Project Definition Document

Aerospace Senior Projects (ASEN 4018 & 4028)
Fall 2004 and Spring 2005

1.0 Information

1.1 Project Title

In Canister Accelerated Reusable and Unfolding Surface Gliding Unit (ICARUS Gliding Unit)

1.2 Project Customers

Customers TBD with interest from the United States Navy

2.0 Background and Context

Unmanned Aerial Vehicles (UAVs) have been used in many roles in the present history. Their role has been expanding in both the military and civilian aviation. The concept of a small-scale deployable (inflatable) wing was first created for Navy munitions application through a Small Business Innovative Research (SBIR) program. In small team, NASA has been successful in researching the prospects of such an inflatable design and created a prototype that can fit into a coffee can.

Deployable wing aircraft are stored until needed, reducing risk of damage. A main advantage of deployable wings is that they can make speed transitions. The aircraft starts compacted into a canister (tube) and then is launched out of the canister, like a bullet. It will free fall for a certain distance and/or time. At a specified time after launch the wings deploy.

A vehicle such as this has many possible applications. After deployment of the wings, the aircraft could act as an observatory airplane to transmit information to its home station. Deployable aircraft could also be used in space exploration. With its small compact design it could be stored on a satellite, rover or other space craft, and then fly around as a space probe after its release. The deployable design would allow the airplane to be steered, accelerated, and decelerated in level flight. Other potential advantages for utilizing deployable wings on future lifting vehicles include providing a greater range, maneuverability, and lower landing speeds than totally wingless vehicles.

3.0 Objectives

3.1 Overall Objective

The overall objective of the proposed project is to conceive, design, fabricate, integrate and verify an unmanned aerial vehicle that is launched out of a tube with deployable wings. The aircraft must be able to be launched and deploy its aerodynamic surfaces resulting in flight. The glider will not have automated control surfaces for control during the flight.

3.2 Aerodynamic Surfaces

3.2.1 Objective

Construct or modify (semi-rigid or rigid, TBD) aerodynamic surfaces which will be mounted on a glider.

3.2.2 Discussion

These aerodynamic surfaces will be optimized to have a large wing loading, high aspect ratio, and minimal drag (TBD based on typical glider values, typically 9.2 to 10 in aspect ratio).

3.3 Mount and Deploy

3.3.1 Objective

Develop a mechanism and technique to attach the deployable aerodynamic surfaces to the fuselage of an aircraft.

3.3.2 Discussion

The aerodynamic surfaces shall be deployed in a controlled fashion at the approximate zero-g point after launch (TBD using a control system). The deployment process will be designed to minimize unbalanced forces and moments about the aircraft cg and within the structural limits of the airframe (TBD). The wing deployment forces will remain within the structural limits of the wing mounting (TBD). The aircraft must be able to fit inside the launch tube with the aerodynamic surfaces undeployed. These wings will first be tested without an attached fuselage. This will allow the mechanism's forces to be evaluated. When the mechanism is functioning properly, it can then be mounted on the glider.

3.4 Launch System

3.4.1 Objective

Obtain or build a tube launching system.

3.4.2 Discussion

The launch tube will be no larger than 2.5 ft. in diameter and no longer than 6 ft. (pending design requirement research). The aircraft will be launched from an inclined, stationary tube at an angle and velocity TBD. The acceleration of the launch mechanism will be limited to a maximum value within the structural limits of the airframe (TBD). The launch design may entail a catapult, a compression piston, or something TBD. This will depend on performance parameters such as force, necessary launch velocity, subject response, and ease of subject attachment.

3.5 Testing

3.5.1 Objective

Test the stresses, forces, moments, durability/reusability, and all subsystems.

3.5.2 Discussion

All systems shall be tested independently before integrated into the final product. This will allow the team to troubleshoot problems before catastrophic risking project failure. Use existing equipment such as wind tunnels (tunnel size flexible as we may only need to test a small wing section, TBD), strain gauges, and load cells, etc. to test the performance of the aircraft and verify its structural integrity. A program such as LabView will be needed for data acquisition (TBD).

Test	Test Conditions	Test Configuration
Launch	Max. g-load	Surfaces undeployed
Deploy	TBD	TBD
Deploy Mechanisms	TBD	TBD
Flight Conditions	Range or Endurance	TBD
Structural Stability	Stress/Load testing	TBD

Aerodynamics (wind tunnel)	TBD	Wing section and/or scale model

3.6 Payload

3.6.1 Objective

Incorporate all data acquisition and testing sensors in the aircraft.

3.6.2 Discussion

The payload will incorporate all the sensors for testing, and will conform to a specific weight (TBD).

4.0 Anticipated Engineering Expertise

Technical Expertise	How Applied
Structure/Mechanism Design	Develop conceptual and detailed solid 3D models of the device components
Aerodynamics	Understand aerodynamics for stability and controlled flight
Electronics	Integrate the electronic components to fit and function within the aircraft
Computers	Program simulations, computer modeling. Animation if necessary.
Systems Integration	Ensuring Subsystems compatibility
Mechanical Fabrication	Part machining
Electronic Fabrication	Analog and digital electronic subsystems
Mechanical and Dynamic Test	Verification of the project

5.0 Resources

5.1 Facilities

The project will require access to a wind tunnel, machine shop, electronics lab, ITLL fabrication shops and facilities, storage and a test facility.

5.2 Additional Advisors

Professor Argrow, Professor Maute, Professor Hoehn, and Professor Felippa. Some outside technical assistance might be used.

5.3 Funds

This project will receive funds from the aerospace department, and will be asking for donations from the U.S. Navy, Advanced Ceramics Research, Scaled Composites, Colorado Plastics, and other companies we can think of later. If additional funds are required, fundraising techniques will be developed.