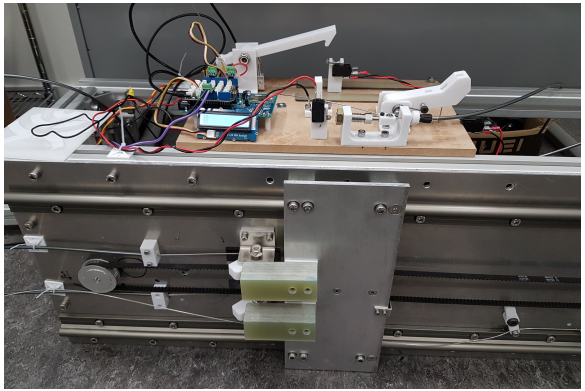
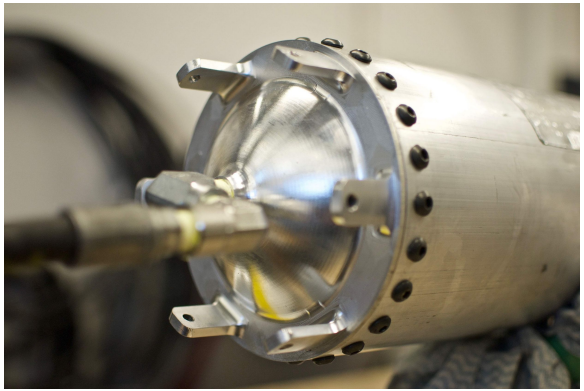
Stefan Martin

Project Portfolio

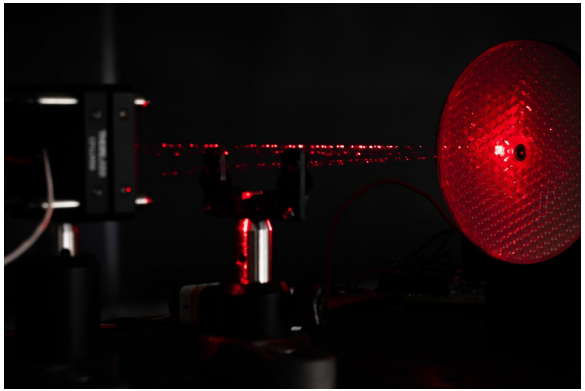
25/01/2020



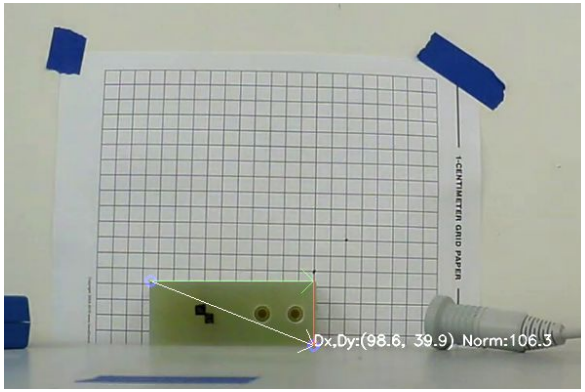
Automated Test Rig



Rocket Oxidizer Tank



Self-Mixing Interferometer

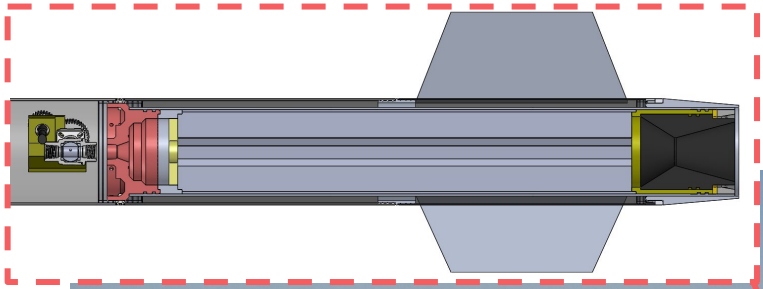


CV Visual Displacement

Hybrid Rocket Systems

More Projects:
stefan-martin.github.io/Website/

Hybrid Rocket



Nitrous-oxide HTPB engine delivering >40,000Ns of total impulse.

Advised in design reviews for safety and system integration. Involved in simulation of the flight and engine dynamics.

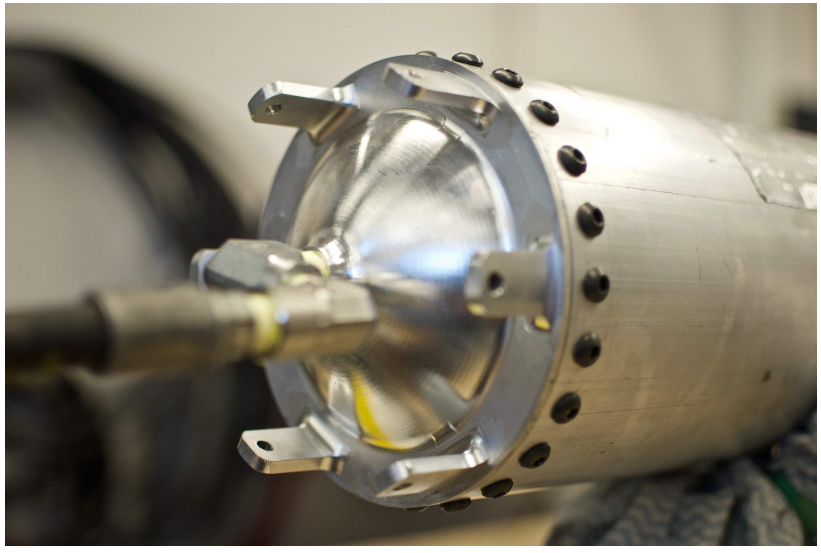
Ground tests of engines and fuel systems.

Results:

Launched to **15,500ft** at IREC 2019

At **5.5m** it is the largest rocket ever (successfully) flown by the team

Rocketry: NOS Pressure Vessel



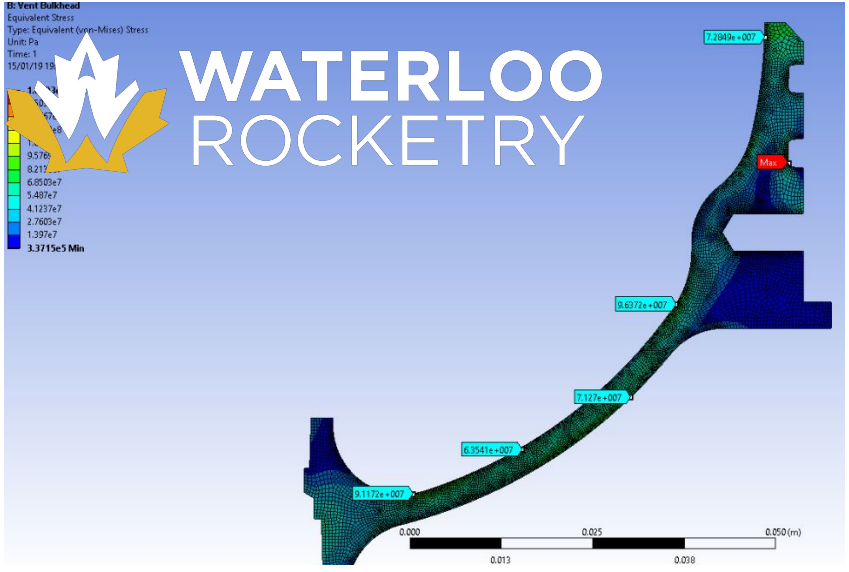
Designed to hold liquid nitrous oxide at up to **1000psi**.

Axisymmetric ANSYS simulation was run to validate calculations for yield safety factor.

Bearing stresses on the tank walls are limiting.

Results: Successfully hydrostatic tested to 1500psi with no leaks.

Hemispherical bulkheads were CNC machined and **weighed 50% less** than the previous year's design.

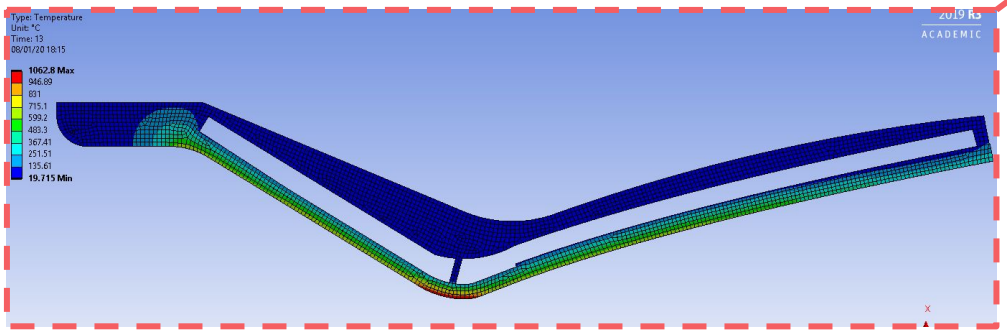


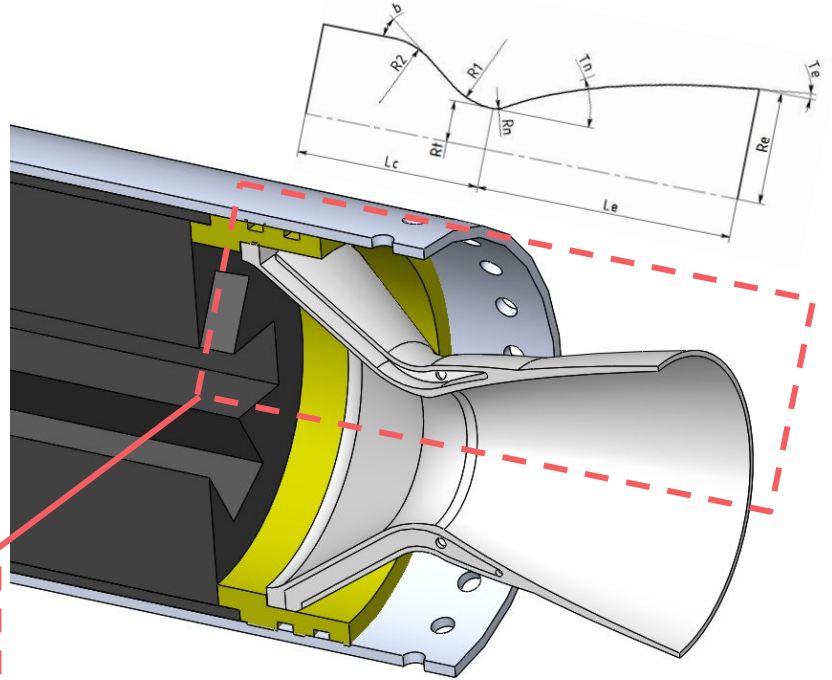
Rocketry: 3D Printed Inconel Rocket Nozzle

Thrust-optimized parabolic nozzle geometry printed out of Inconel 625 gains 3% performance over previous conical design while weighing 30% less.

Water cooling channels designed using ANSYS transient thermal so that it will survive the 3000K combustion gas temperature.

Engine combustion simulation in Rocket Propulsion Analysis.

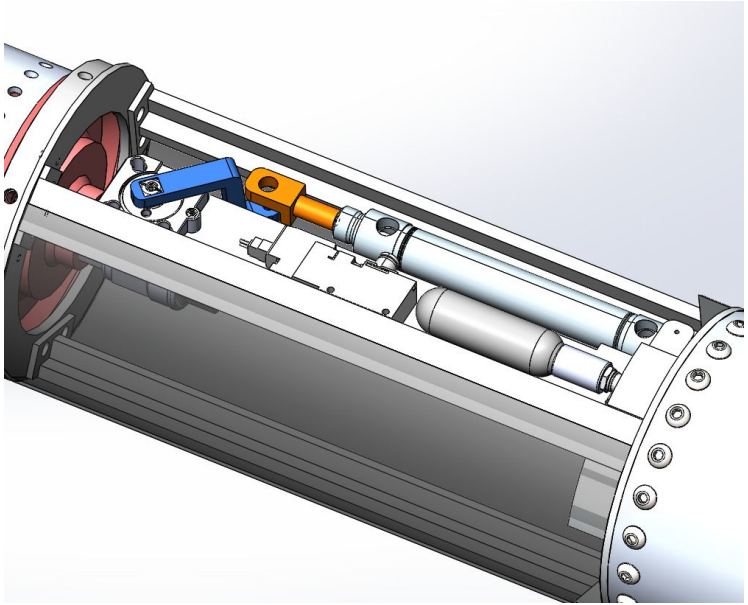


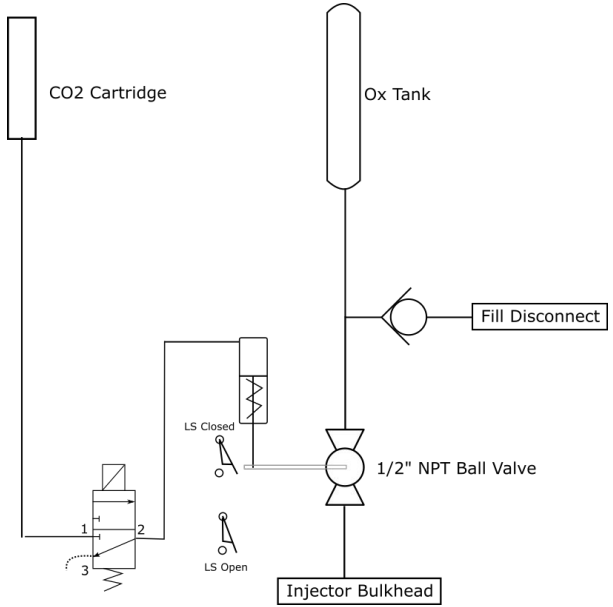


Rocketry: Pneumatic Injector Valve

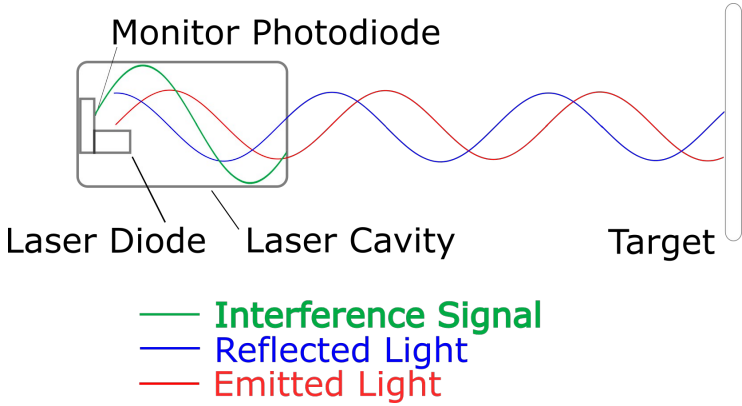
Pneumatic and mechanical design for a compact valve actuation mechanism.

Using a lightweight CO2 cartridge to power the system and open the valve in under 0.5 seconds.





Capstone: Self-Mixing Laser Interferometer



Optical feedback configuration for a interferometer at a cost which would undercut the market by an order of magnitude.

Targeting **150nm resolution** (λ/4) with a goal to make this technology commercially viable.

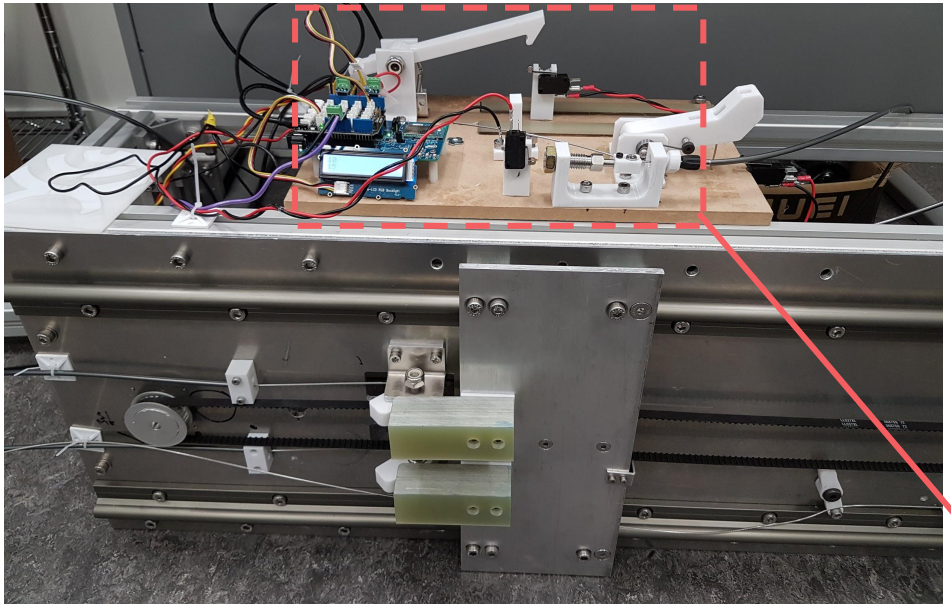
Optical design for novel configurations and calibration systems which minimize measurement errors.

Completed:

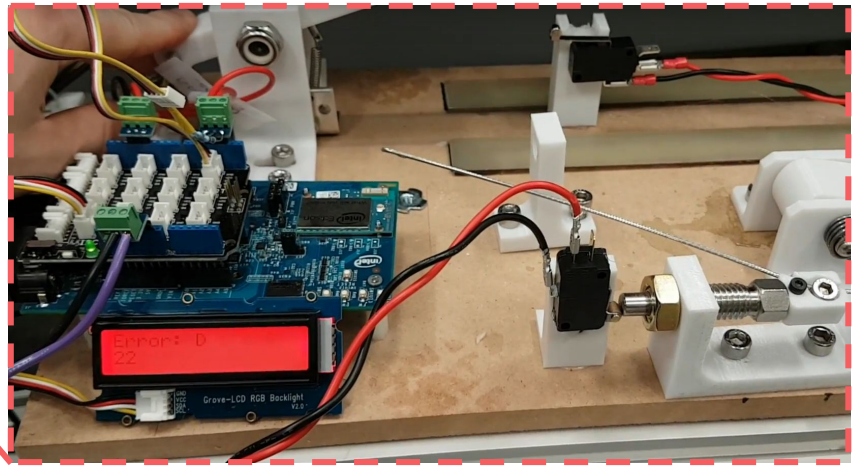
Design and testing of circuits to rapidly sample the SMI signal and provide telemetry of the system for calibration purposes.

Developing software filters and experimenting with optical parameters to reduce noise.

Automated Test Rig



Limit switches for error detection in SUT



Designed and assembled a linear motion system driven using a programmable brushless servo.

Results:

Ran **>20,000 cycles** of fully automated testing using an Arduino to provide error logging and diagnostics

Visual Displacement Tracker

OpenCV point tracking as a tool to measure displacements.

1. Contrast enhancement and lens distortion pre-processing.
2. Optimal tracking points are computed in the image.
3. Track using LK flow.
4. Compute displacement using camera FOV and distance.
5. For lost or obscured points, reattachment is done using template matching based on capture of point when first created.

Results:

Validated to achieved **millimeter resolution** and accuracy based on calibration tests.

Used in observing loading tests to measure maximal deflection.