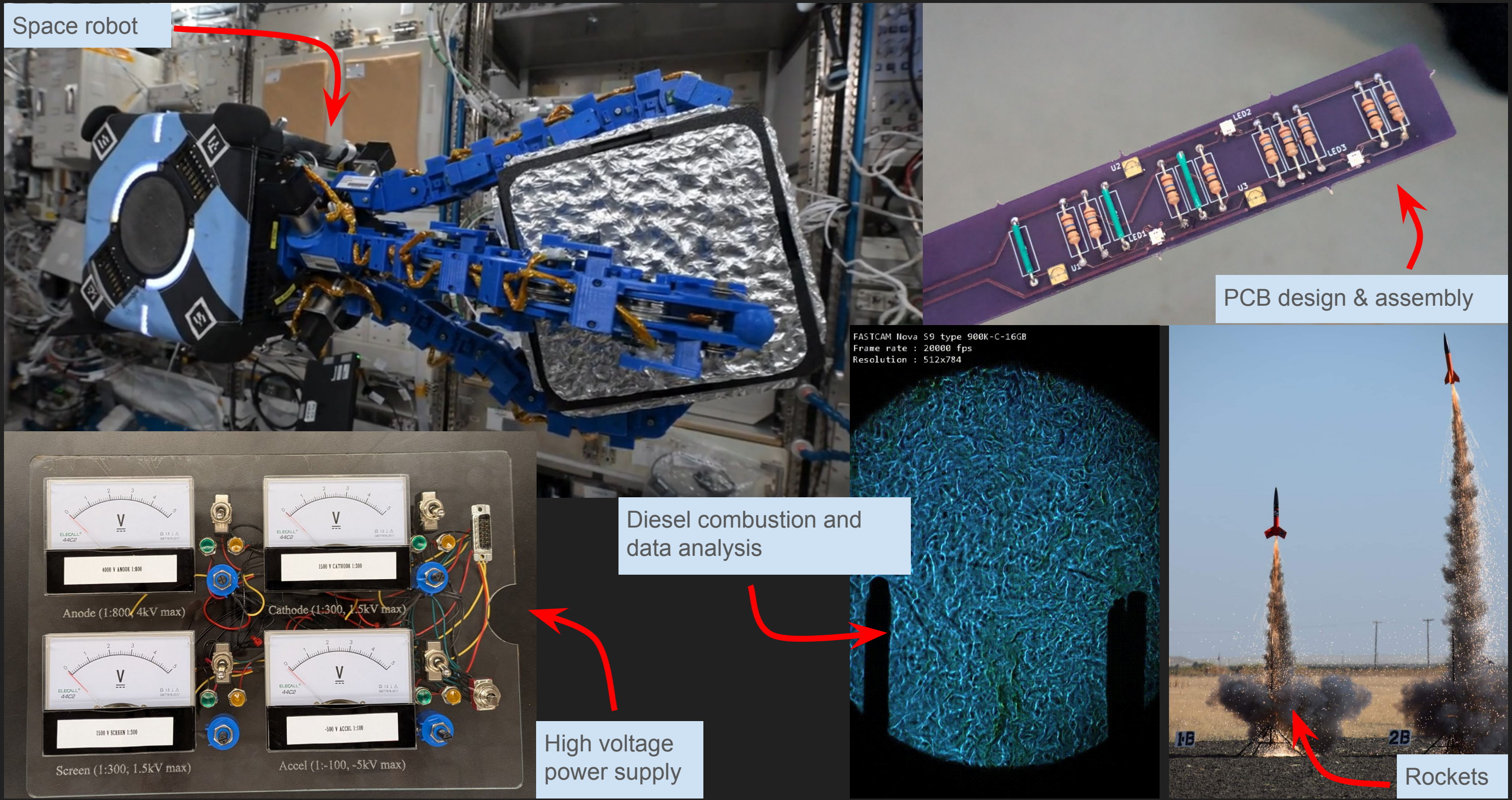
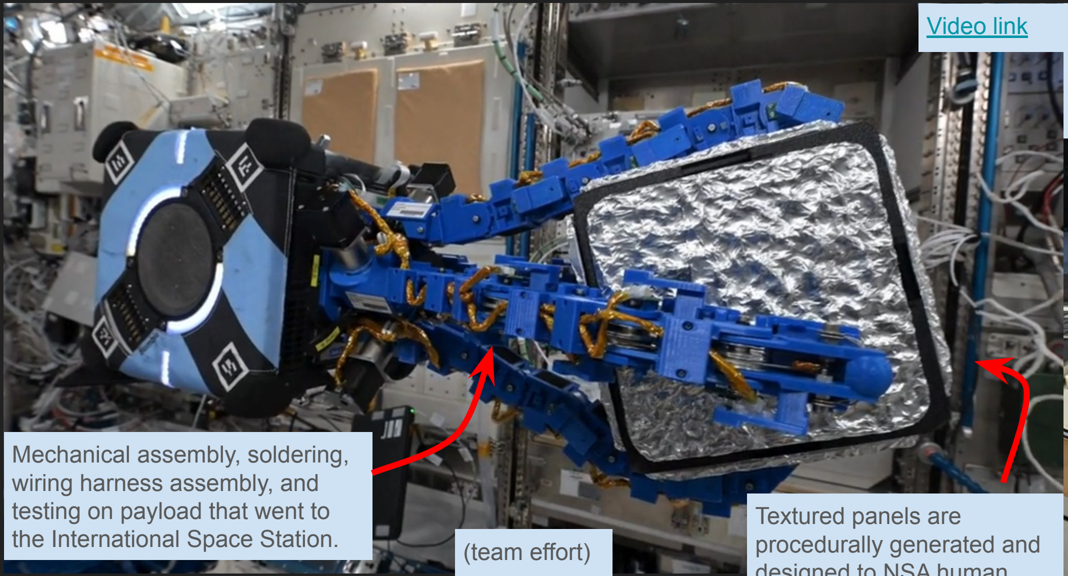
# Portfolio

Noah Milivojevic
noah@milivojevic.org

# Hi! I build space robots. And other things



# Kall Morris Inc – REACCH tech demo (ISS)

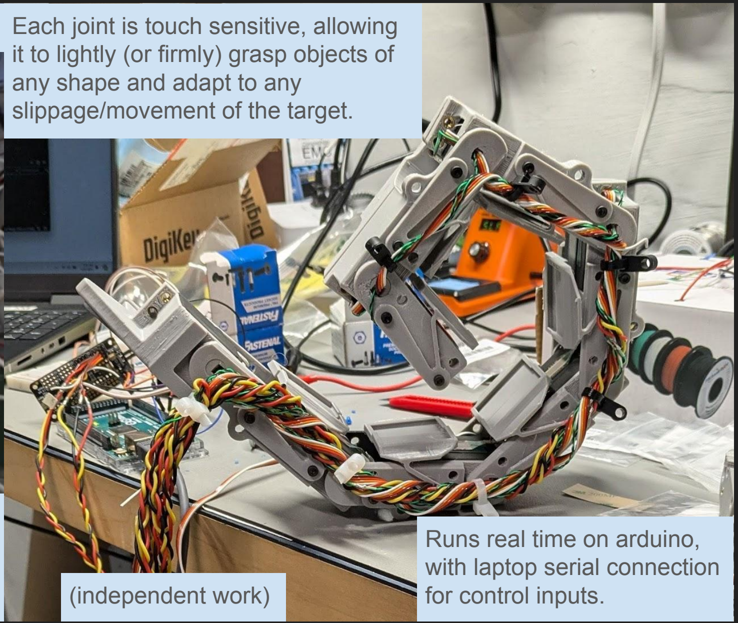


[Video link]

Mechanical assembly, soldering, wiring harness assembly, and testing on payload that went to the International Space Station.

(team effort)

Textured panels are procedurally generated and designed to NSA human fitness requirements.



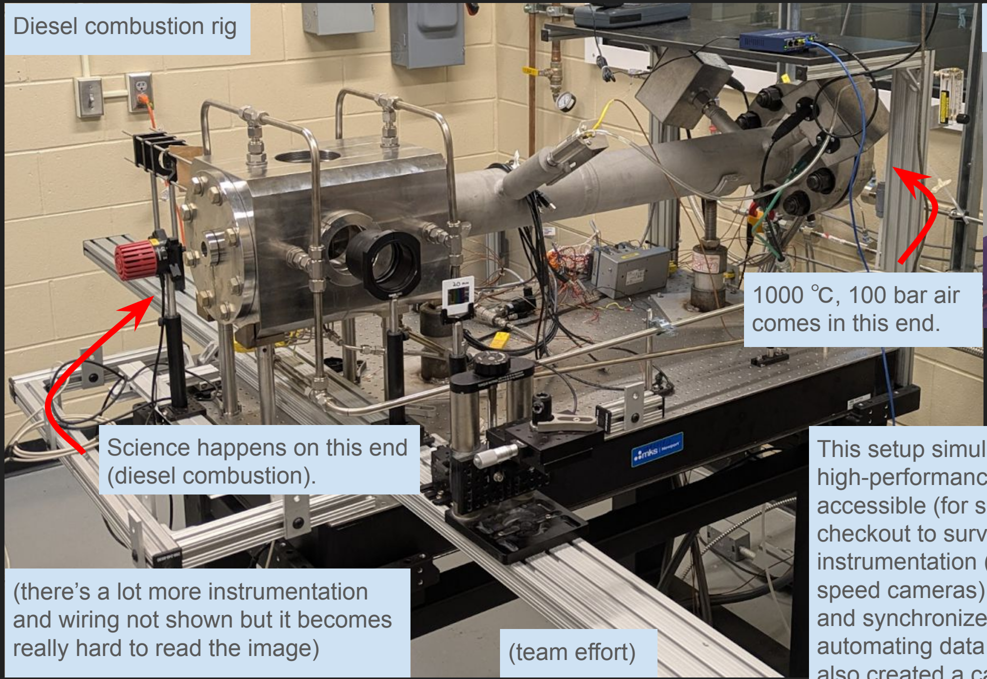

Each joint is touch sensitive, allowing it to lightly (or firmly) grasp objects of any shape and adapt to any slippage/movement of the target.

(independent work)

Runs real time on arduino, with laptop serial connection for control inputs.

The REACCH tech demo was used to demonstrate orbital debris capture and handling on board the international space station. The REACCH payload used underactuated joints (one motor controls many joints). I also created and tested a fully actuated version that was used to evaluate the two actuation schemes. Unfortunately, I cannot show any more detailed design/electrical work for security reasons.

# National Science Foundation REU (hardware)



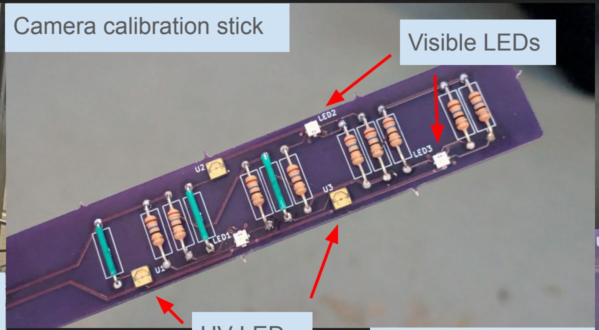
Diesel combustion rig

1000 ℃, 100 bar air comes in this end.

Science happens on this end (diesel combustion).

(there's a lot more instrumentation and wiring not shown but it becomes really hard to read the image)

(team effort)

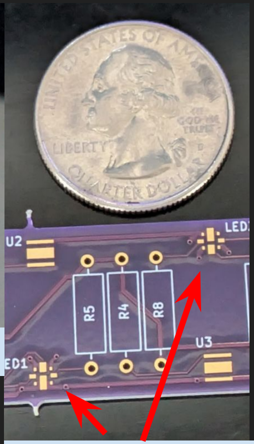


Camera calibration stick

Visible LEDs

UV LEDs

(independent work)

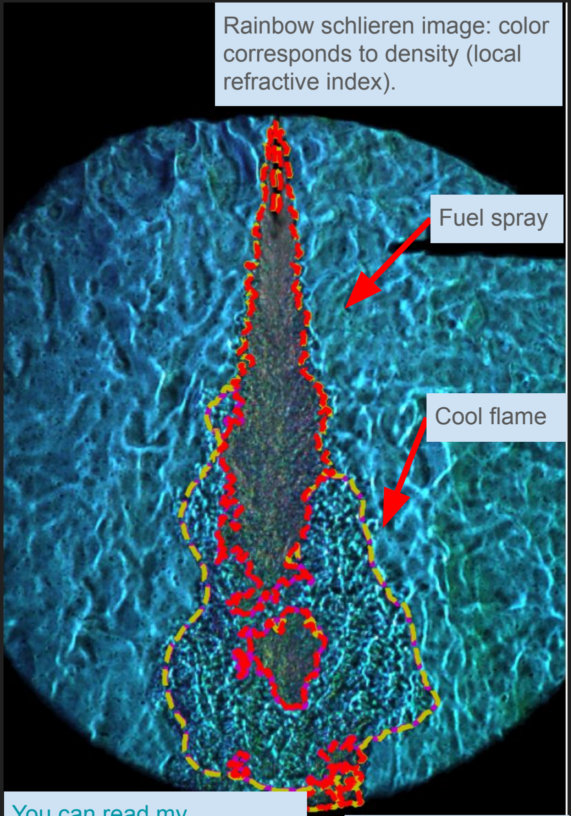



0.3 x 0.4mm solder pads (assembled by hand on first try)

This setup simulates the conditions inside of a high-performance diesel engine, while still remaining optically accessible (for science). Along with mechanical assembly and checkout to survive the harsh conditions, I wired instrumentation (thermocouples, pressure transducers, high speed cameras) and set up LabVIEW to monitor system safety and synchronize diesel injections and high speed cameras, automating data collection (a typical run was ~1000 shots). I also created a camera calibration stick, allowing all three cameras to be synchronized (the old method involved setting the chamber on fire – not recommended).

# National Science Foundation REU (software)


Diesel combustion results!



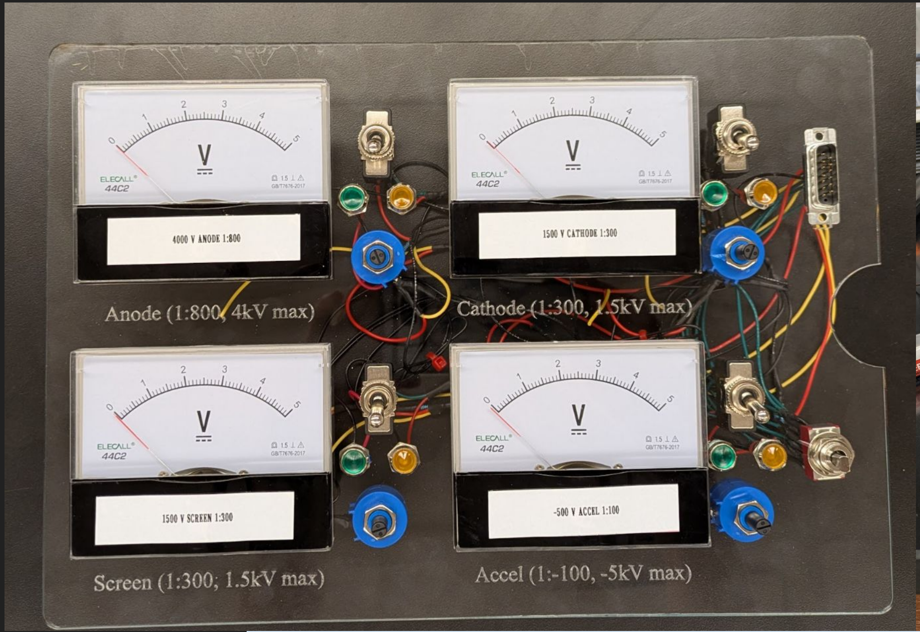

[You can read my dissertation on this here]()

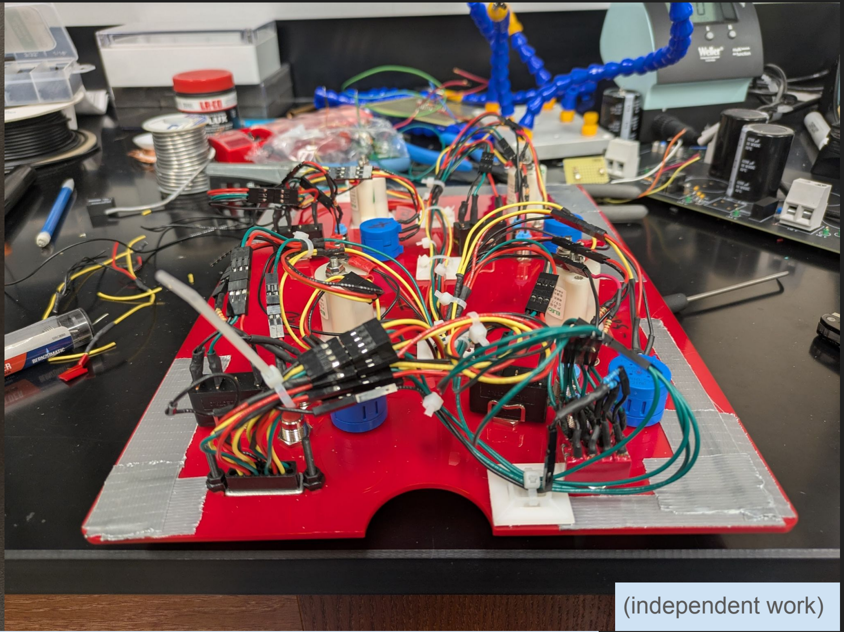
(independent work)

Combustion happens in multiple phases, including mixing, cool flame (a sort of pre-combustion), and hot flame. I created an algorithm to separate out the different combustion modes in a schlieren image.

Along with performing data analysis, I set up software systems to automate camera calibration, keep track of calibration and test data files, and automate the creation of intermediate data analysis files (some of these take a while to generate, so it's better to keep them pre-processed). Basically, you can now just hit 'run' on your code instead of having to hunt down which test data file corresponds with which calibration files and which test conditions, as well as cutting down (50%) on the amount of time it takes to run an analysis.

# High voltage power supply



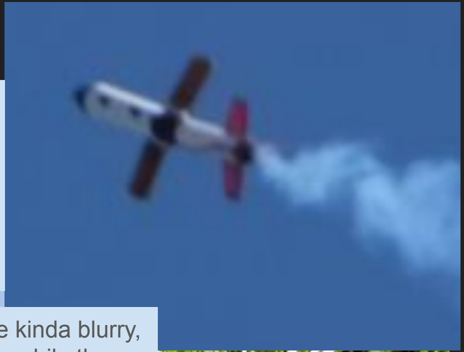



(independent work)

0 - 4k V, four channel DC-DC power supply control panel (transformers not pictured), built to support ion engine vacuum chamber testing. Each channel is individually controllable, and can be manually shut off. System is fail safe (releasing the momentary switch disables all four channels). All components are modular, allowing them to be swapped out without soldering or crimping.

# Rockets

All of these rockets on the left were made for an altitude target competition. All were actively controlled using an onboard Teensy (Arduino-derivative) with a custom PCB shield. Work involved airframes, mechatronics, control algorithms, making test day run as smoothly as smoothly as possible, and organizing test data and lessons learned.

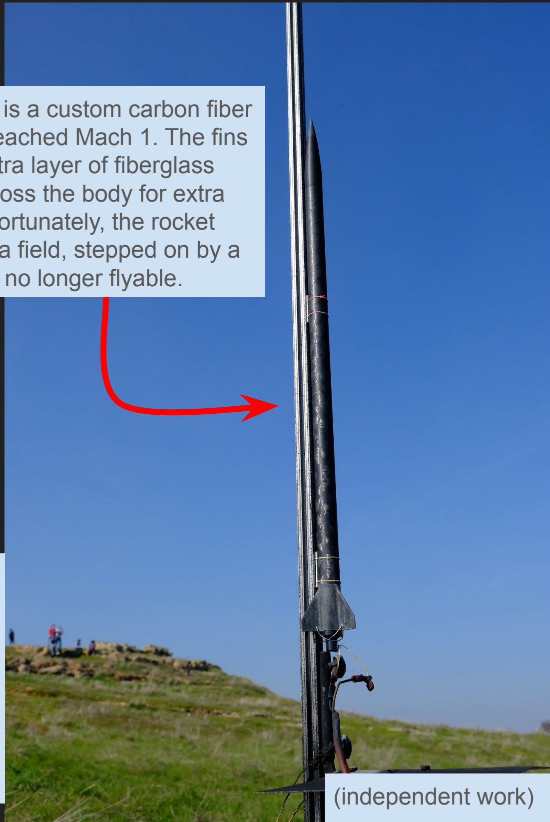


(sorry these are kinda blurry, they were taken while the rockets were in flight)

Mechanical parachute deployment mechanism, needs to be sturdy under shock loads, hold enough force to successfully deploy a parachute, and run on only 3.7v power (less than what most servos are happy with).

Drag flap detail (bottom) and drag flaps in flight (top). The control scheme uses live regression modelling to learn throughout flight and produce an optimum control output – no PID tuning or overshoot. Fitting servos into such a small space was a pain, but offered near-instant actuation time.

This rocket is a custom carbon fiber build that reached Mach 1. The fins have an extra layer of fiberglass bonded across the body for extra rigidity. Unfortunately, the rocket was lost in a field, stepped on by a cow, and is no longer flyable.



(independent work)