SPEC-15-*[DBF]*

PROJECT SPECIFICATION

APPROVALS

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-	Initial Release	*[01/25/15]*	*Michael Lau*

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1 PROJECT SPECIFICATION OVERVIEW

1.1 Executive Summary

The UC Irvine Design/Build/Fly team is a student-led project that participates in the annual AIAA Design/Build/Fly competition. The team is led by two project managers, who oversee the operation of the project, and the chief engineer, who is responsible for leading the design aspect of the project. Assisting the project leaders are the sub-team leaders, who are in charge of the design and optimization of their respective components. Each sub-team has multiple members to aid in the design, manufacturing, and testing process.

The AIAA DBF Competition is an annual international remote-control airplane contest with over 80 participants from all over the world. The contest rules are released in September and teams have until April to finalize the plane designs. The competition is divided into three flight missions and one ground mission, often requiring multiple types of payloads to be carried. The plane must be designed to complete these missions and must adhere to multiple other constraints and safety regulations. The written design report is also a major aspect of the competition. The 60 page design report documents the entire project, from design to manufacturing to testing.

As a senior design project and engineering club, DBF is meant to be a channel for students to apply analytical knowledge taught in class to real life applications. Fluid mechanics, structures of materials, programming, computer-aided design, and more are utilized in the design process of the plane. The project also provides the opportunity for students to learn information usually not taught inside the classroom. This includes extensive composite manufacturing, iterative design processes, airplane assembly, and documentation. Students are given more hands-on and practical experience, compared to the theoretical and conceptual focus of the engineering curriculum.

<u>Team Summary</u>

Aerodynamics:	*Computes the flight characteristics and necessary wing dimensions. This team also ensures that the aircraft meets certain control and stability standards, and uses numerical modeling to predict flight performance.*
Wings:	*Experiments with new manufacturing methods for the wings and fuselage in order to decrease overall weight while maintaining structural integrity.*
Propulsion:	*Analyzes and tests the propulsion system to find the best motor, propeller, and battery combination for the aircraft.*
Molding:	*Designs, experiments, and manufactures molded fairings and fuselages.*
CAD:	*Creates detailed drawings of every component of the aircraft system and aids in the rapid visualization of possible aircraft solutions.*
Fuselage and Payload:	*Designs and builds fuselage and payload restraint and release mechanisms.*
Motor Mount:	*Focuses on fabricating motor mount that connect motor to fuselage boom.*
Landing Gear:	*Designs and fabricates landing gears integrated to the fuselage.*
Testing:	*Fabricates test apparatuses and conduct load testing for manufactured parts while collecting data for documentation purposes.*
Test Flight and Telemetry:	*Organizes and conducts test flights, performs preflight/post-flight inspection and collects flight data.*

2 Product Description

The end product of our project is an airplane that is as light as it can possibly be manufactured while adhering to all of the constraints placed upon the teams by AIAA. The end product should also be able to complete all of the missions that will be flown during the competition in April. Yet, another component of our end product is the report that is submitted in February that specifies the design process of the airplane from the concept to the end product as well as detailing the manufacturing process and testing of the various prototypes.

2.1 Product Context

This product does not necessarily relate to other products but could be seen as part of the Unmanned Aerial Vehicles (UAV) since the product is remote-controlled. The distinction between our project's product and that of UAV is the purpose of the product.

2.2 Constraints

Manufacturing

We cannot use store bought components except for electronics; everything else has to be student made. We can only use methods that are can be reproduced by our members and is within our budget. Many of these manufacturing methods lead to easy repairability in case a component fails or is not made properly. Another manufacturing restriction is weight. Every time a part or component is being manufactured, our members weigh the amount of material being used and their final product so that we can continue to decrease the overall weight of the airplane. Weight is an important constraint because the empty weight of the airplane is used in calculating the final score of the competition.

Space

The only working space available to us is the Engineering & Computing Trailer (ECT), which is shared with Human Powered Airplane (HPA) and Unmanned Aerial Vehicles (UAV Forge).

Cost

The project is limited to the Mechanical and Aerospace Engineering (MAE) department account, which gives us $100 out of $160 for every person enrolled in MAE 189. The total amount from this is around $2200 per quarter. This year we were also able to get funding from Undergraduate Research Opportunities Program (UROP) for $1500 for the entire year. The budget for each plane is about $1000 per plane. We must use our funds wisely in order to be efficient.

2.3 Dependencies

The whole project is dependent on each aircraft component (e.g. wing, balsa fuselage, landing gear, motor mount, control surfaces, etc.) being built on time. The aircraft components are dependent on having dimensions set up for parts to be built according to the CAD of the plane.

3 Requirements

1. Number of servos
2. Empty weight
3. Payload release mechanism (must release one ball per lap)
4. No fuse limit
5. Battery must weigh less than 2 lbs

3.1 Functional and Performance Requirements

Must be able to fly 4 laps unloaded as fast as possible
Must be able to carry a stack of 3- 2”x6”x10” pieces of wood (~5 lbs)
Must be able to carry a team-defined number of wiffle balls (~2.4 oz) and drop one ball per lap

3.2 Maintenance Requirements

Must be able to be repaired during competition if necessary.

3.3 Standards Compliance

All components secured to vehicle
Integrity of propeller structure and attachment
Radio range check
Controls move in the proper sense
Integrity of payload release mechanism
Center of Gravity (CG) at the quarter-chord
Radio fail-safe check

3.4 Deleted or Deferred Requirements

[Identify any requirements that have been deleted or moved to a later date.]

4 Appendix

4.1 Definitions, Acronyms, and Abbreviations

AIAA – American Institute of Aeronautics and Astronautics
DBF – Design/Build/Fly
CAD – computer-aided design

4.2 References

2014/15 Rules and Vehicle Design
http://www.aiaadbf.org/2015_files/2015_rules_final_20141031.html