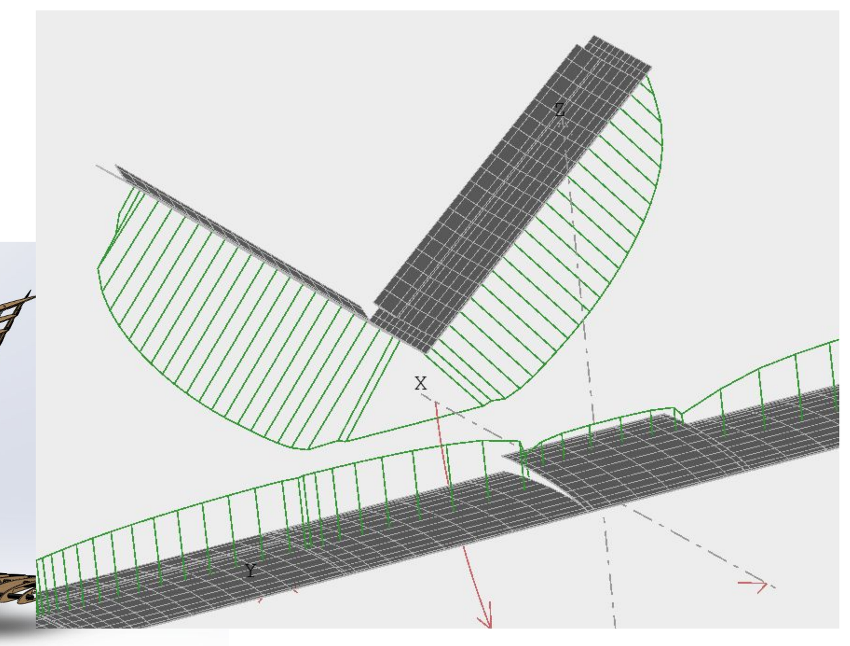

Figure 3: Lift distribution from ruddervator deflection. Lateral forces cancel for this type of deflection

Launcher

Overview: Motor driven launcher system

Takeoff Requirements:
Takeoff velocity: Must reach 14 m/s in 3.5m
Acceleration: ~3 G's

Dimensions:
- Length: 4m
- Launch Angle: 7 deg
- Mass:: 30kg

Figure 4: CAD model of launcher structure

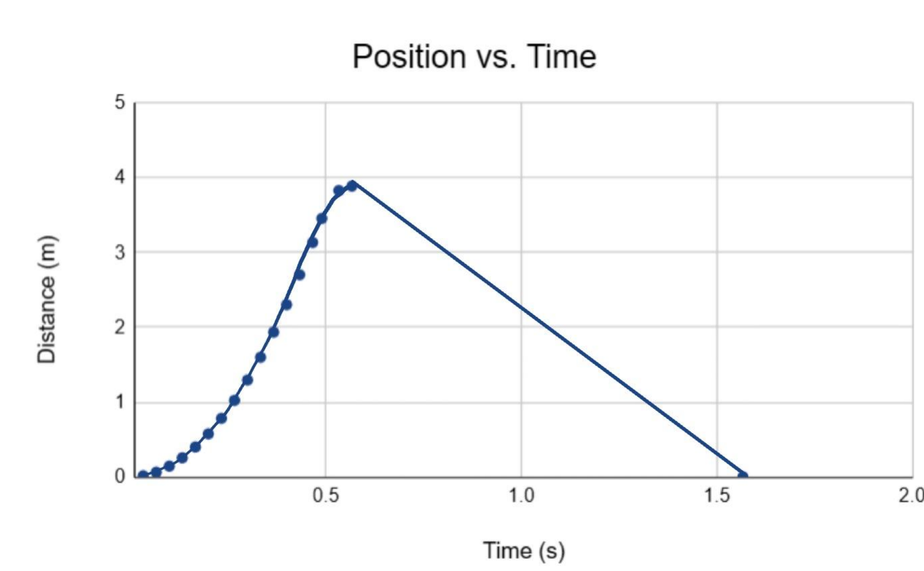

Figure 5: Position profile of carriage

Recovery

Spring Loaded Parachute Recovery System
For minimal operator input, a parachute recovery system was selected for recovery. This system is self contained within it's own canister allowing for faster redeployment removing the need to repack the parachute immediately after landing

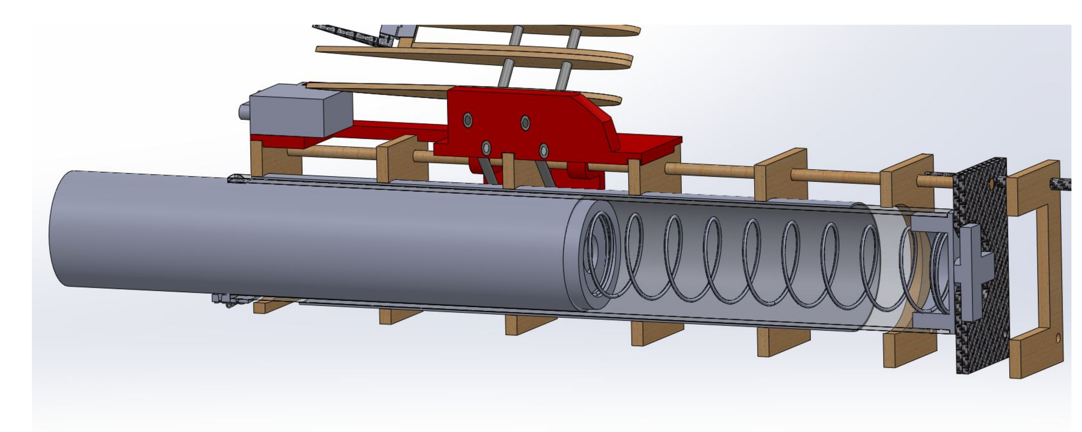

Figure 6: Spring Loaded Parachute Canister

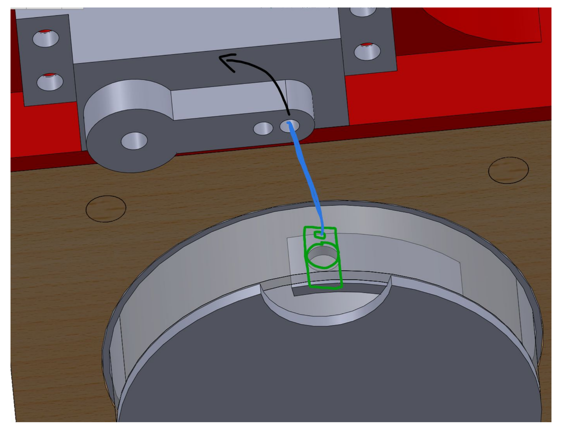

Figure 7: Servo-Pin Deployment Interface

Payload

Modular Payload System
To increase deployment speed, 3D printed Compliant Clips were integrated into the aircraft fuselage requiring no fasteners to change payloads

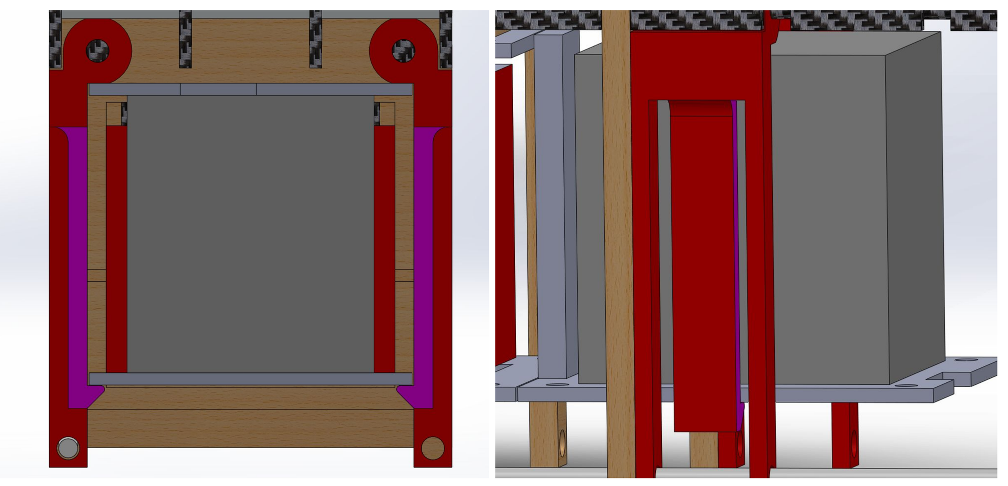

Figure 8: CAD model of payload system

Future Work

- Aircraft wing quarter turn screws for quick assembly
- Mail room payload concept for efficient payload swap with varying MOs
- Software swarming feature to simultaneously monitor all deployed vehicles
- Hinged folding design on launcher for simple setup by single operator

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