



# Mark Menezes Portfolio

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# Content

## **Formula SAE:**

26-27 – Chassis Design Lead

25-26 – Ergonomics Lead and Chassis Design Engineer

24-25 – Steering Design Lead

23-23 – Chassis Apprentice

## **Summer Internships:**

‘26 – Canon Nanotechnologies (Austin, TX)

‘25 – Robotics Automation and Design Lab (College Station, TX)

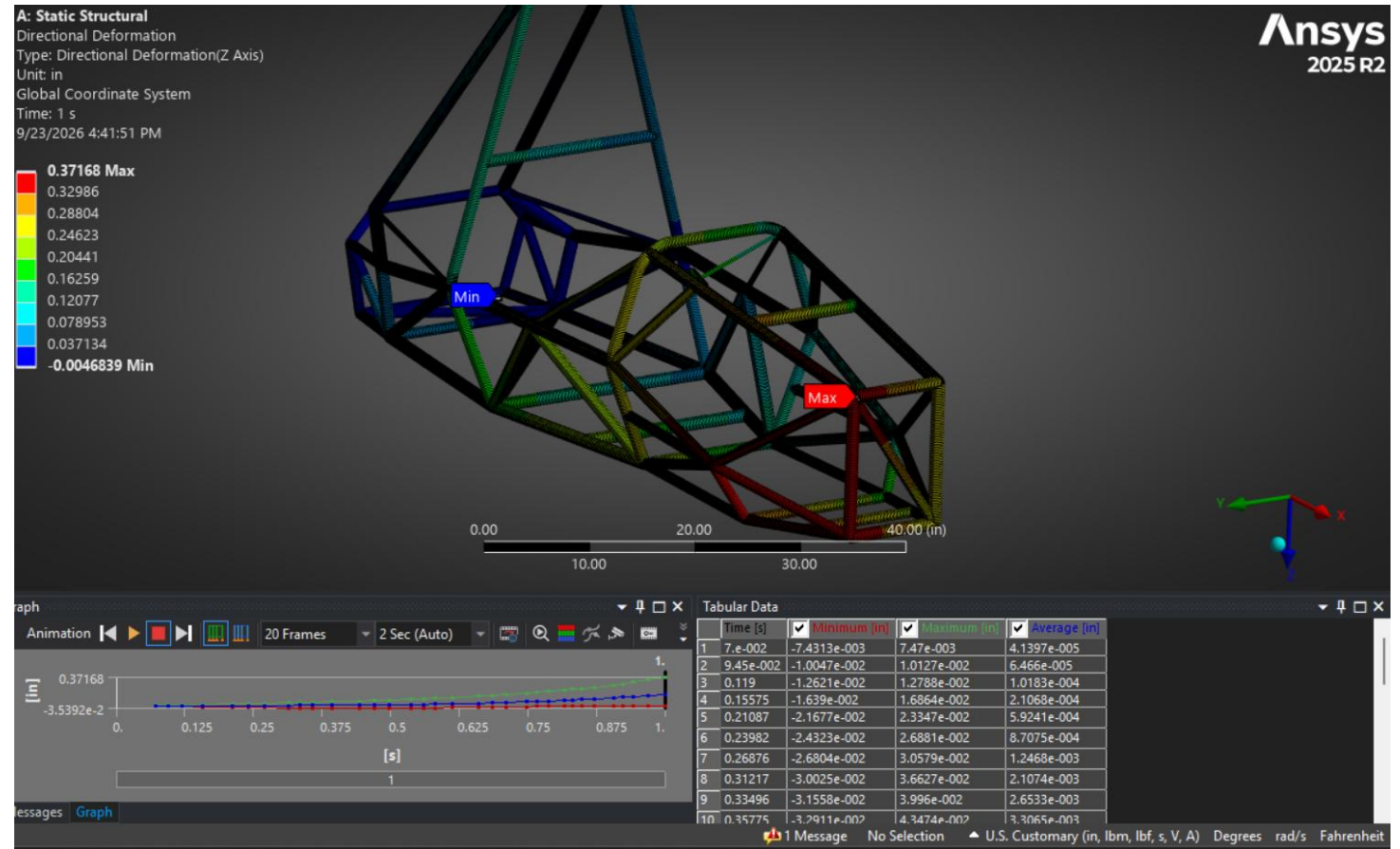
‘24 – Robotics Automation and Design Lab (College Station, TX)

# 2026 – 27 FSAE

This season, I am leading the design of the chassis, simulation, and manufacturing.

This chassis will have significant improvements over the previous season design:

- ~7 lbs lighter
- 50 ft-lb/deg stiffer
- Manufactured 1 month earlier
- Simulations in ANSYS with a solid body mesh
  - Goal of more “characteristic” simulations results
  - \*Stiffness is to be physically validated



More content will be added as the project continues

# 2025-26 FSAE

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Over this season, I led the development and integration of the chassis subteam.

My roles included:

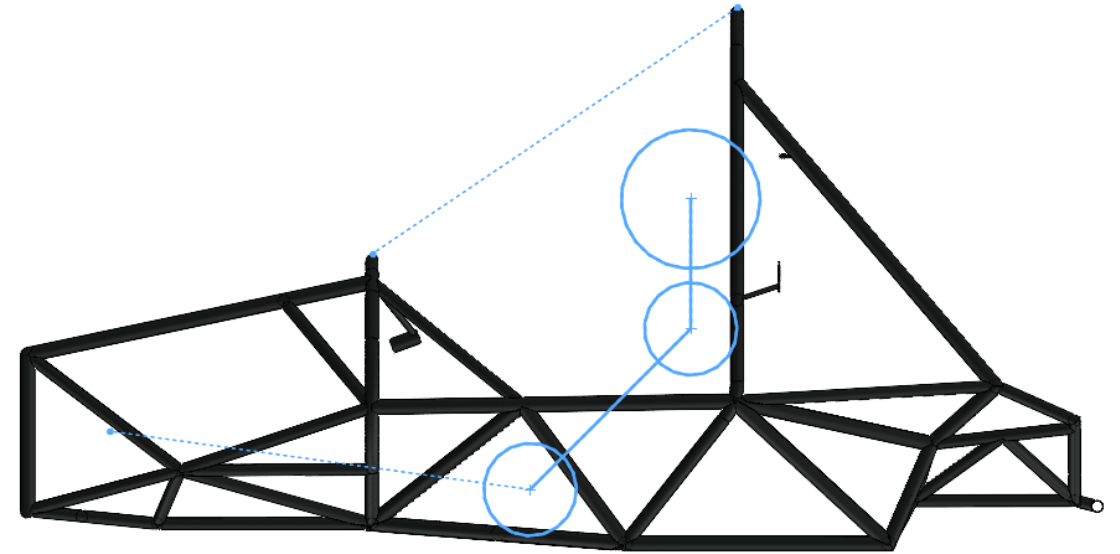
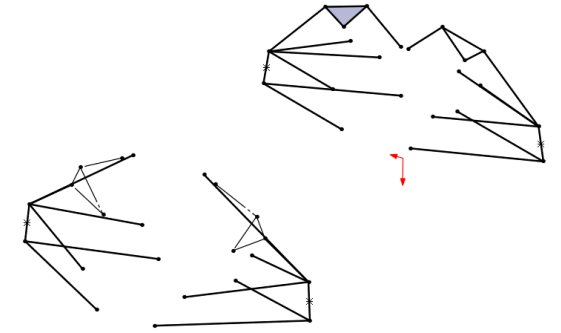
- Designing and simulating the chassis vehicle
- Managing the CG and polar moment of the vehicle
- Integrating all other subteams
- Designing all ergonomic components



# Design and Simulation

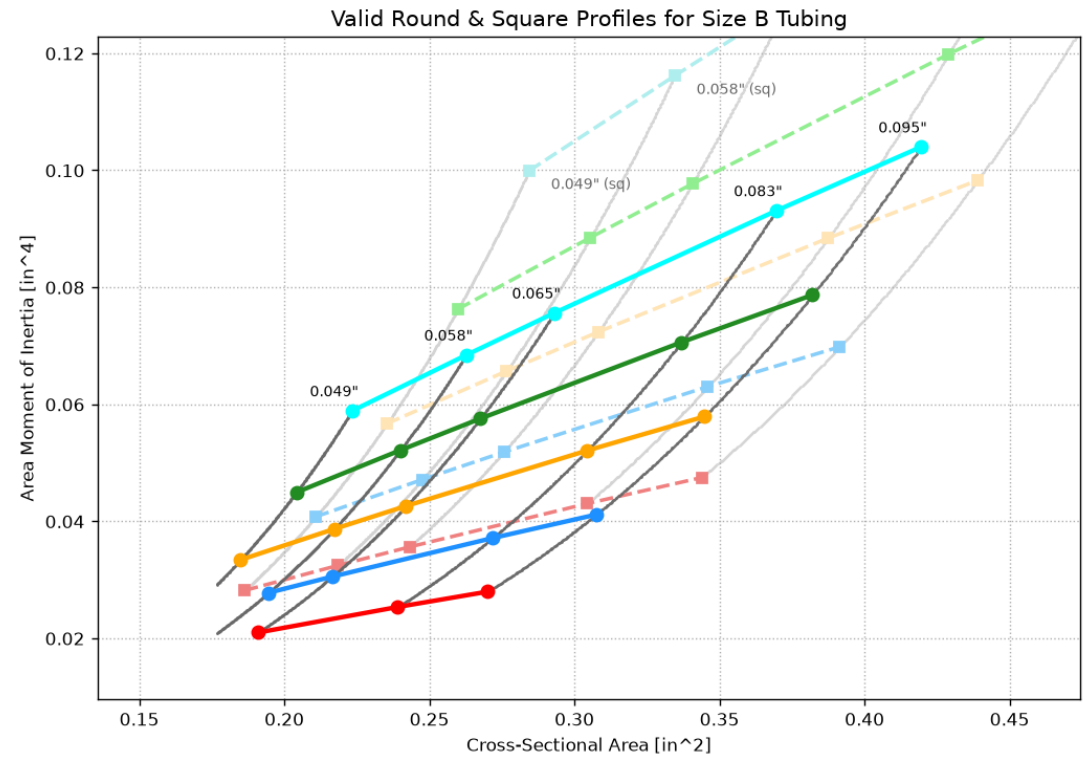
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- Suspension points that need to be triangulated with chassis nodes to efficiently distribute forces
- Other sub teams have space claims for their components
  - To efficiently package components, I developed a CG and polar moment calculator
- This season, I developed an ergonomics rig to accurately determine the driver's preferred positioning for ergonomic components
- Minimum tube moment of inertia and outer diameters are set by rules, I wrote a script to determine the lightest tube that meets the minimum requirements



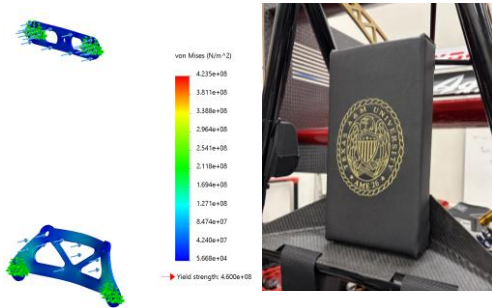
| Subsystem          | Weight (lbs) | X-pos (in)          | Y-pos (in) | Z-pos (in)         | Mx (in*lb) | My (in*lb) | Mz (in*lb) |
|--------------------|--------------|---------------------|------------|--------------------|------------|------------|------------|
| Chassis            | 82.84        | 35.30               | 0.35       | -13.41             | 2924.53    | 29.21      | -1110.56   |
| Powertrain         | 90.27        | 6.62                | -0.01      | -11.81             | 597.67     | -0.80      | -1065.82   |
| Battery            | 83.27        | 18.26               | 0.02       | -5.38              | 1520.49    | 1.53       | -448.11    |
| Electronics        | 15.25        | 27.42               | 1.92       | -17.98             | 418.16     | 29.35      | -274.19    |
| Aerodynamics       | 35.05        | 19.86               | 0.00       | -10.22             | 695.94     | 0.00       | -358.17    |
| Suspension         | 79.58        | 33.37               | 0.08       | -9.03              | 2655.30    | 6.76       | -718.57    |
| Driver             | 175.00       | 34.55               | 0.00       | -10.00             | 6046.25    | 0.00       | -1750.00   |
|                    |              |                     |            |                    | 0.00       | 0.00       | 0.00       |
|                    |              |                     |            |                    | 0.00       | 0.00       | 0.00       |
| Total Weight (lbs) |              | CGx (in)            |            | CGy (in)           |            | CGz (in)   |            |
| 561.25             |              | 26.47               |            | 0.12               |            | -10.20     |            |
| Wheelbase (in)     |              | Front Axle (lbs, %) |            | Rear Axle (lbs, %) |            |            |            |
| 60.50              |              | 245.59              |            | 315.66             |            |            |            |
|                    |              | 43.76%              |            | 56.24%             |            |            |            |
| Track Width (in)   |              | Left (lbs, %)       |            | Right (lbs, %)     |            |            |            |
| 50.00              |              | 279.31              |            | 281.95             |            |            |            |
|                    |              | 49.76%              |            | 50.24%             |            |            |            |

CG Tracking Calculator

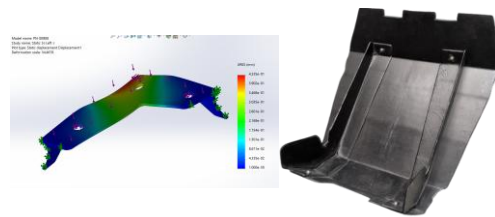


Example Tube Optimization  
(CSA vs MOI)

- 1" Round
- 1" Square
- 1.12" Round
- 1.12" Square
- 1.25" Round
- 1.25" Square
- 1.38" Round
- 1.38" Square
- 1.5" Round
- 1.5" Square



Headrest Design



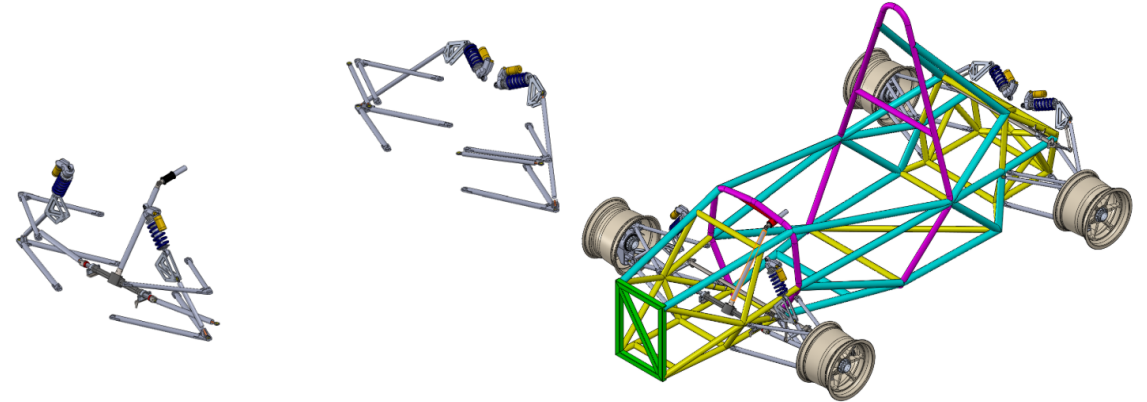
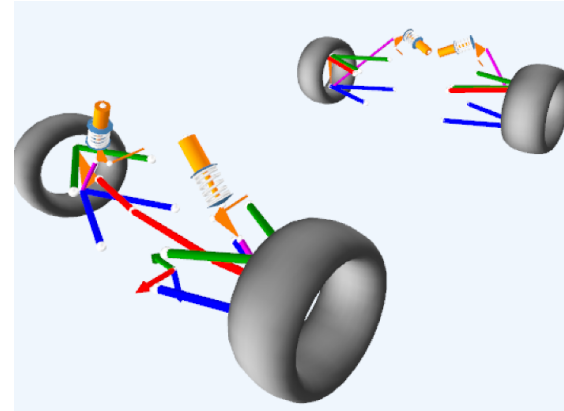
Composite Seat  
and Tab Design

# 2024-25 FSAE

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This season, I led the steering development and manufacturing.

I also developed an algorithm to convert geometry from OptimumK (Vehicle dynamics sim, top left) to Solidworks (Design sim, remaining 3 pics)



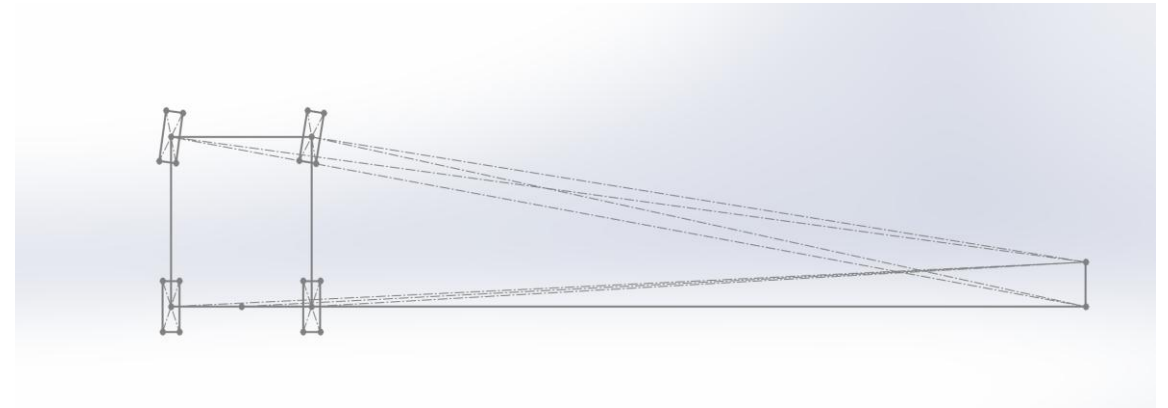
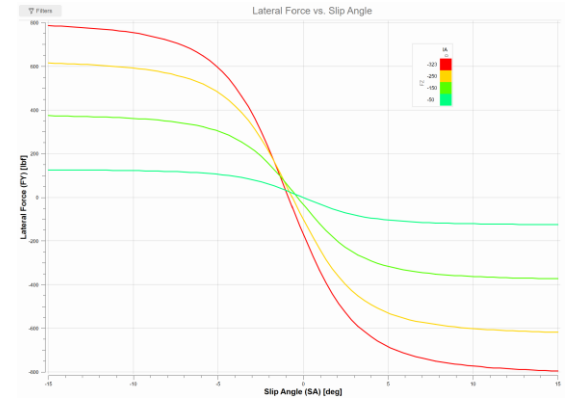
# Kinematic Design

I based the steering design around the skidpad event.

Used tire and load transfer data to target slip angle with peak lateral grip.

Managed steering effort through custom calculator.

|                                    |          |
|------------------------------------|----------|
| Tire Self Aligning moment          | 22       |
| Cornering force                    | 443      |
| Mechanical Trail                   | 0.35     |
| Moment (in-lb)                     | 155.05   |
| Moment (ft-lb)                     | 12.92083 |
| Aligning moment (ft-lb)            | 34.92083 |
| Tie Rod moment arm upright (in)    | 2.97     |
| Force in Tie Rod (lbf)             | 141.0943 |
| Radius of steering wheel (in)      | 3.74     |
| Linear displacement for 1 rev (in) | 23.49911 |
| Rack ratio                         | 0.14724  |
| Force on steering wheel (lb)       | 20.77466 |
| Steering torque (ft-lb)            | 6.474771 |
| Steering torque (N-m)              | 8.805688 |



# 2023-24 FSAE

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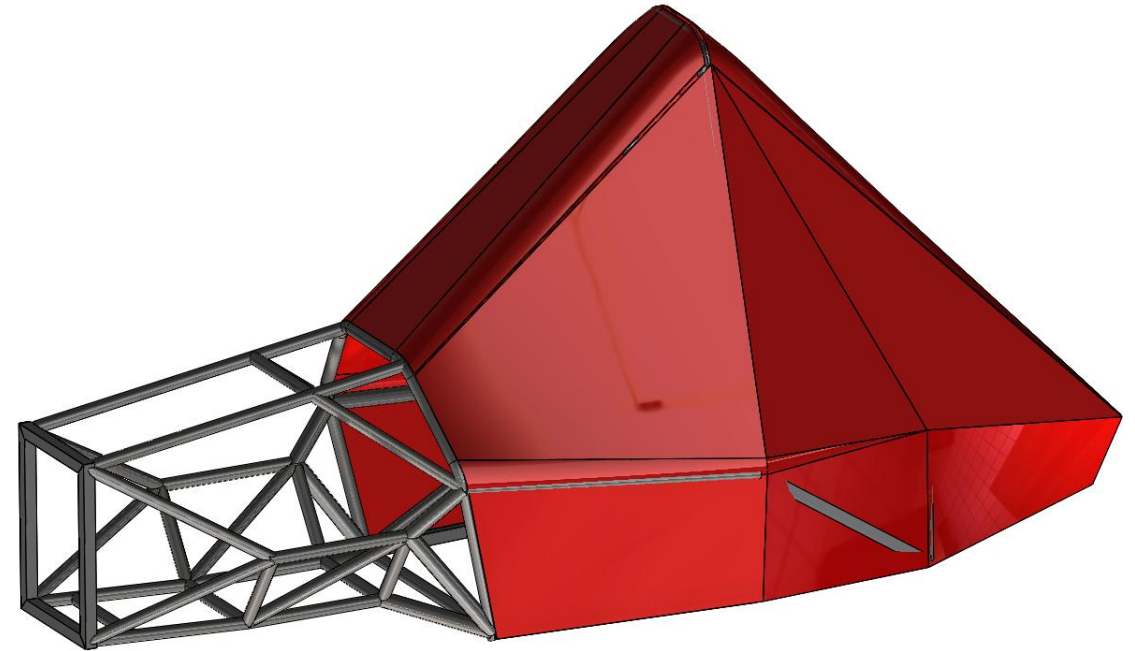
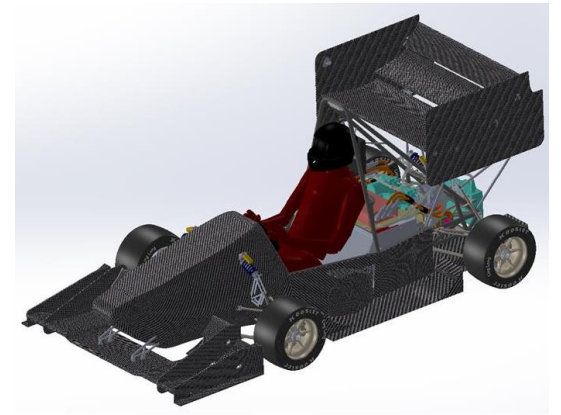
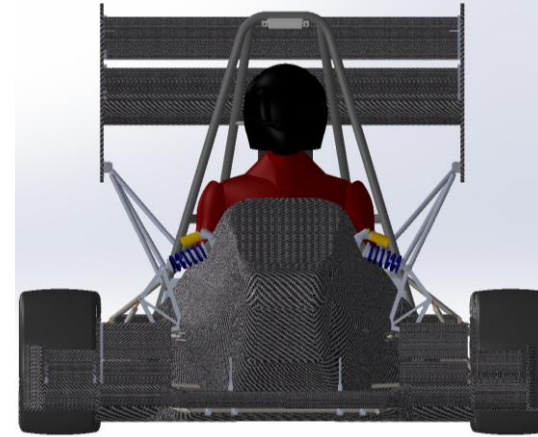
Designed 1:1 scale articulatable driver model and mapped rollover envelope

## Driver model

- Allowed for positioning of pedals, seat, steering wheel, and headrest
- Also served as a design parameter for various rules required clearances

## Rollover Envelope

- Developed a parametric bound to verify component packaging legality



# Summer Internships

# Canon Nanotechnologies – Summer '26

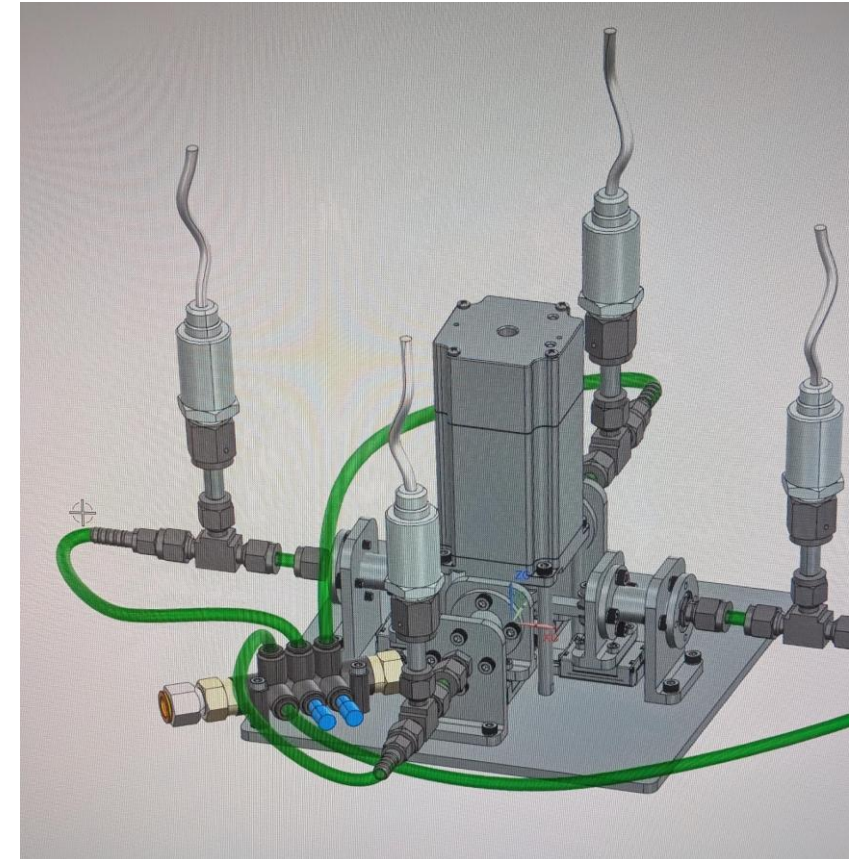
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## **An NDA limits what I can present**

I designed and manufactured a fatigue testbed of vacuum components for the wafer lift mechanism. This condensed the testing cycle from over one year to two weeks

Additionally, I developed all the software to run the testbed and read data coming from the sensors, motor, and Bluetooth modules in C++. I also made a separate dashboard to enable live data analysis.

My final project involved designing and assembling an enclosure to test resist curing under high-power UV LEDs. The enclosure increased operator safety and reduced sample testing time.



# Robotics Automation and Design (RAD) Lab - Summer '25

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Due to the sensitive nature of the work, I can provide limited content

2025 – Manipulator Group:

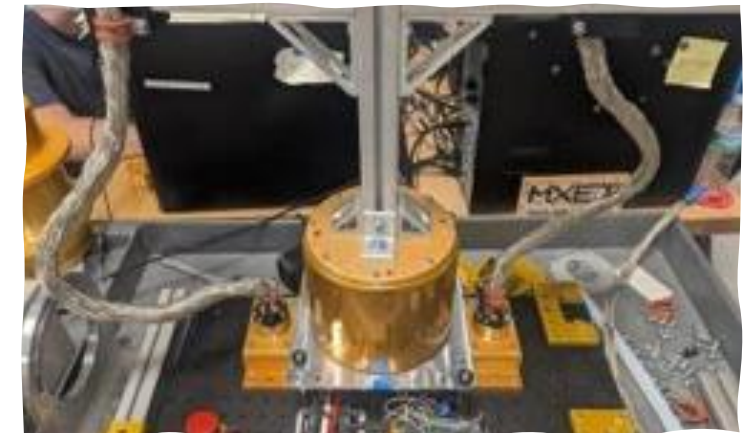
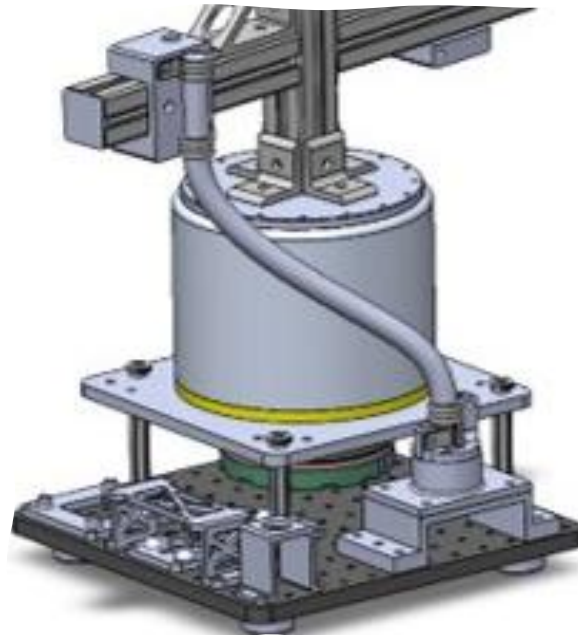
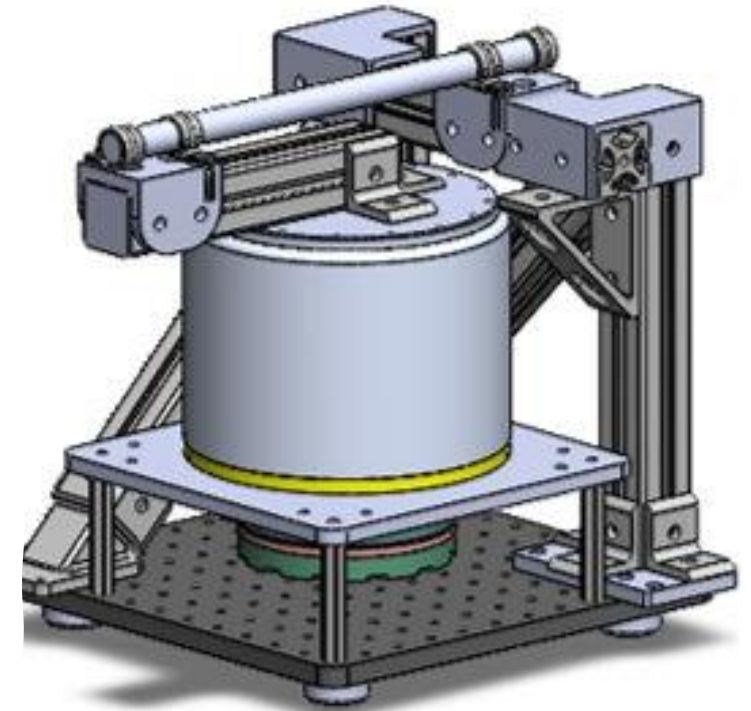
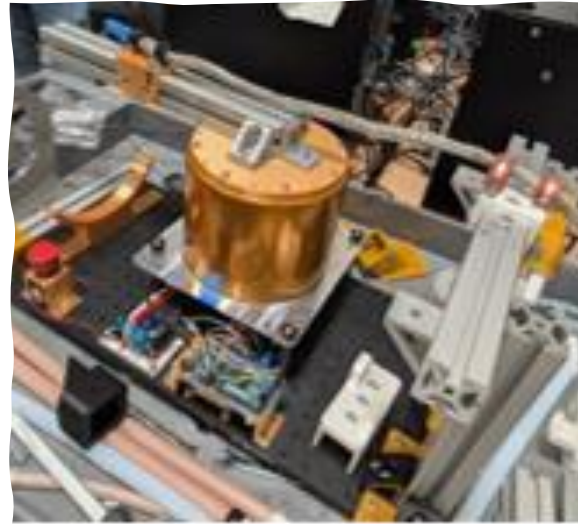
- Designed and Manufactured a parasitic torque testbed (next slide)
- Encoder flatsat tester
  - Testing apparatus for custom motor controllers
- Redundant arm mock-up
  - For navigating harnessing and generating assembly instructions
- Custom PCB mounts
  - Mount PCBs to optical tables
- Wire harnesses
  - Designed harnessing for absolute encoders to custom Harwin pinouts



# Parasitic Torque Testbed

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Determine parasite torque generated from external power and fluid cables on space-rated robotic arms. Tested infinite mounting positions and two load cases (pitch and roll)



# Robotics Automation and Design (RAD) Lab – ‘24

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2024 – Space Modular Manipulator (SMM) Group:

- Developed minimum bolt size calculator through VBA
  - Given desired preload, material thicknesses, bolt strength would output bolt size (metric and customary)
- 1 million cycle wire fatigue testbed
  - Tested torsional fatigue for power cables running through the bore of the actuator in a TVAC
- 3<sup>rd</sup> generation harmonic drive actuators
  - Developed optimized actuators with reduced mass, outer diameter, length, and 100% internal diameter optimization (controlled so no pictures)

