Design of a Tube-Launched Fixed Wing UAS for Surveillance Missions
Mission Specification for A&AE 451 Aircraft Design, Fall 2016

Background: Small, affordable, easily launched remotely piloted Unmanned Aerial Systems (UAS) are of great interest to both civil (e.g., public safety, hazard monitoring), commercial (e.g., crop observation, cargo delivery), and military (e.g., surveillance, communications) sectors. While some of these systems will be on quadrotor platforms, to achieve the range and speed needed for select missions, highly efficient fixed-wing aircraft are needed. The FAA has issued the "Small Unmanned Aircraft Rule (Part 107)" in June of 2016[1] that outlines and proscribes authorized commercial small UAS (SUAS) operations to allow for SUAS use while mitigating *threats* to public safety and maintaining consistency in operations. You must become familiar with this rule to ensure your SUAS concept, technology options, and operations would comply with this regulation if actually fielded.

The Design Challenge: Your challenge is to design, build, and flight test a tube-launched, electric powered, remotely piloted fixed-winged aircraft that can satisfy the following mission requirements. The tube must be no more than 1 foot in diameter and continuous. The tube must house the aircraft in its entirety and launch the aircraft without use of chemical explosive means. The launch angle of the tube and all other aspects of the launch process are your design choices.

The aircraft must be able to climb to 300 feet, cruise/loiter for at least 8 minutes, record flight telemetry (position, altitude and velocity) and must be able to image the ground while in flight and use ground-based processing after flight to identify targets that will be placed in the field. The aircraft must be designed to land in a 'skidding' mode (no wheeled landing gear!) and able to be re-launched immediately in field!

The aircraft must be as light as possible and will be evaluated on its overall weight, handling qualities, and ability to fly the specified mission profile and achieve the stated mission objectives. Your team can pick from many available camera systems and flight telemetry to integrate onto the aircraft. You may use components where possible from the provided Arduino kits and/or Eagle Tree and related components available to the class in the Lab.

Flight Test Overview and Design Constraints: Flight test of your SUAS solution must be safely demonstrated outdoors at the airfield in McAllister Park, Lafayette, IN. The vehicle should be stable under all flight conditions. More specifically:

* It must demonstrate *ease of deployment and flight*: a) be able to set-up and assemble/present for flight to the pilot in the field within 10 minutes, b) exhibit features of modularity and proper access to accommodate future swapping of payloads and/or different batteries, c) be able to safely operate without damage from launch or recovery mission phases d) be easy to fly for the remote pilot by demonstrating Level 1 flying qualities.
* It must demonstrate the *ability to reliably record flight telemetry and take images/video of the ground* such that the team can correlate location information and images to determine the location of target objects on the ground.
* It must *be as light as practical*, carrying a 0.5lb payload consisting of a set of stacked quarters in addition to the required imaging equipment and all other flight systems.

Each team will have a set of components and tools provided to them (primarily an Arduino kit and full toolbox) AND a budget of $300 to purchase materials and items specific to your aircraft/launch system. Any deviations must be formally requested in writing to the customer (Professor DeLaurentis and TA Brandon Sells) and justified using sound engineering and business logic.

[1] https://www.faa.gov/uas/media/Part_107_Summary.pdf