Jerry Lu | Engineering Portfolio

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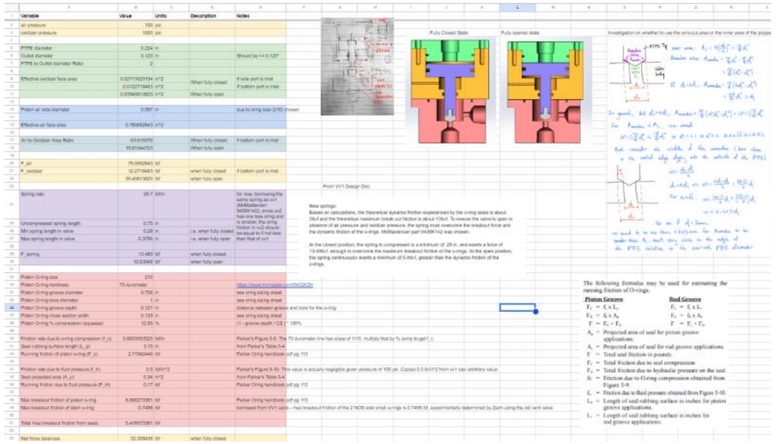
2nd-Gen Oxidizer Vent Valve for 2023 Hybrid Rocket | Waterloo Rocketry

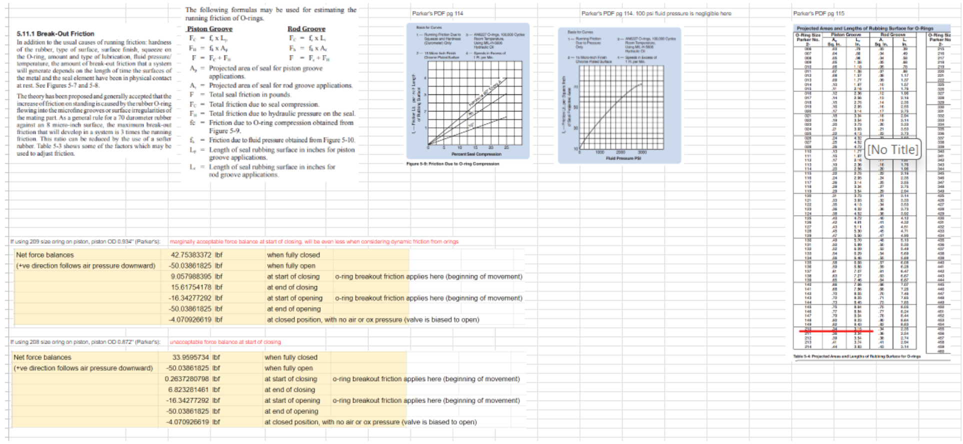
Goal: Build a pneumatically-actuated, normally-open, light & compact valve to control oxidizer venting from the launch vehicle.

First, lots of design calcs:

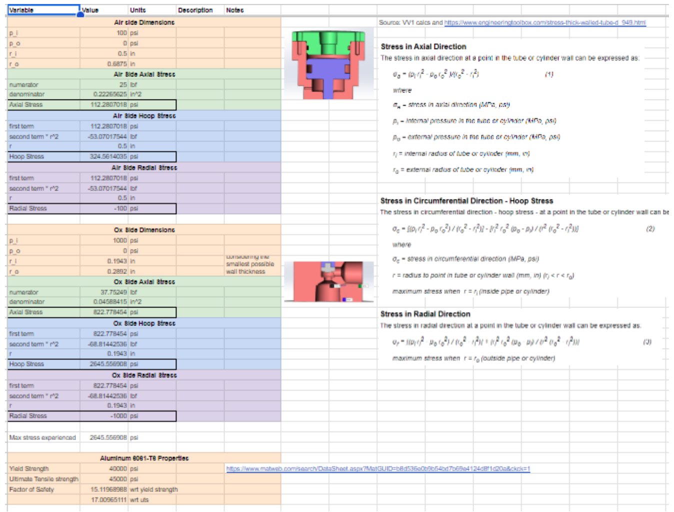
Force balance on valve piston



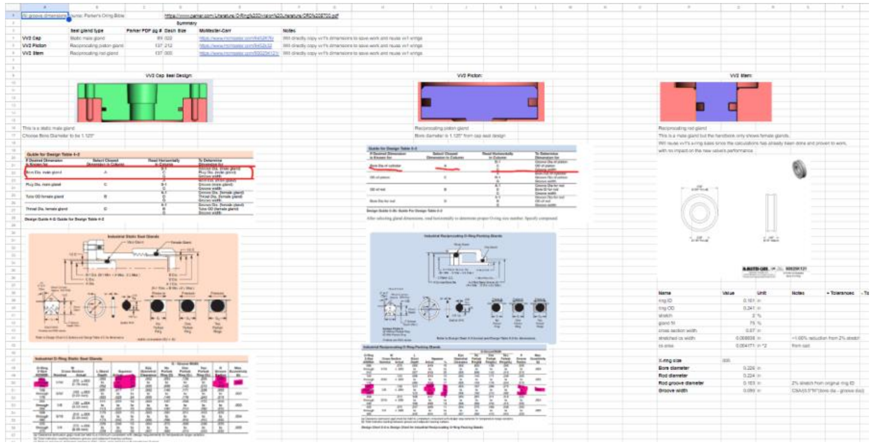
Dynamic friction due to O-ring seals



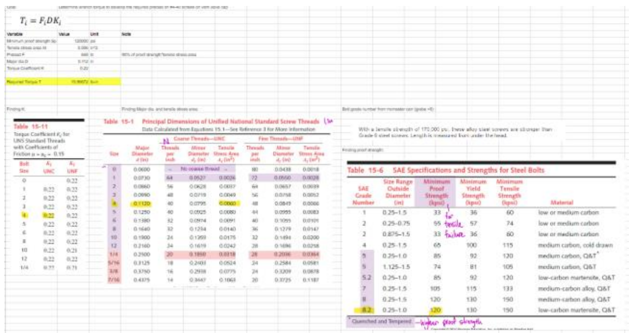
Stresses on valve components

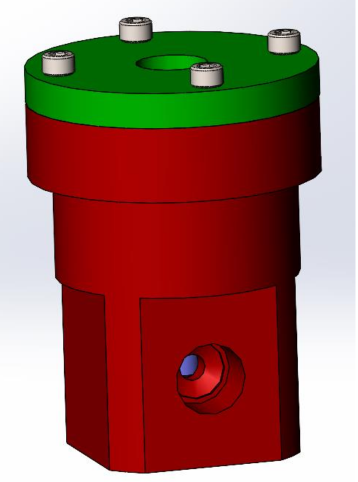


O-ring groove sizing (Shoutout to Parker's Handbook)

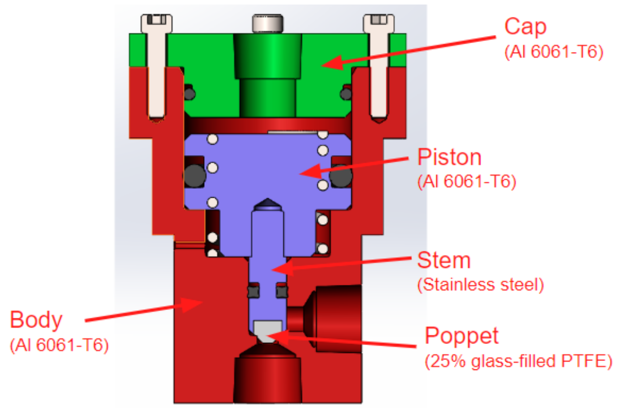


Torque spec for fasteners





Initial design!



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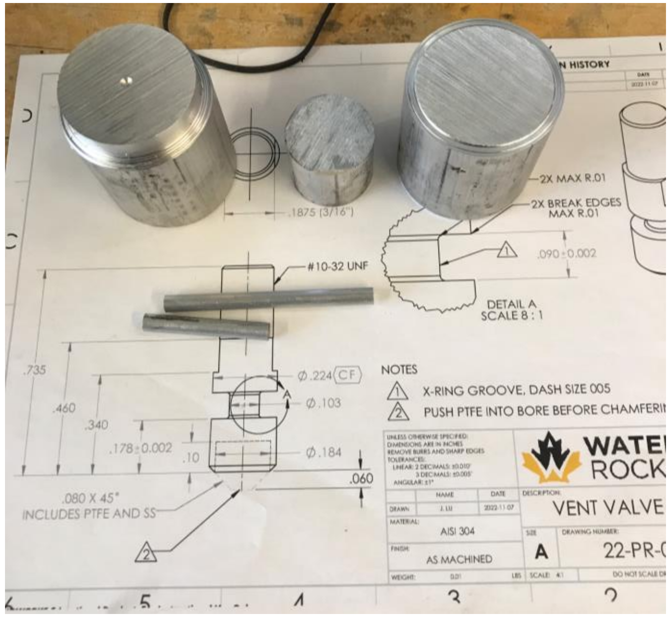
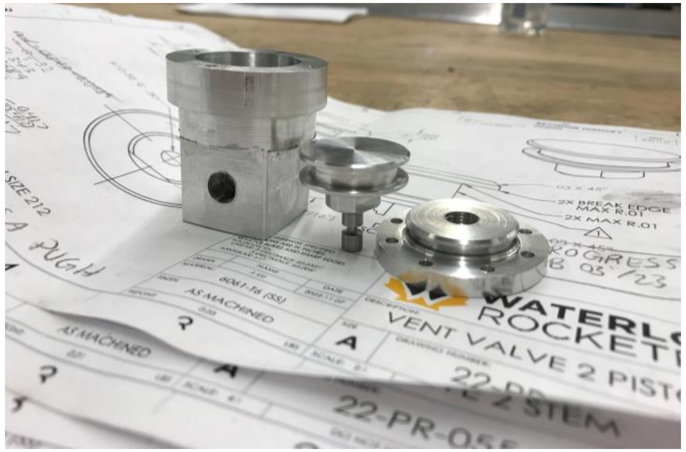
Cont'd: 2nd-Gen Oxidizer Vent Valve for 2023 Hybrid Rocket | Waterloo Rocketry

It's machining time!

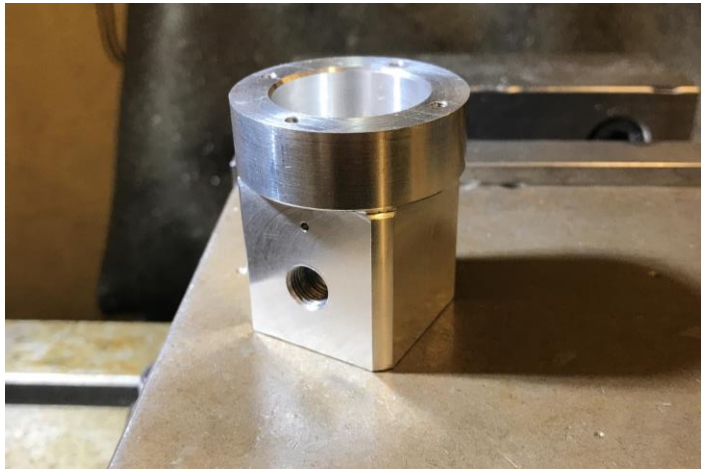


Before

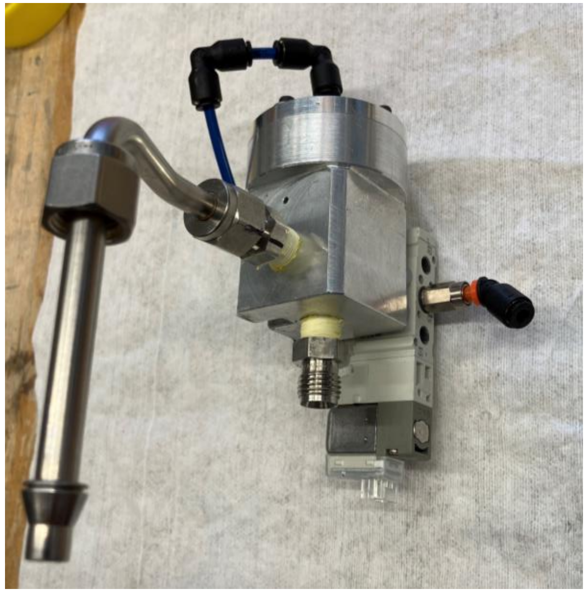
After



Hydrostatically tested to spec and now strapped atop the engine testing container prior to static fire test.



New and prettier body for easier integration of pilot solenoid valve and thermistor.



Assembled, tested, sanitized, and ready to fly!

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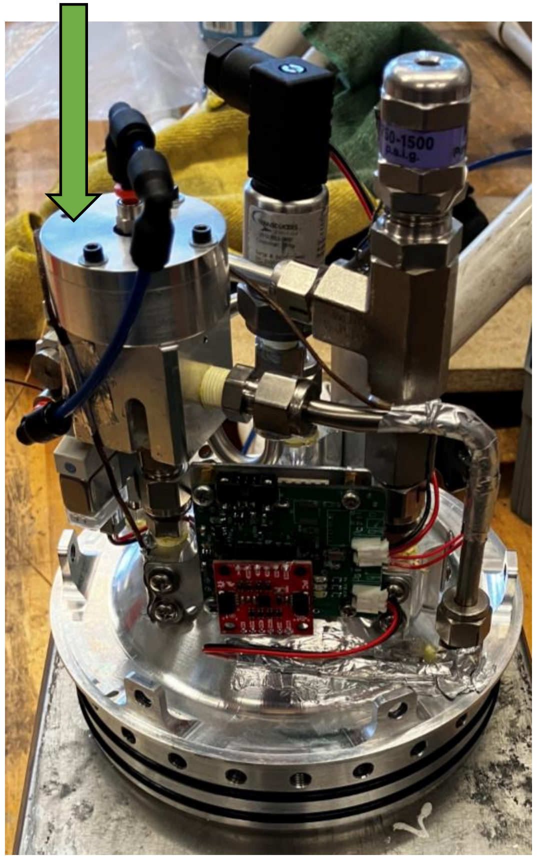
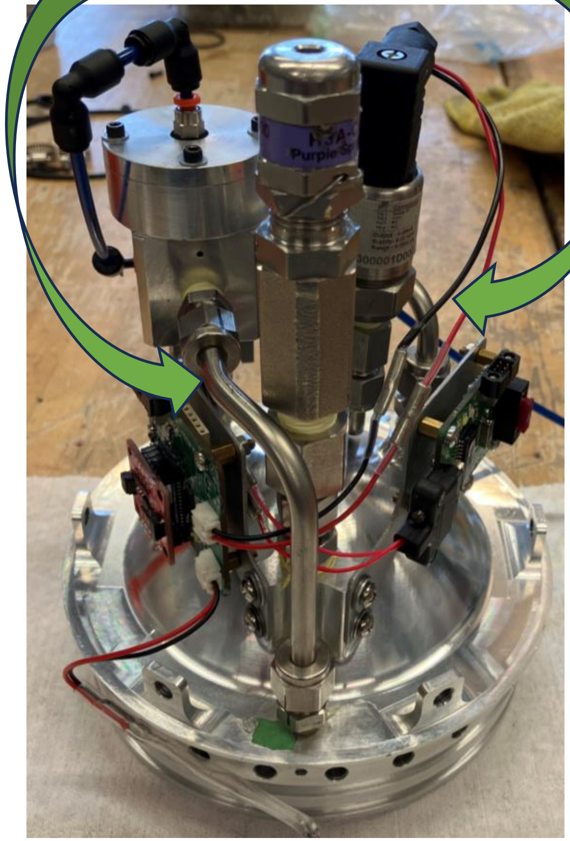
High Pressure Oxidizer Venting System for 2023 Hybrid Rocket | Waterloo Rocketry

Goal: Integrate the oxidizer vent valve, pilot solenoid valve, pressure-relief valve, pressure transducer, actuator control board, sensor measurement board, and two Raspberry Pi cameras into a 5.5” by 10” cylindrical space atop the oxidizer tank.

Look, there’s the vent valve!



Epic tube bends by hand



Awaiting systems test in front of a beautiful sunset.

Tested, sanitized, and ready for pre-flight assembly!

Post-launch and -recovery in the New Mexico desert! Welcome back ☺

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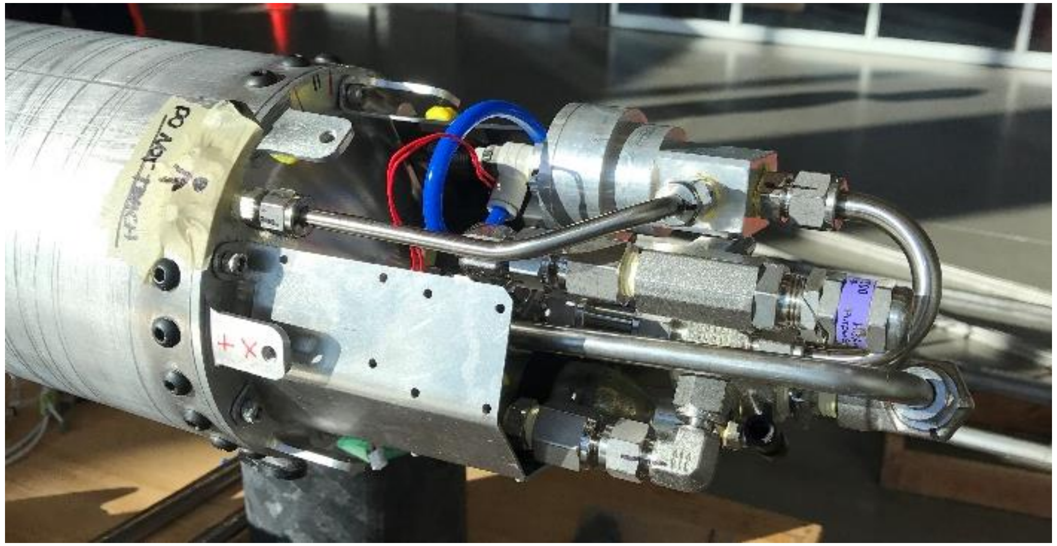
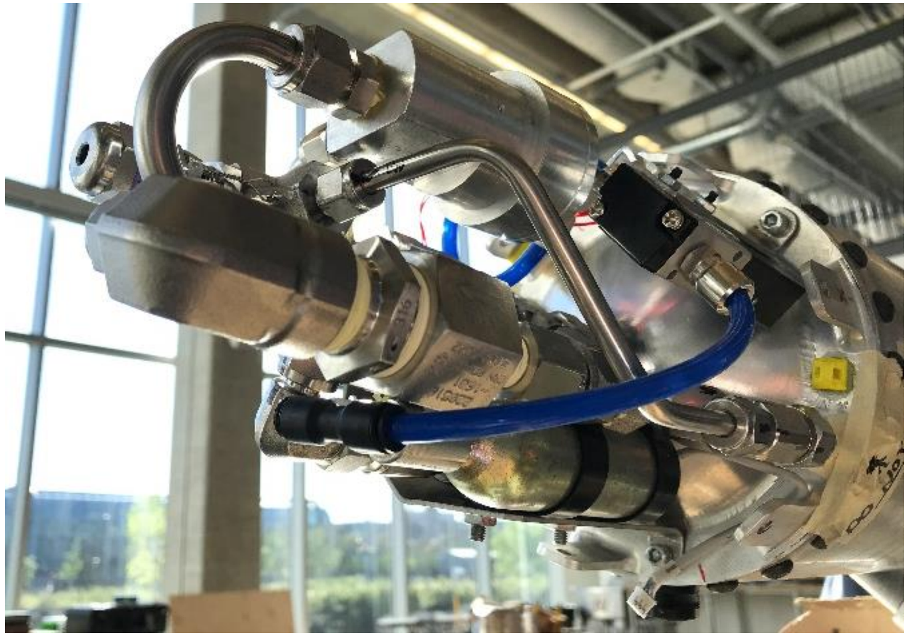
High Pressure Oxidizer Venting System for 2022 Hybrid Rocket | Waterloo Rocketry

Goal: Same as the 2023 system from last page, but plus a rupture disc assembly, a pneumatic reservoir, and a larger, legacy oxidizer vent valve with a larger pilot solenoid valve instead of the 2nd-Gen one.

Oh also, there is only one fluid port to interface with the oxidizer tank (for two valves, one rupture disc, and one pressure transducer).

Oh also, there's a pandemic so you can't actually touch any hardware until much, much later in the design phase ☺





The result: a tube and fittings jungle that drastically enhanced my skillset in systems integration, design for assembly, fluid systems, and how to bend tubes.

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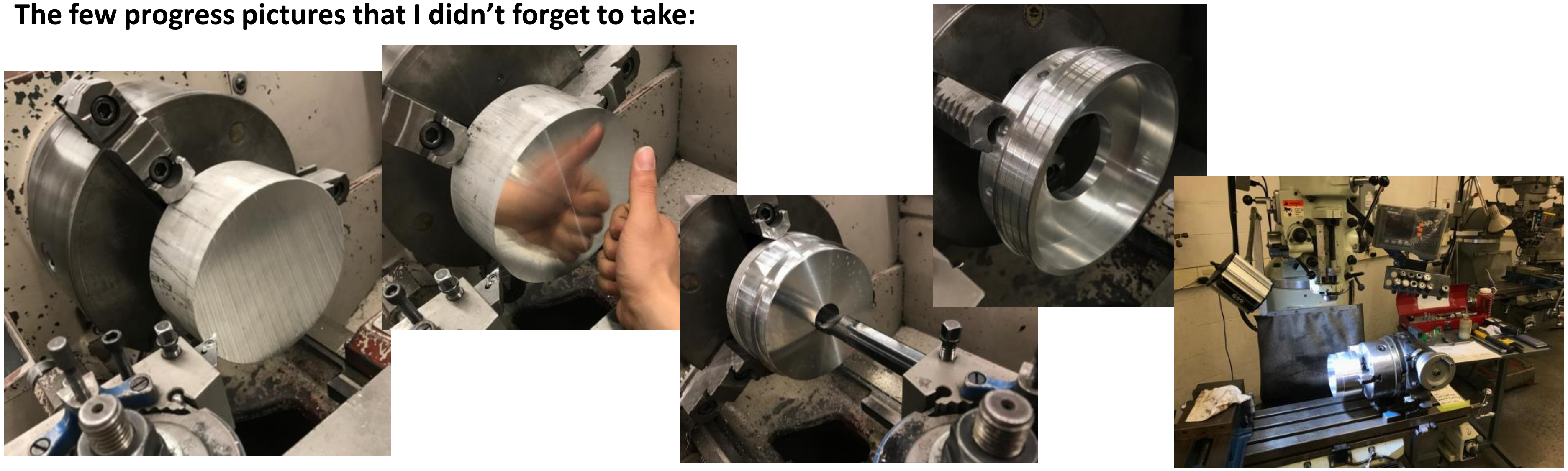
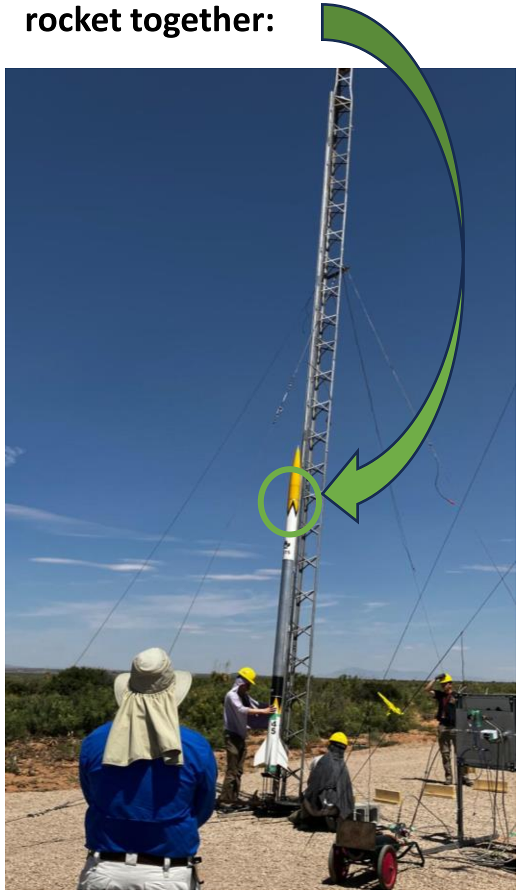
Airframe Couplers for 2023 Hybrid Rocket | Waterloo Rocketry | May – June 2023

Goal: Machine three critical airframe couplers to ensure timely assembly of the launch vehicle airframe.

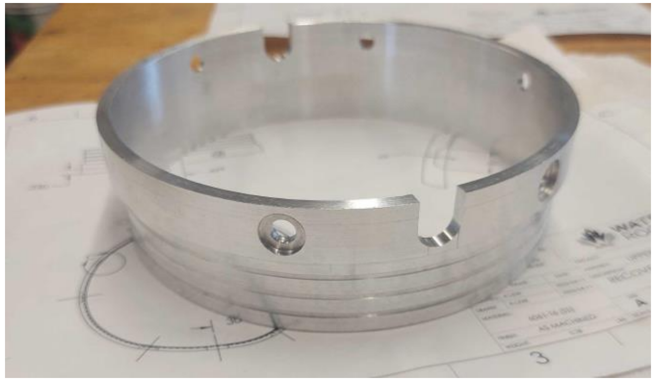
The few progress pictures that I didn't forget to take:



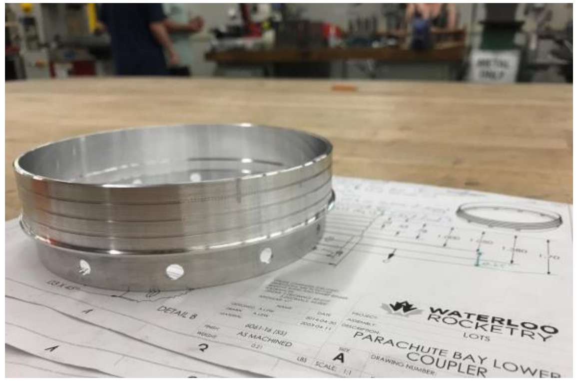
The couplers holding the rocket together:



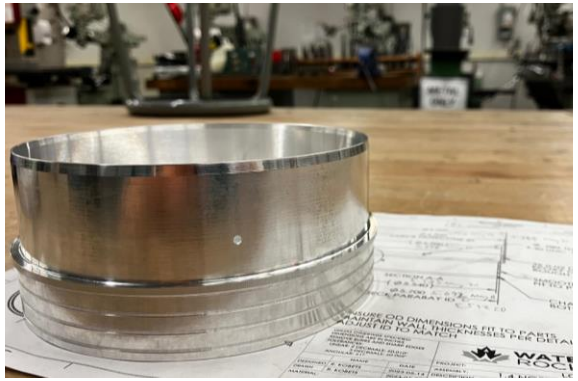
Recovery bay coupler:



Parachute bay coupler:



Nose cone coupler:



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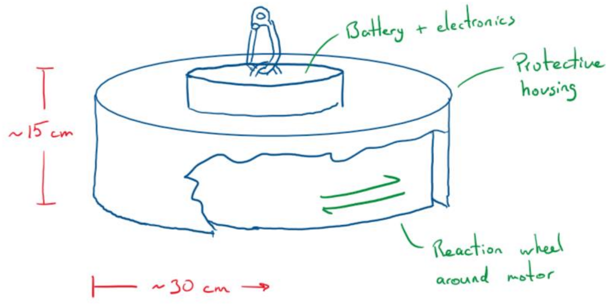
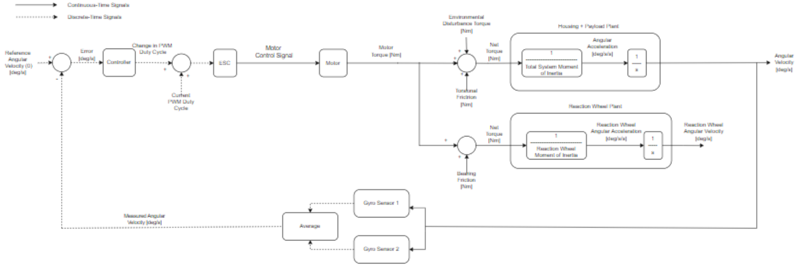
Spin-Stabilization System for Hoisted Payloads (SpinStop) | Engineering Capstone

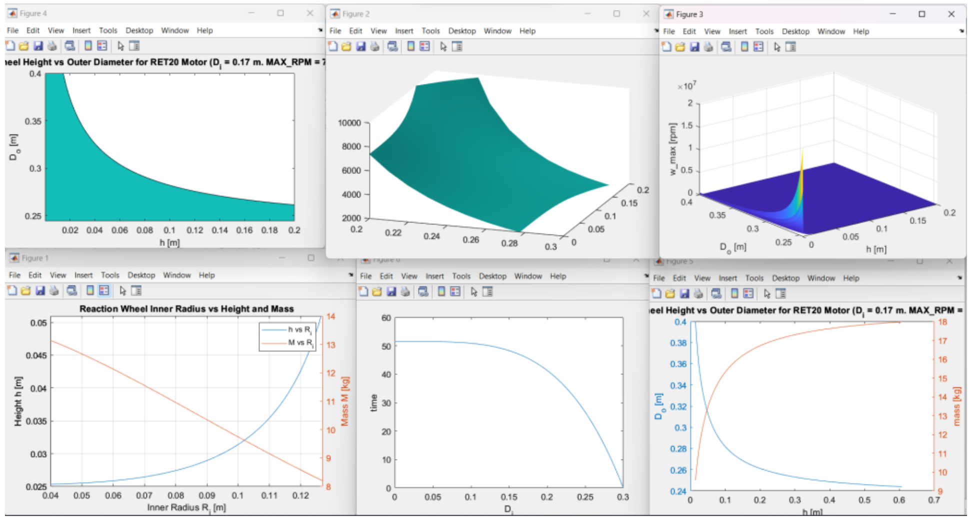
Goal: Build a system to stabilize uncontrolled spinning of helicopter-hoisted payloads during rescue operations (and applicable to other cases).

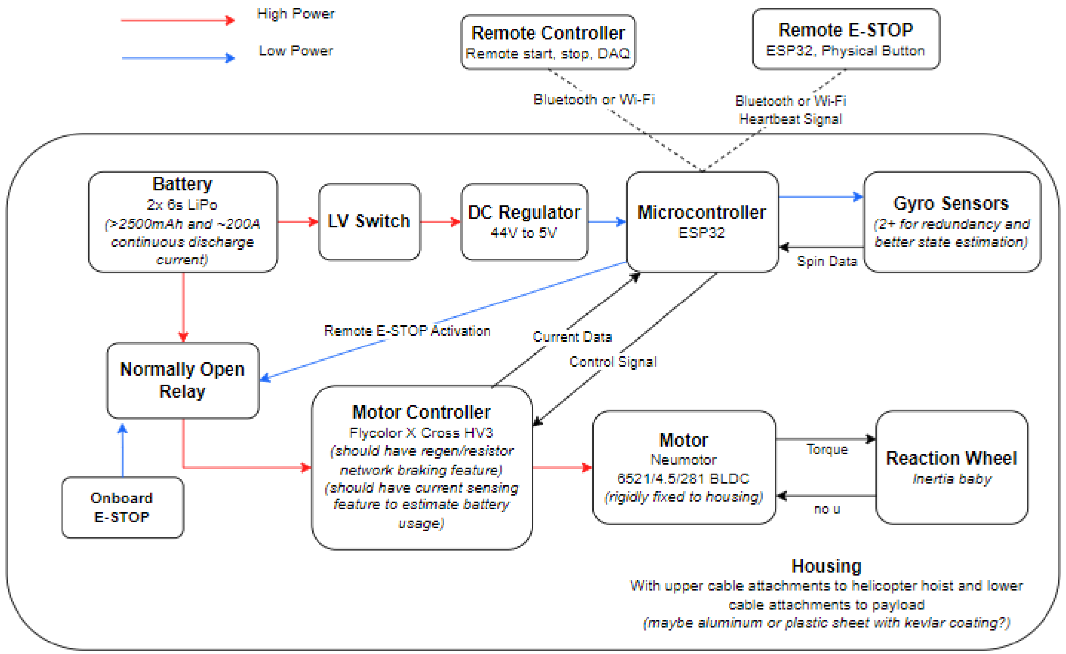


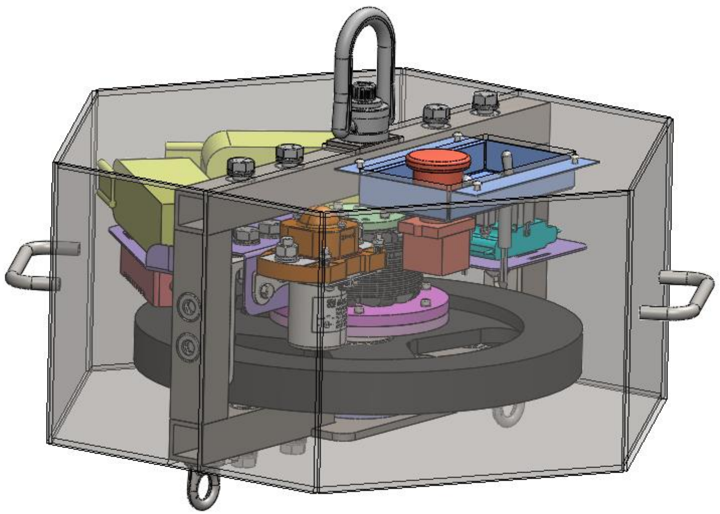
Controls Scheme

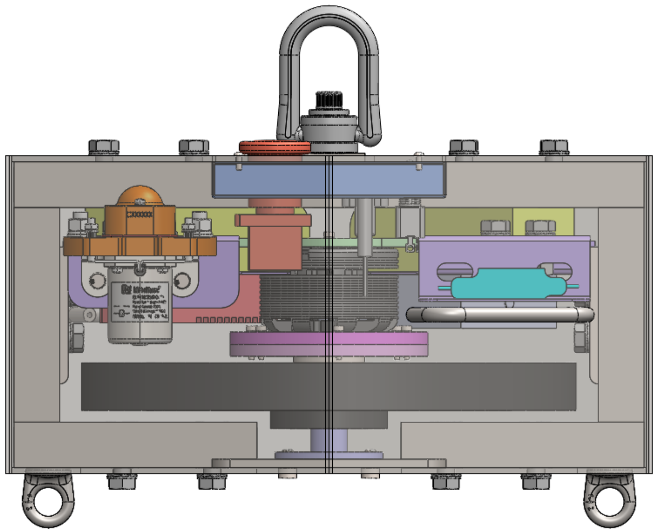


Reaction Wheel Sizing









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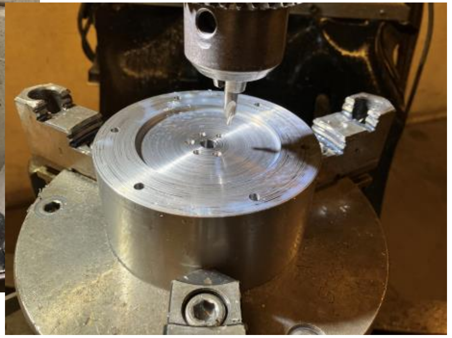
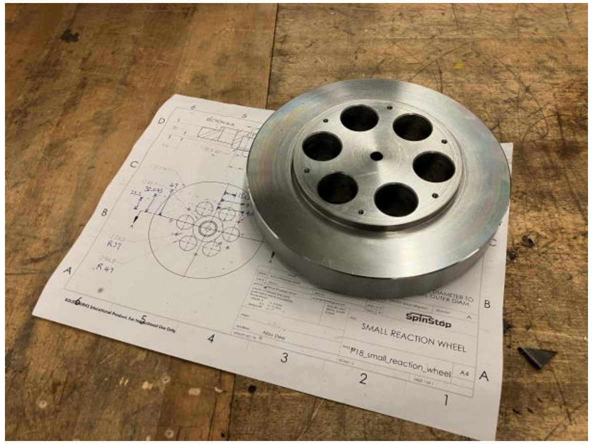
Cont'd: Spin-Stabilization System for Hoisted Payloads (SpinStop) | Engineering Capstone

Enough designing, let's machine some parts:

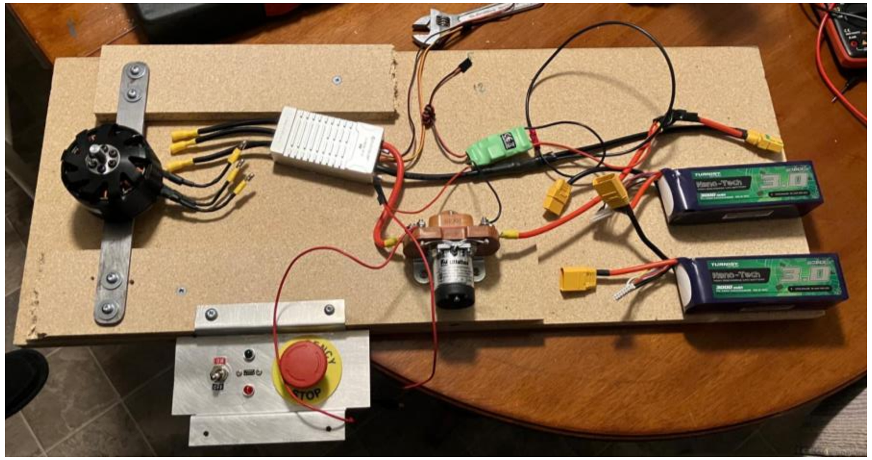
Motor coupler plates!



Reaction Wheel!

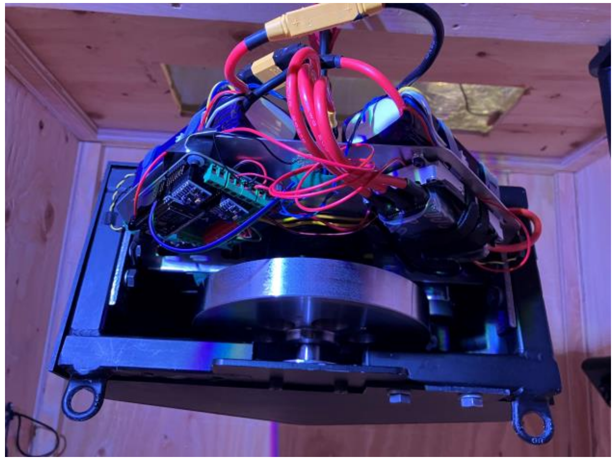


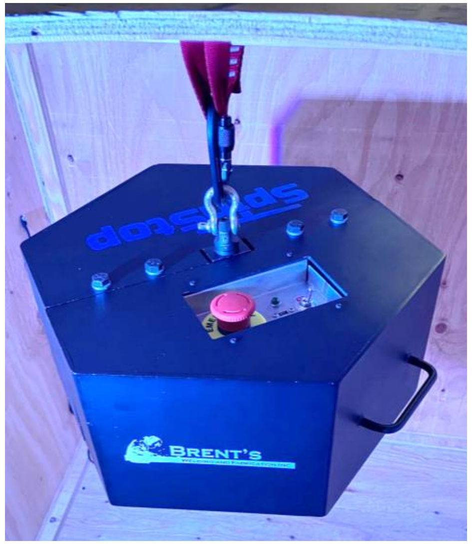
And test the electrical system!



Shoutout to Brent's Welding for making our system housing!

Integration and Assembly





Controls and Testing ongoing…

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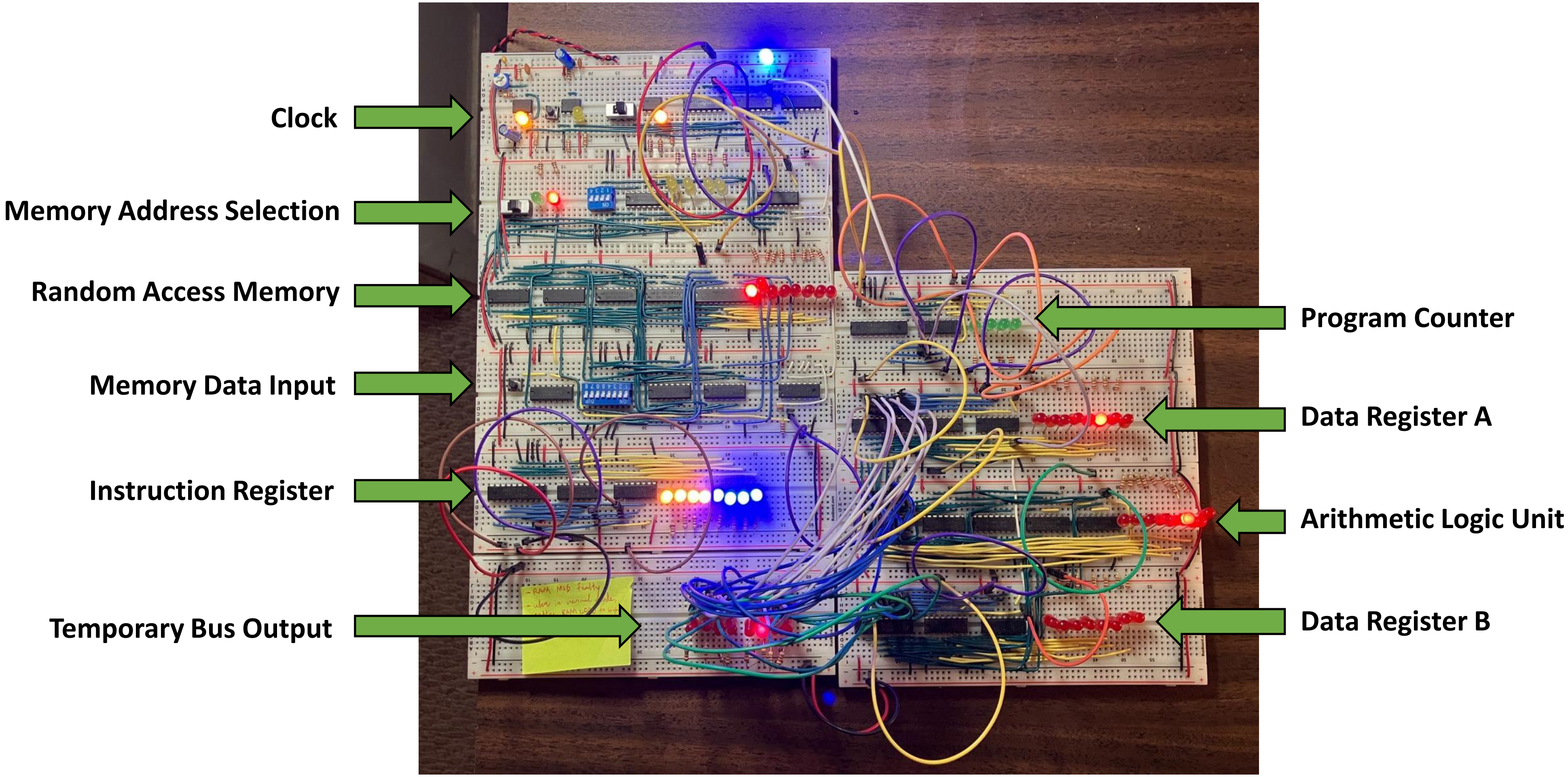
8-bit Breadboard Computer | Personal Project | July 2023 – On Hold for Now

Goal/Motivation: Computers are very cool and I want to learn something out of my comfort zone, so I'm following online tutorials to build a first-principles digital computer from low-level IC components.



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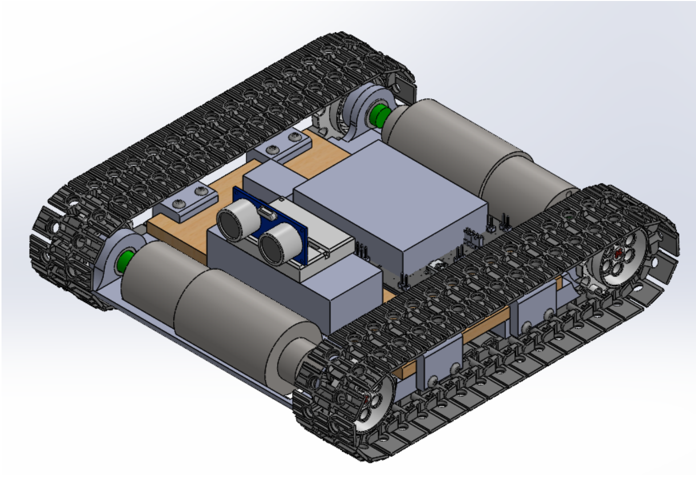
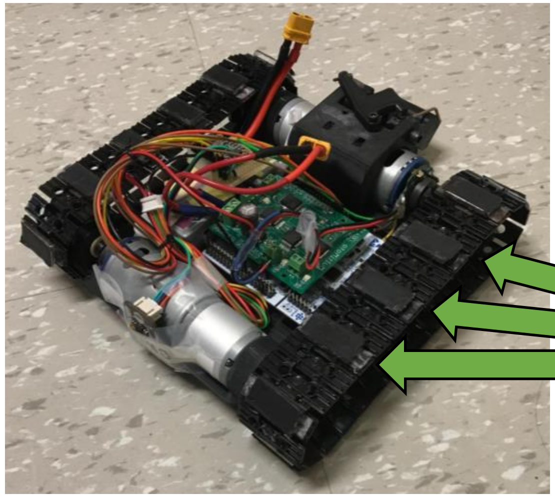
Autonomous Wall-Climbing Robot (Wall-e) | 3rd Year Course Project

Goal: Build a system capable of autonomously getting over a steel wall and locating a target on the other side.



Expectations



Reality

Neodymium magnets with rubber coating for best results driving on steel wall

Wall-e in action:

It is evident from these hands that we were not too confident in Wall-e

Wall-e needed some human help to get over the top of the wall. This project taught me the importance of rapidly testing drastically different proofs-of-concepts before making minuscule improvements to a particular design (we only did the latter).

Wall-e in retirement: