Liquid Propulsion System - Rocket Propulsion Laboratory (Multidisciplinary)

Open Positions

ME: 8 | EE: 2 | CE: 1

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. To compete, RPL must provide FAR-Mars a thrust vs. time curve of the rocket engine, so a test fire of the propulsion system is imperative.

Problem Statement

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

- Carry 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])

RPL has already determined that the ideal propulsion system should meet the following specifications:

- Maintain 700 lbs thrust for 13 seconds
- Use a LOX-CH4 oxidizer-fuel combination
- Sustain a combustion chamber pressure of 300 psi
- Weigh less than XX lbs, including plumbing and valves

Solution Concept

Baby Come Back's propulsion system consists of a combustion chamber, nozzle, fuel injector, control valves, and tanks for fuel, oxidizer, and inert gas. The fuel and oxidizer will be driven through the injector into the combustion chamber by a pressurized helium tank. The combustion chamber and nozzle must use an ablative cooling system to prevent engine overheating. Additionally, a test rig capable of acquiring test data and firmly securing the propulsion system must be built. Thermocouples, pressure transducers, and other sensors must be integrated into the system to acquire the necessary data, and a GUI must be developed to interface with the system, acquire data, and perform system diagnostics. The test rig shall fit on a trailer capable of being towed by a pickup truck to the FAR test site in the Mojave Desert.

Timeline

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

Phase 2 (January-March 2020): Components tested and ready for system integration: test rig fixturing designed

Phase 3 (April-June 2020): System tests with water and successful test fire of complete system