

COLIN DUFFY ENGINEERING PORTFOLIO

Skilled Generalist Mechanical Engineer.

Specialization is for insects!

ABOUT ME

From Omaha, Nebraska (Go Big Red!)

BS, MS Mechanical Engineering @ USC

CURRENTLY: Mechanical Engineer @ Lumindt:
abundant long duration energy storage

Avid surfer, reader, musician, cyclist when 000

Past internships @ Virtual Incision (*surgical robotics*) + NovaSignal (*neural imaging*)



Mechanical Engineer @ Lumindt: *a license to build*

Scrappy, do-it-all engineer owning unit storage cell
for long-duration energy storage startup!

- **Scale-up:** lab-scale → mid-size → production
- Prod: QTY 150; 5"Ø x 20' L; 750lb; 60kWh ea.
- ***Critical and Comprehensive Testing Campaigns!!!***

Critical Support Structures: FEA + Fabrication

Parts: sheet metal , CNC, ceramics, extrusion, more!

Custom Tooling and Jigs

Weld Procedure Definition, Qualification, Proof, NDE



Top: x3 production vessel stack
Bottom: Exothermic Charge!

Mechanical Engineer @ Lumindt: *a license to build*

Other Responsibilities + Side Quests

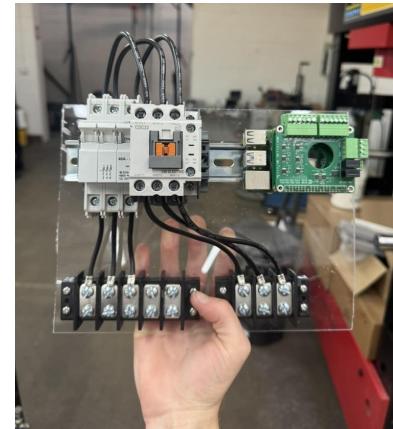
- Many Custom Test Benches: Experimental Design + Automation
- Electrochemical Salt Reactor Design/Build - Corrosive Environment
- Bespoke High-Power Kiln design
- Exploring 2ax TIG welding robot
- Lots and Lots of Prototypes!



Self-Fixturing Weldments



Salt Reactor



High-Power Distributor



New Office Setup



Water-Cooled Vessel

Introduction: Thrust Vector Control RE

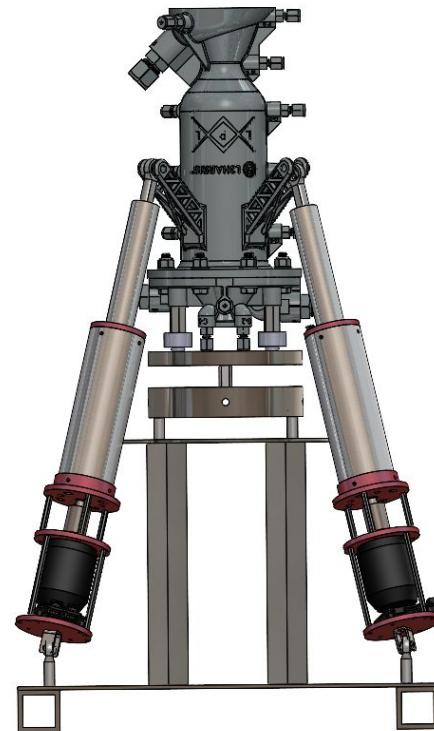
Led small + scrappy team (4) to design VTVL hopper flight-quality stabilization system in 10 weeks!

Owned design of \$300 actuators exceeding performance of \$3000 OTS comparison

Streamlined pad integration w/ integrated thrust structure

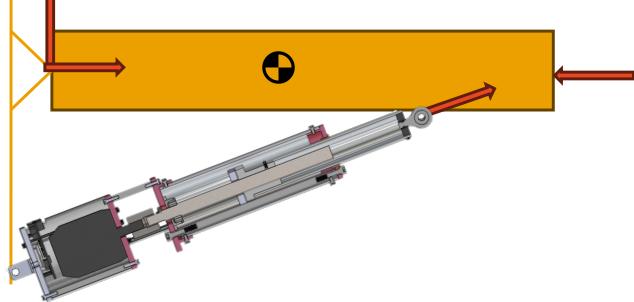
Manufactured parts w/ variety of methods + machine shop tools

Managed controls, MFG, EE engineers!



Kinematics + System Sizing

Free-Body Diagram



Equilibrium Equation, solve for F_A , R_{Gx}
(actuator axial load, gimbal thrust load)

$$\sum F_x = F_A \cos \alpha - T + R_{Gx} = 0$$

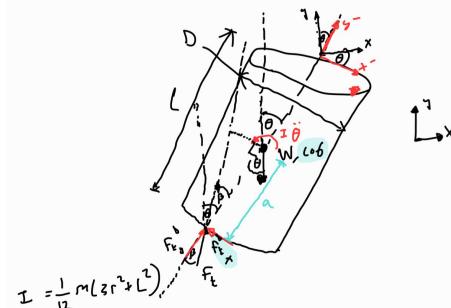
$$\sum F_y = F_A \sin \alpha - Mg + R_{Gy} = 0$$

$$\sum M_G = F_A l_{GAx} \sin \alpha - Mg l_{CG} + F_A l_{GAy} \cos \alpha = 0$$

$F_A = 21.12 \text{ lbf}$

$R_{Gx} = 685 \text{ lbf}$

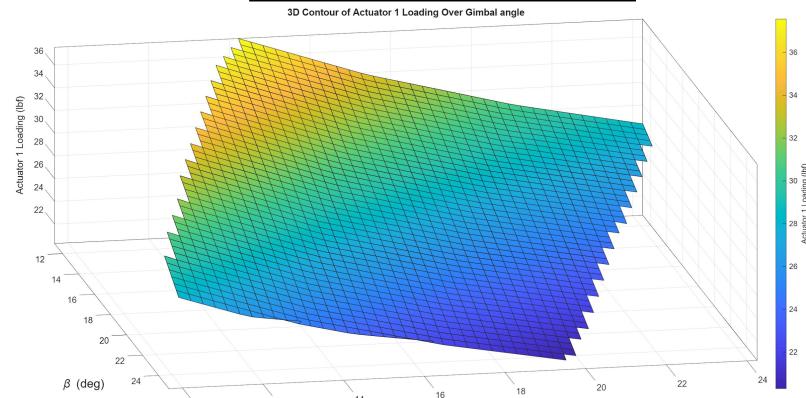
Engine mass moment, not thrust, drives loading!



Hopper dynamic model

- solve $\min \theta'$ required for flight stability
- convert to linear actuator speed

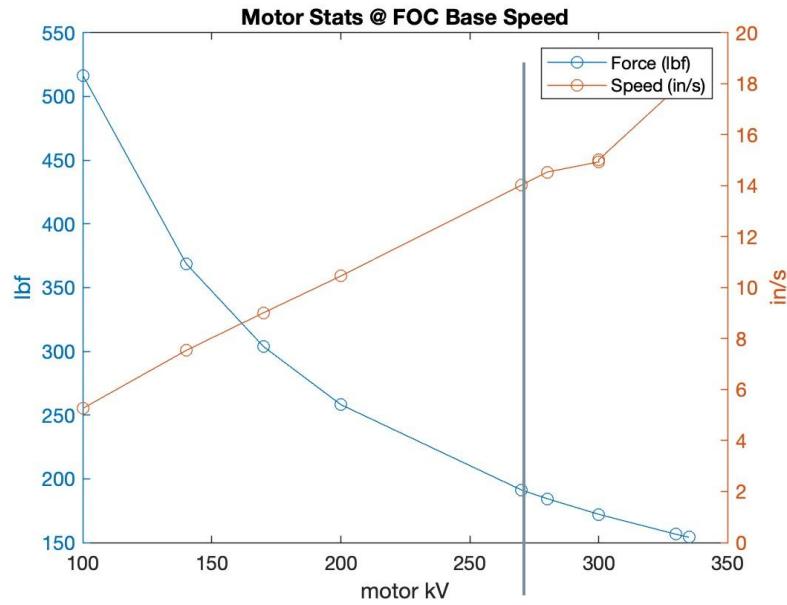
$0.5 \text{ rad/s} \parallel 5 \text{ in/s}$



Verified in 3D over all gimbal angles

BLDC Sizing // Field-Oriented Control

Goal: Spec a BLDC from motors available on Amazon



15.5 in/s

191 lbf

*Large FoS for
forwards-
compatibility*



Why Field-Oriented Control?

- Fast Acceleration
- High torque @ low speed

270 Kv Motor Specifications

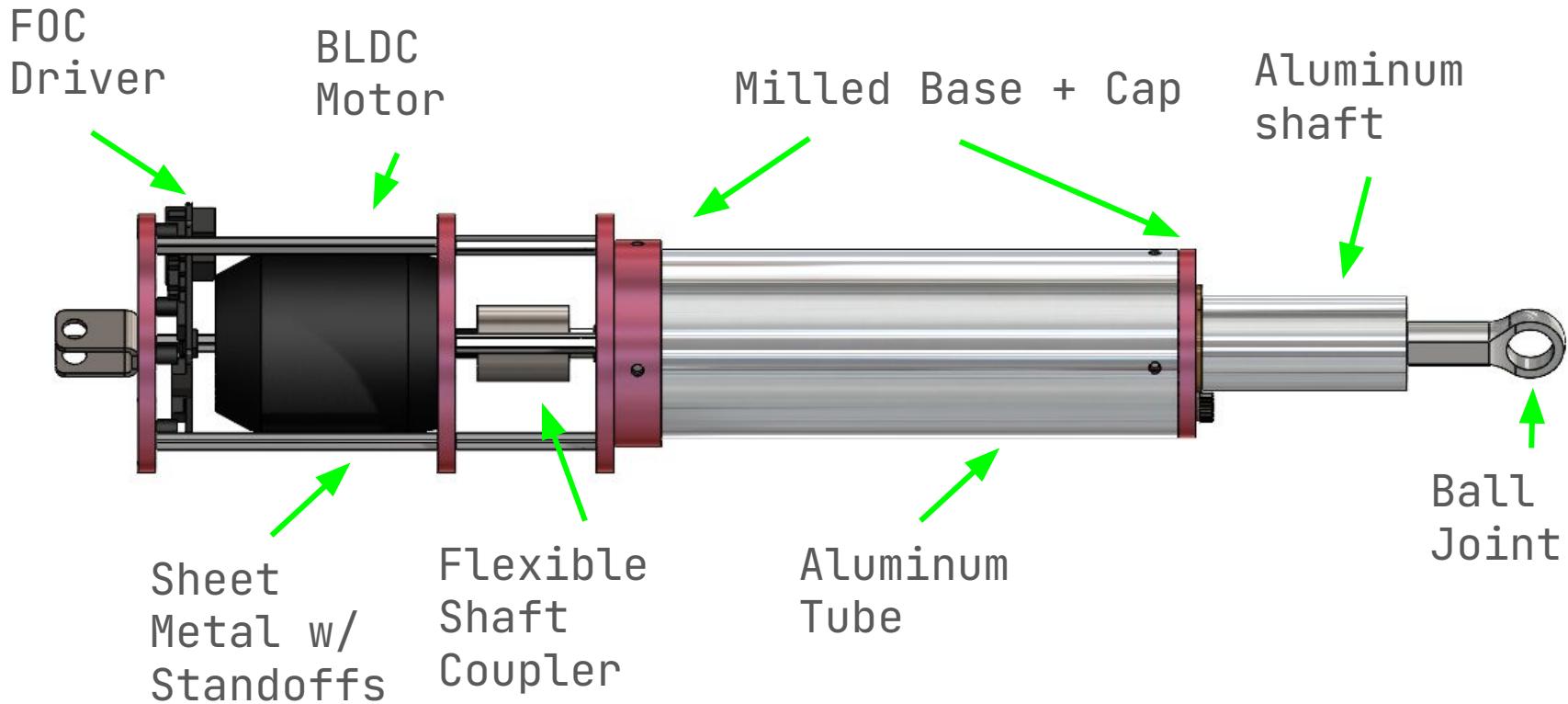
- Torque: 0.665 N/m
- Max current: 80A

Moteus Motor Controller

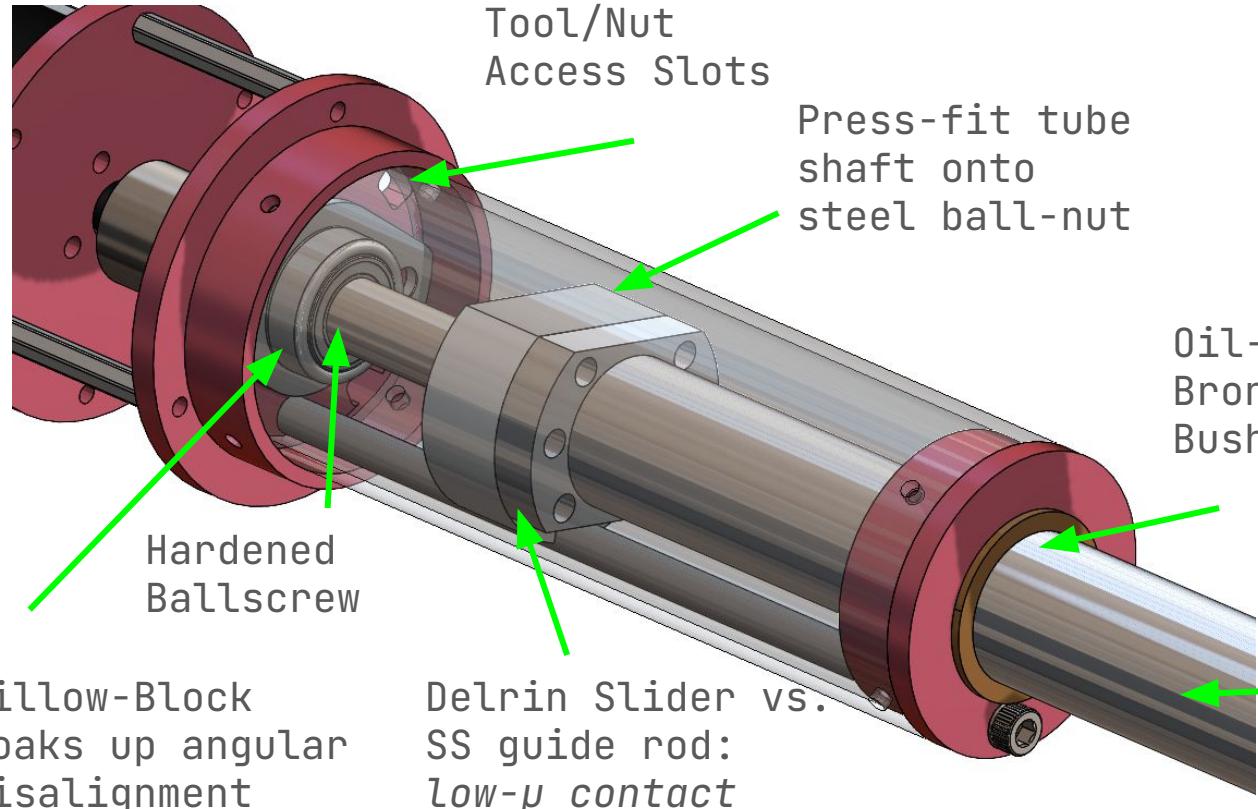
- 3-phased FOC driver (500W)
- Strong Open-Source Community



Anatomy of an Actuator: *beat \$3k COTS specs for \$300*



Anatomy of an Actuator pt.2: *smooth linear motion*



GOAL: avoid overconstraint, stay simple!



Copious amount of grease

Aluminum tubing shafts provide rigidity, controlled OD

Articulated Gimbal Ring

Waterjet rings + McMaster ball-joints

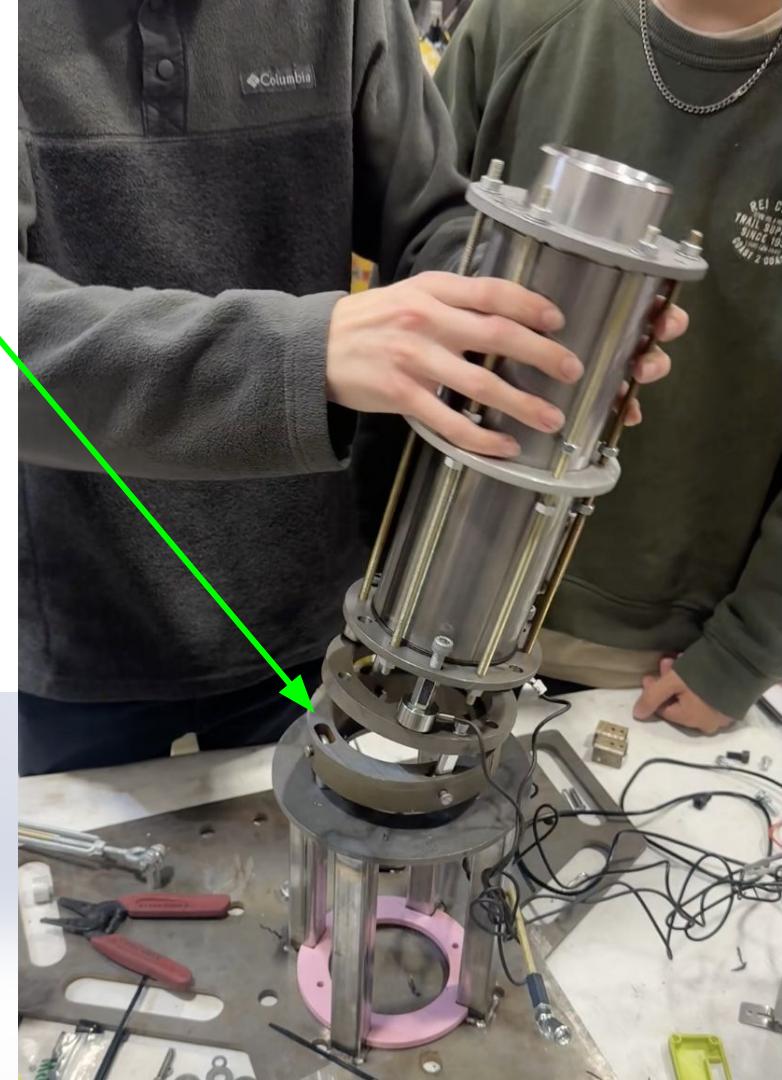
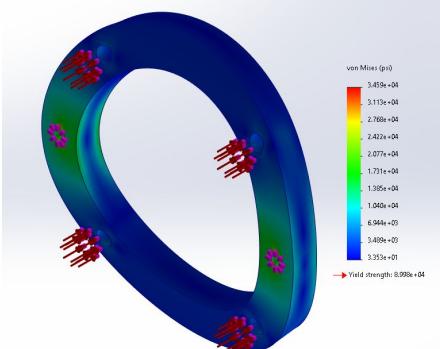
Ring-shaped for axial hose pass-thru

Load cells - thrust reading @ any axis

Guaranteed 12° of XY gimbaling

Easy setup + teardown on the pad

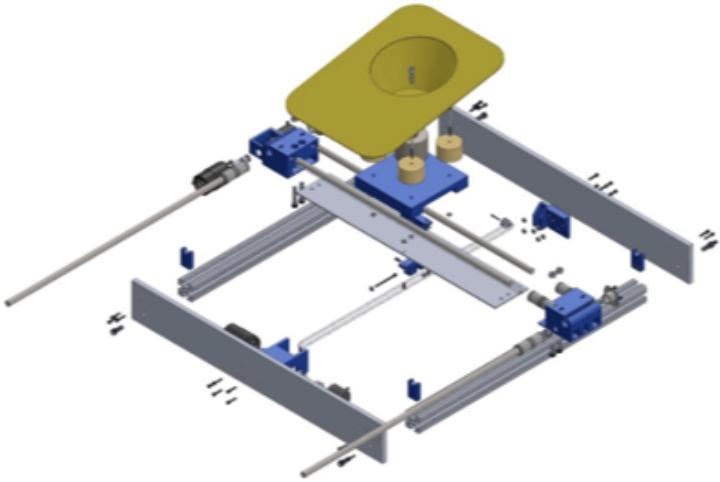
Made from scrap steel!



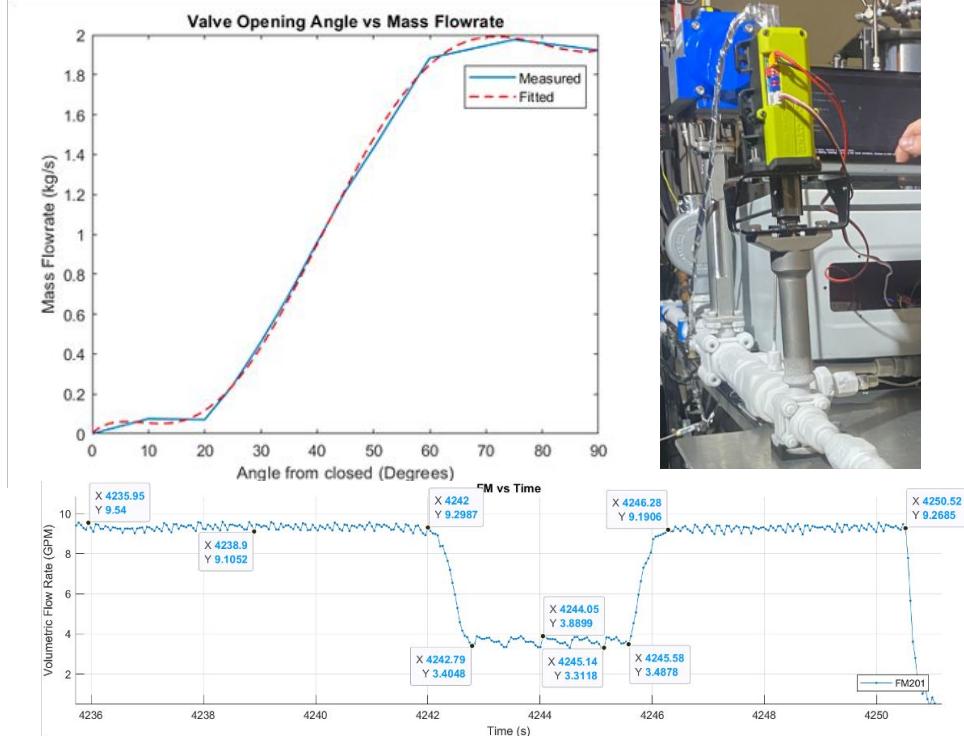
*CAD's cool, but there's nothing like
watching your team's hardware rock IRL!*



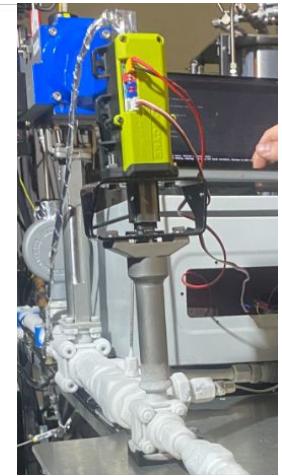
Other Projects



Stereoscopic Vision Beanbag-Catching Robot



USC LPL: Closed-Loop Throttle Valve Control



Making Beyond Engineering

(even when it's not, it's always engineering)



Hand-shaped + glassed surfboard reclaimed from broken board (composite layup process)

Goes like a dream!



Laser-engraved redwood coasters



President of USC's largest outdoors club, led team of 50



Hand-embroidered pants



Giant shark parade float for local middle school

Surf Camera: Project Overview

Aug 2025 - present:

I want surfing clips of myself + friends. There's an existing product, but it has this bulky wearable and costs \$1500.

I can do better.

Goal: Build MVP under Industrial Design constraints, provided by friend [Jackson Rench](#) (Eight Sleep)

Deliverables:

Camera Base Board + Housing
Wearable Device Board + Housing

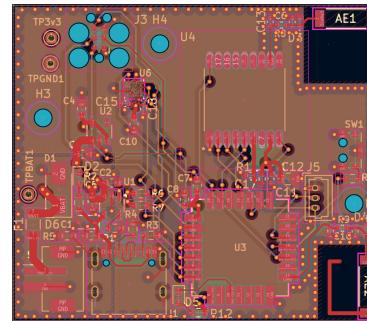
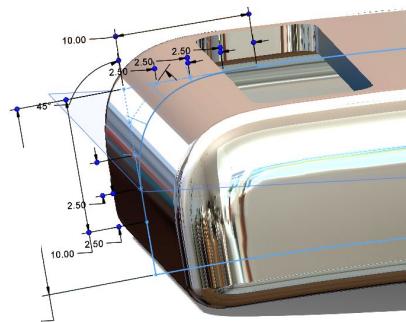
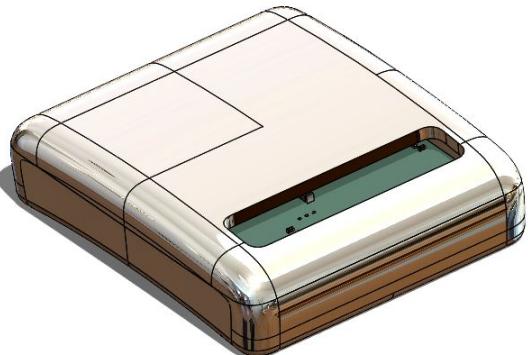


*It will be so cheap and easy
I won't feel bad if it gets
stolen from the SF dunes
while I surf*

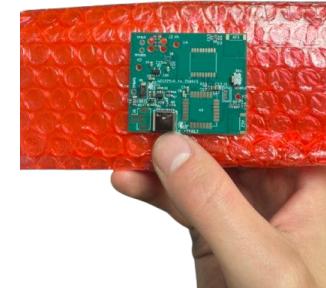
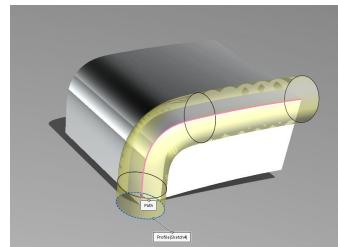


Design with ID Constraints

Given G2+ ID concept, add functional features (RF window, PCB mounts, o-rings, screw bosses/holes)



Layout: note RF grounding +
keepouts for integrity, Pi-pad
for antenna tuning.
Hand pic for scale



Kelp Head-influenced
camera base concept

1. Design + validate housing around PCB
2. Shrink housing → design new PCB to fit