Avionics - Rocket Propulsion Laboratory (Multidisciplinary)

Open Positions

ME: 3 | EE: 5 | CE: 5

About RPL

Rocket Propulsion Laboratory is a student group at UCSB dedicated to giving students more opportunities to pursue educational and industrial paths in aerospace. Currently, RPL is working on *Baby Come Back*, a Class O liquid-fueled rocket to compete in a competition run by Friends of Amateur Rocketry (FAR) and The Mars Society.

Project Description

FAR-Mars hosts an annual collegiate rocketry competition, in which student teams all over the country launch liquid-fueled rockets for a $50,000 first prize. An additional $50,000 award is given to a team that successfully uses liquid oxygen and liquid methane as their oxidizer-fuel mixture. To qualify, the rocket must reach an apogee between 30,000-50,000 feet and safely descend without damaging the payload supplied by FAR-Mars, which transmits flight data to verify the maximum altitude. Qualifying rockets are ranked on a points system, such that rockets flying above 45,000 feet lose 5x the points as those flying below 45,000 feet, per unit distance. Although *Baby Come Back* is prohibited from using active navigation, an onboard flight computer is necessary to transmit flight data for diagnostic purposes, deploy the recovery system, and open safety valves as needed.

Problem Statement

As a potential entry to the FAR-Mars competition, *Baby Come Back* must meet the following requirements:

- Carry and safely recover a 2.2 lb (1 kg) payload supplied by the competition organizers
- Must not exceed the Class O 9208 lbf-s total impulse limit
- Must use a liquid bi-propellant propulsion system (e.g. LOX-RP1, LOX-CH4, etc.)
- Must be passively controlled (i.e. no engine gimbaling, fin adjustment, or other navigation during flight [thrust magnitude control is allowed])

The onboard avionics system must be capable of the following:

- Collecting and processing real-time data to determine *Baby Come Back*'s altitude and location relative to the launch pad
- Locally storing flight data, sensor readings, and possibly video footage, and transmitting data without interruption up to 9 miles away from the pad
- Withstanding intense dynamics from engine ignition, trans-sonic flight, parachute deployment, and landing impact
- Interfacing with fuel and oxidizer valves, sensors, deployment mechanisms, and other peripherals

Solution Concept

Baby Come Back's avionics system should fit within a 6" diameter cylinder less than 1' in length, excluding peripherals like valves, sensors, etc. The compartment housing the flight computer shall be designed to damp high frequency vibrational modes to improve accelerometer accuracy. Additionally, the compartment shall be vented to the atmosphere to obtain altitude data, which will be used as a redundancy to the altitude data obtained from integrating the acceleration data. At this time, *Baby Come Back*'s outer airframe is not radio-transparent, so the antenna used will have to be externally mounted, taking measures to minimize drag.

Timeline

Phase 1 (October-December 2019): Preliminary component designs and SOPs for component tests. Flight computer designed.

Phase 2 (January-March 2020): Flight computer built and bench tested with peripherals

Phase 3 (April-June 2020): Final applied system tests and performance analysis