DEFN-14-RP

PROJECT DEFINITION

APPROVALS

ROLE	NAME	SIGNATURE	DATE
General Manager	*Brandon Hernaez*		
Advisor	*Kenneth Mease*		
Advisor	*Dave McCue*		
Propulsion Lead	*Jaspal Sidhu*		
Structures Lead	*Yuan Zhang*		
Avionics Lead	*Michael Rappuhn*		

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UCI Rocket Project

Revision History

REV	DESCRIPTION	DATE	APPROVED BY
-	Initial Release		
[A]	*[enter description]*		

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1 PROJECT OVERVIEW

1.1 Executive Summary

The Purpose of this document is to summarize UCIRP Team. The goal of the Rocket Project this year will be taking a step in a new direction. The research and work put into this project is geared toward at a multi-year goal. That goal is, in short, to carry the payload of a CubeSAT to the edge of the earth's atmosphere via Rockoon. The team needs to design and develop an Engine, Avionics System, and Launching Apparatus to complete this task. All three sub teams are tasked with fabricating and testing a preliminary design this year.

Typically this senior project is has been geared towards simple competitions that involve altitude goals and rocket performance. In most cases sounding rockets are used for research purposes to gather data at certain altitudes when studying the atmosphere. A rocket's performance is reliant on many factors, however. Weather, Drag, Weight, Thrust, Balance, Size, Geometry, are a few professional rocketeers as well as students carefully balance in order deliver an adequate vehicle specified to perform a specific task and to do so within a budget. This project, however, is not about competing the moment at it is purely research and development for the students involved to design and create their solutions to the original goal.

The uniqueness of the project is that is combines essentially three sub teams with their own goals that will come together later on. For now they will act separate and focused on their own objectives.

2 PROJECT DETAIL

2.1 Project Objective(s)

The project is divided into three Sub Teams: Avionics, Structures, and Propulsion.

Avionics: Michael Rappuhn
Objective: The main goal of this project is to develop an active control system that can measure the rockets position and orientation in real time and ensure that it stays on its intended flight path. The system will counteract any aerodynamics forces that could potentially cause the rocket to deviate from the desired flight path. This will be accomplished by implementing actuated fin tips that will act as control surfaces imparting moments on the rocket during flight. After simulating the system in a computer environment we will perform a physical test by attaching the system to an existing rocket that was built by the UCI Rocket Project a few years ago. This rocket is mostly ready to launch; it needs a nose cone, propellant and it needs to be retrofitted with our active stabilization system.

Structures: Yuan Zhang
Objective: The focus for the structure team this year will be to prove the concept of using a Rockoon as a less expensive method to reach higher altitudes than conventional sounding rockets. Our goal is to design, build, and launch a rocket from an elevated starting position from a balloon platform, and then safely recover both the rocket and platform. In order to achieve this, we will fabricate two prototype Rockoons that allows us to test our components and concepts in an inexpensive and expendable manner.

The first prototype Rockoon will be on a much smaller scale than our final design and will not be capable of reaching the mesosphere. It will allow us to test our 3D printed gimbal system, balloon, and launch tower using a small model rocket. First, we will start this test on the ground, and subsequently at a low altitude of 30 meters (circa 100ft). With a precision landing and recovery system, we can continue on to our second Rockoon. The second prototype will be much larger, with a balloon platform that will be able to reach 15km-20km. With this Rockoon, we will more accurately test the recovery systems, rocket avionics, and the larger gimbal system at a very high altitude. When both prototypes meet our goals we can continue on to build a Rockoon that will reach the mesosphere.

Propulsion: Jesse Sidhu
Objective: Test how well our theoretical design calculations match with the actual rocket engine. The development of the engine is currently broken down to the major engine components of the nozzle, combustion chamber, ignition system and injector plate. We will be designing this engine to conduct static test fires to measure total thrust output. A static test fire is when a rocket engine is ignited for a short period of time to see if the engine is operating correctly and once it is deemed fully operational, the burn sequences are lengthened to measure thrust output.

In years past, UCIRP has launched several solid engine rockets but because we are creating a new engine design, we plan on testing its performance before we attach it to an airframe. In doing, so we will also need to create a static fire test stand. The test stand will allow us to mount the rocket engine along with the propellant tanks so that we can measure vital performance data. The development of this test stand will be a joint project with the Friends of Amateur Rocketry. The Friends of Amateur Rocketry also have a need for static test fire stand for the same reason of wanting to test a liquid engine’s performance before building an airframe.

2.2 Scope Details

This is expected to be a 3 to 4 year goal. As the infancy of the individual objectives are gown to larger scales, they are expected to converge as the individual designs begin to integrate one another. We are simply doing preliminaries the first year as well as feasibility. With proof of concepts and valuable test data on hand, we will push to acquire permission from the FAA to begin large scale tests. At the very end we aim to have tested the Structures Team's Gimbal, the Propulsion Team's Engine, and the Avionics Teams Control System at large scale before they will all come together.

2.3 Project Milestones

Milestone Name	Target Date	Comments
Finish Preliminary Designs	21/1/2014	
Complete Fabrication	3/20/15	
Perform Final Tests	5/20/15	

2.4 Project Team

#	Name	Project Role	Email	Phone	Standing	Units
1	David Lee	Injector Plate	Davidhl2@uci.edu	909-270-0147	Sr	0
2	Nicholas Cordero	Ignition	ncordero@uci.edu	626-678-3546	Sr	1
3	Taylor Jones	Injector Plate	Tajones1@uci.edu	541-5171396	Jr	1
4	Grant Dang Wu	Mounting	gdwu@uci.edu	626-231-6885	So	1
5	Jesse Sidhu	Propulsion Lead	Jsidhu1@uci.edu	408-457-4352	Sr	1
6	Isaiah Navarro	Rockoon-FAB	icnavarr@uci.edu	714-319-0434	So	1
7	Robert Chung	Rockoon-CAD	roberthc@uci.edu	714-388-2032	Sr	1
8	Nathan Cox	Gimbal Stand	coxna@uci.edu	949-892-0504	Sr	1
9	Yuan Zhang	Structures Lead	yuanz9@uci.edu	949-527-4316	Jr	1
10	Rachel Bola	Coding	bolar@uci.edu	714-651-3693	Jr	1
11	David Chen	Electronics	taiweic@uci.edu	949-241-0549	So	1
12	Abdullaah Tarif	3D Printing	atarif@uci.edu	714-797-7315	Sr	0
13	Michael Morey	Avionics-CAD	mamorey@uci.edu	805-760-4116	Sr	1
14	Carlos Ribeiro	Dynamics	goncalvc@uci.edu	949-537-9651	Sr	0
15	Micheal Rappuhn	Avionics Lead	mrappuhn@uci.edu	310-491-8520	Sr	2

2.5 Steering Team

#	Name	Title	Steering Role	Email	Phone
1	Kenneth Mease	Professor	Advisor	kmease@uci.edu	949-824-5855
2	Dave McCue	UCI Retired	Advisor	dmccue@ucil.edu	949-584-4210
	Colin Sledge	Project Assistant	Advisor	csledge@uci.edu	970-319-8887

2.6 Project Costs Estimation

Qty.	Project Expense	Subsystem	Est. Amount ($)
	Propulsion Team		
1	7/8" 6061 Aluminum Hexagonal Bar	Ignition	$10.61
4	D5-P Quest Motor	Ignition	$24.00
1	Neoprene O-Rings (Pack of 15)	Injector + Nozzle	$10.88
1	Neoprene O-Rings (Pack of 15) small	Injector	$13.48
1	4.25" 6061-T6 Aluminum Round Bar	Injector	$53.05
1	Ultra Temp 391 Ceramic Tape	Combustion Chamber	$120.00
160 L	Liquid Oxygen	Oxidizer	$83
5 gal	JP-4	Fuel	$30
1	Injector plate Machining	Injector	TBD
	Structures Team		
1	XBee-PRO XSC S3B	Recovery	$84.00
1	SparkFun XBee Explorer Regulated	Telemetry	$10.00
1	Mega Pro 5V	Telemetry	$90.00
1	SparkFun OpenLog	Data Recording	$50.00
1	900Mhz GSM Yagi antenna 12 dBi RP-SMA male connector	Telemetry	$20.50
1	GSM Omni Antenna 3.5 dbi 900MHz RP-SMA male	Telemetry	$6.50
3	Helium	Testing	$130
	Avionics Team		
4	captive nut	Middle Assembly	$6.85
4	screw, 4-40, 1/4"	Middle Assembly	$8.50
2	screw, 1/4"-28, 1/2"	Electronics Module	$7.42
2	nut, 1/4"-28	Electronics Module	$3.14
16	washer, ID .109", OD .250"	Servo Motor	$2.73
16	screw, 3-56, 3/4"	Servo Motor	$10.05
8	clevis	Servo Motor	$6.99
1	bulkhead_main_sled	Servo Motor	$4.50
4	1/8" x 3/4" x 6"	Servo Motor	$ 5.04
2	nut, 10-24	Servo Motor	$1.72
12	nut, 6-32	Servo Motor	$2.61
12	screw, 6-32, 1-1/4"	Servo Motor	$6.65
1	accelerometer_ADXL377	Electronics Sled	$24.95
1	altimeter_MPL3115A2	Electronics Sled	$14.95
1	ZIPPY, 2S, 1300mAh, 25C	Electronics Sled	$6.67
1	gyroscope_ITG-3200	Electronics Sled	$24.95

1	microSD_breakout	Electronics Sled	$9.95
1	microSD_card	Electronics Sled	$7.99
1	power_supply	Electronics Sled	$20.00
1	propeller_mini	Electronics Sled	$24.99
1	bulkhead_main_sled	Electronics Sled	$4.50
1	tube_motor	Motor Tube	$28.00
4	U channel 1/16" x 1/2" x 1/2" x 6"	Motor Tube	$5.48
1	Retainer aeropack 38mm	Motor Tube	$25.00
2	2.6" x 38mm	Motor Tube	$11.00
4	screw, 8-32, 1/2", CS 82deg	Fin Assembly	$3.10
4	Shaft OD .250, ID .120, 4"	Fin Assembly	$14.23
4	washer, ID .173", OD .375"	Fin Assembly	$1.60
4	washer, ID .199", OD .315"	Fin Assembly	$7.82
8	dowel pin, 3/32", 1/2"	Fin Assembly	$7.34
4	screw, 8-32, 7/16"	Fin Assembly	$10.00
4	washer, ID .250,	Fin Assembly	$8.49
8	clevis	Fin Assembly	$6.99
2	Rods: 2-56, 30"	Fin Assembly	$1.78
2	2-56, 30"	Fin Assembly	$1.78
2	2-56, 30"	Fin Assembly	$1.78
2	2-56, 30"	Fin Assembly	$1.78
1	Tube: 2.6" x 48" fiberglass	Forward Assembly	$70.00
2	Bulkheads	Forward Assembly	$9.00
1	Parachute	Recovery	$40
		Total	$1197

2.7 Resource Estimation

Name	Est. Hours	Rate ($/hr)	Est. Total ($)
David Lee	20	15	300
Nicholas Cordero	*40*	15	*600*
Taylor Jones	*40*	15	*600*
Grant Dang Wu	*40*	15	*600*
Jesse Sidhu	*40*	20	*800*
Isaiah Navarro	*40*	15	*600*
Robert Chung	*40*	15	*600*
Nathan Cox	*40*	15	*600*
Yuan Zhang	*40*	20	*800*
Rachel Bola	*40*	15	*600*
David Chen	*40*	15	*600*
Abdullaah Tarif	*30*	15	*450*

Michael Morey	*40*	15	*600*
Carlos Ribeiro	*40*	15	*600*
Micheal Rappuhn	*80*	20	*800*
			9950

3 Project Risks and Communication

3.1 Risk Mitigation Plan

Risk	Severity	Probability	Mitigation
Liquid Oxygen Explosion	High	Low	Procedural Use, Bunker, Separate Pump, Proper Transportation and Ventilation
Electric Shock or Burn	Medium	Low	Proper use of Tools and Soldering
Falling Object Strike	High	Very Low	Call to Attention During Launch, Bunker
Sky Writing	Low	Very Low	Proper Avionics Testing and CP/CG Location
Cuts and Splinters	Low to High	Low	Protective Gloves and Proper Training with Saws
Fiberglass and Carbon Dust	Medium to High	High	Protective Facemask and Clothing, Ventilated or Outdoor Workspace during Cutting and Sanding

3.2 Communication Plan

Communication Type	Audience	Frequency	Responsibility
General Meeting	Entire Team	Bi-Weekly (Odd Weeks) 6:30	Brandon Hernaez
Managers Meeting	Team Leads	Bi-Weekly (Even Weeks)	Brandon Hernaez
Propulsion Team Meeting	Propulsion Team	Even Weeks	Jaspal Sidhu
Structures Team Meeting	Structures Team	Tuesdays 6:30pm	Yuan Zhang
Avionics Team Meeting	Avionics Team	Even Weeks	Michael Rappuhn

4 Additional Project Details

N/A