Multidisciplinary Senior Design
Project Readiness Package

Prepared by Art North on June 24, 2019

Project Title	3μ Cubesat *(Solar Sail)* Continuation - Flight Control
Project Number	P20101
Primary Customer	RIT Space Exploration Research Group (SPEX)
Sponsor	
Faculty Champion	Mihail Barbosu mxbsma@rit.edu
Other Support	[As applicable]
Project Guide	Art North ajnddm@rit.edu
IP Considerations (must pick one)	a) Team retains ownership, no additional requests for use

Each section contains a brief explanation to help you complete the form. Please remove any gray text before submitting.

When complete, please submit this document through our online form, located at https://goo.gl/forms/J3G8G2jhTUFuJCYe2

Project Information

Overview

In 2017 an MSD group created a solar sail deployment method that was placed in a 3U CubeSat (P17101: CubeSat Solar Sail - http://edge.rit.edu/edge/P17101/public/Home). To provide some background, a solar sail is a form of propulsion that utilizes photons emitted by the Sun. In order to avoid the weight and limited in-flight supply of ordinary fuel based propulsion, a thin metallic sheet made of biaxially-oriented polyethylene terephthalate (BoPET) is instead placed on the spacecraft as a sail. This sail harnesses the momentum of these photons, similar to a sailboat in the wind.

In 2018 the goal was to be able to control the solar sail and to be able to provide power to the cubesat. Also investigated was a way to control the tilt of the sail in order to correct orbit and maximize the effectiveness of the sail. (See http://edge.rit.edu/edge/P18101/public/Home .)

A comprehensive study of then-available solar panels was performed, panels fell within the size and power constraints – less any not-yet-developed comm. and attitude requirements - for the satellite. This year the team will undertake the design of a third unit to the module incorporating avionics and communication into the system.

Long term, this design will be available open source to inspire further research into solar sail experimentation to create a fully operational CubeSat for the SPEX to one day launch into space. Though this specific project is just for orbital corrections, fuel-less propulsion could greatly affect space travel to fly further with less weight, cost, and limitation of fuel supply. Additionally, this 3µ design may yield to other payloads of interest.

Preliminary Customer Requirements (CR)

- Any new scope to be determined at Client interview, plus
- Solar sail deploying from a single cubesat of no larger than 3U
- Remote control of solar sail deployment and stability in flight
- Condensed electronics
- Avionics and communications
- Fits within all standard Cubesat regulations

Preliminary Engineering Requirements (ER)

- Size of Cubesat (2U to 3U)
- Max Weight of 2U - 2.66kg
- Max Weight of 3U - 4.00kg
- Center of gravity within allowable range of geometric center
- Electrical components to be compatible with existing power supply voltage.
- Electrical components to comply with all safety requirements detailed in “CubeSat 101: Basic Concepts and Processes for First-Time CubeSat Developers” or similar documentation.

Constraints:

- Cubestat specifications and regulations
- Budget
- Low Gravity
- Potential High Atmosphere Radiation. ● Sub-Freezing Temperatures
- Ultra Low Pressure Vacuum of Space

*** Project Deliverables:**

- All design documents (e.g., concepts, analysis, detailed drawings/schematics, BOM, test results)
- Working prototype
- Technical paper
- Poster
- ImagineRIT exhibit

† Budget Information:

Additional funding being provided by client. Amount TBD.

*** Intellectual Property:**

No portion of this project is anticipated to contain or utilize confidential information in its execution.

U.S. Citizenship

None

Travel Opportunities

None anticipated

Project Resources

Anticipated Student Staffing by Discipline

Department	Expected Activities
Biomedical Engineering	
Computer Engineering	Write control code for avionics and communications
Electrical Engineering	Overhaul of Electrical Components - Program and install new Arduino/processor to sport additional GPIO ports that satisfies power requirements. Model additional circuitry to be fabricated onto a PCB board. Design and implementation avionic and communication equipment in 3rd unit of module.
Industrial & Systems Engineering	Manage risk and problem solution, scheduling, overall system design.
Mechanical Engineering	Design and construct solar panel flaps, flap deployment mechanics, and tilt mechanism. Design chassis to protect electronics. Make alterations to chassis to support heavier sails functionally equivalent
Other	

Required Resources

Faculty	Faculty champion, SPEX members, others as required
Environment	MSD Design Center will be primary space unless space otherwise acquired
Equipment	As needed
Materials	As required
Other	