sMULTI2: Rocket Propulsion Laboratory - RPL | Novel Metal 3D Printed Injection System

Open Positions
ME: 5 | EE: 2 | CE: 2

Sponsors: Raytheon, UCSB Engineering, Peter Carter, UMBRA Labs, ATA Engineering

Project Description

The Rocket Propulsion Laboratory at UCSB is a group of highly motivated students dedicated to giving more educational and industrial opportunities in the paths of aerospace and propulsion. In the last year, RPL has conceptualized a preliminary design for a static fire rig, which includes its supporting structure, the feed system, injector, and carbon fiber engine. Currently, the team is aiming for a water flow test of our system by the end of the year while developing a novel injection system using metal 3D printing - all in the effort to realize our design and capitalize on the limitless capabilities of additive manufacturing. Performing this test allows students to solve some of the industry's hardest problems related to propulsion and aerospace, and solidifies our understanding of a pressure fed system.

Having the ability to compare two injectors, one manufactured by students, and one metal 3D printed injector, allows for a direct comparison between our simulated analysis and water flow test. Companies like Additive Rocket Corporation and Relativity Space have shown the viability and freedom of design that comes along with additive manufacturing, such as a superior weight ratio to conventionally manufactured components.

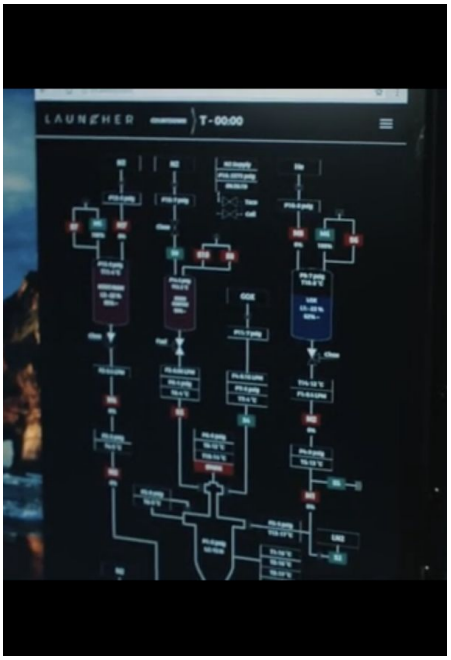
The ultimate goal of the project is to design and test our feed system and injector designs using a water pump to receive necessary spray angles, flow rates and confirm our design is to

specifications at given low-medium pressures. This project seeks to merge all aspects of engineering with its EE, CE, and ME oriented focus.

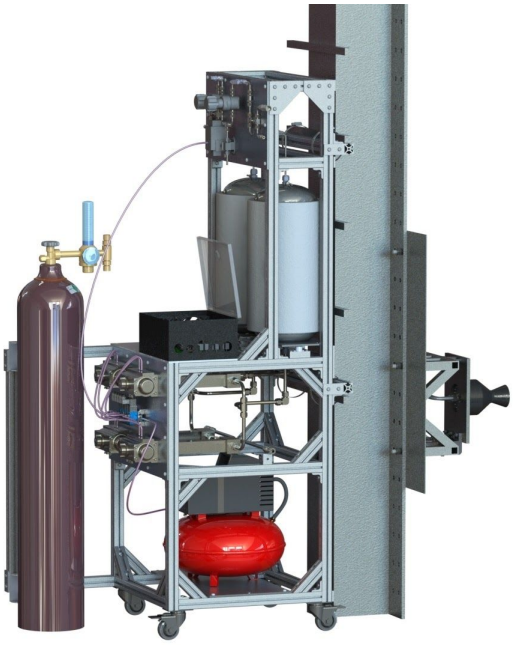
Project Scope

- Optimize the existing feed system to spacing requirements, ideal valve selection, and accumulators to avoid water hammer effects.
- Finish the optimization of the existing Pintle-Tip injector with the added orifice plate and design a novel metal 3D printed injector for optimal spray angles, pressure drops, flow rates, and weight.
- Test at 3 different medium pressures under 150 psi provided by a commercially available water pump
- Confirm our own analysis with respect to the system's pressure drops, flow rates, major and minor losses, spray angles, mimicking mixture ratios, and discharge coefficients against a water flow test.
- Dry test the capabilities of our existing safety procedures by simulating different scenarios, which close and open a variety of valves by advancing the development of a robust GUI from the avionics team.
- Design the rig to be transported safely and easily for a water flow test.

Example GUI:



2019 Design:



2019 Injector Design: