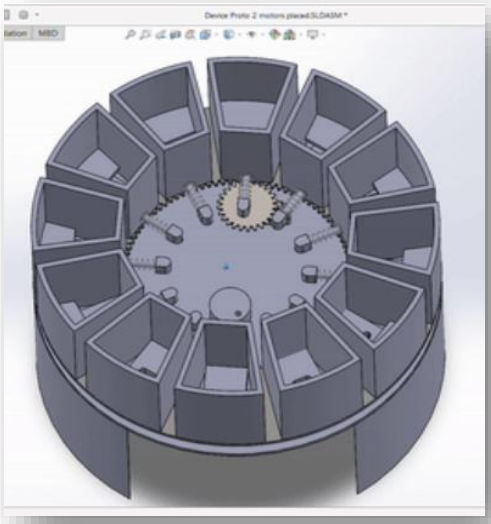
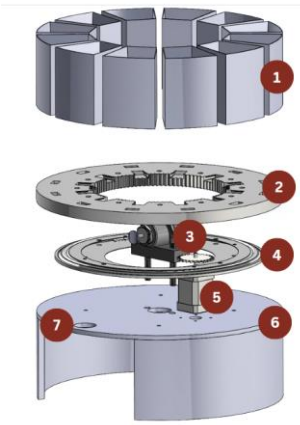
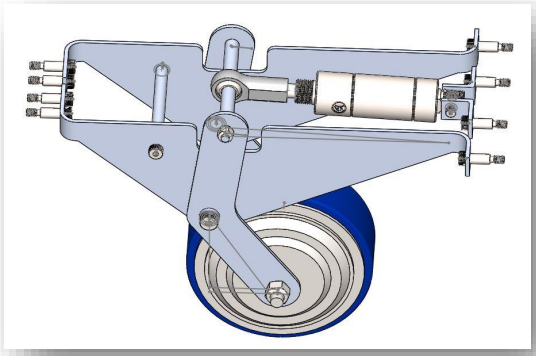
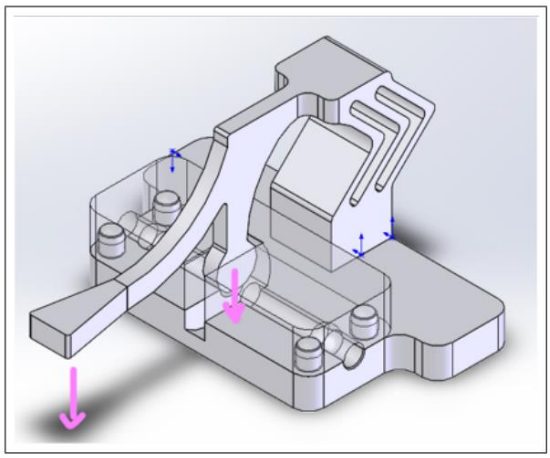
MECHANICAL PROJECTS

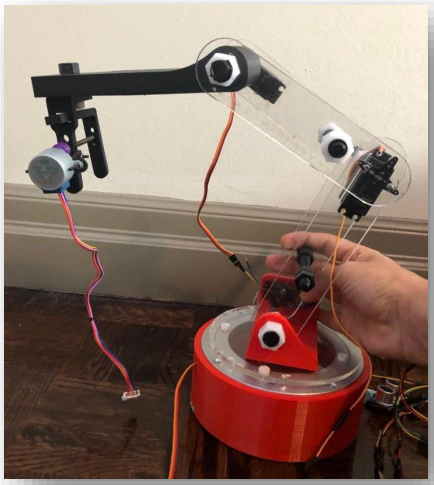


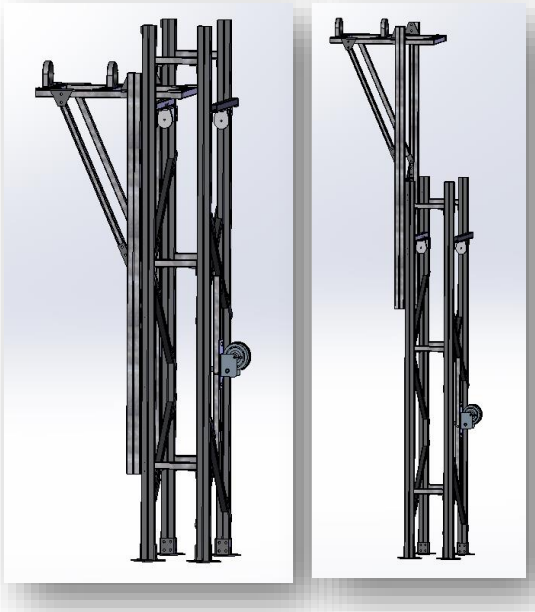


1. Spice Containers
2. Gear plate
3. Solenoid
4. Ball bearing plate
5. Stepper motor
6. Base
7. Dispensing hole



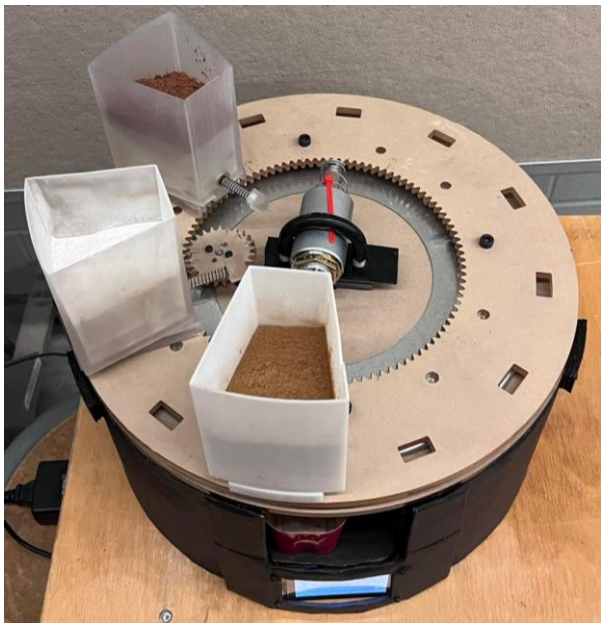


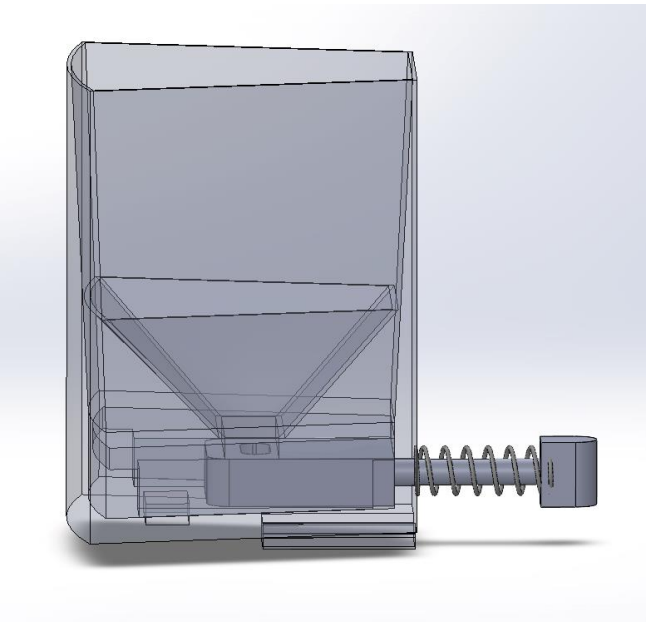




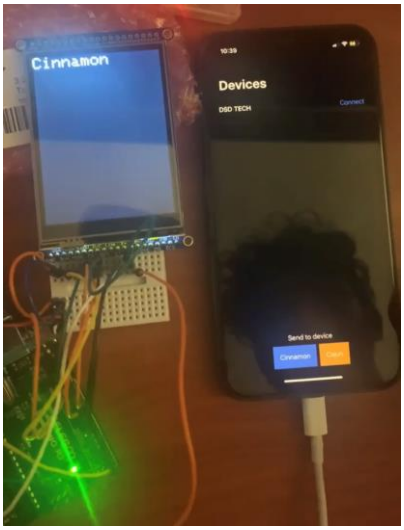
SMART HOME SPICE BLEND MAKING DEVICE

Mechanical: Individual “spice dispenser” capable of dispensing powders with a range of sizes accurately. A system containing a solenoid and thrust bearing to actuate 12 different “spice dispensers”.
Electrical: Arduino connected to iPhone app via Bluetooth and a touch screen. Stepper motors and limit switch responsible for accurate rotation





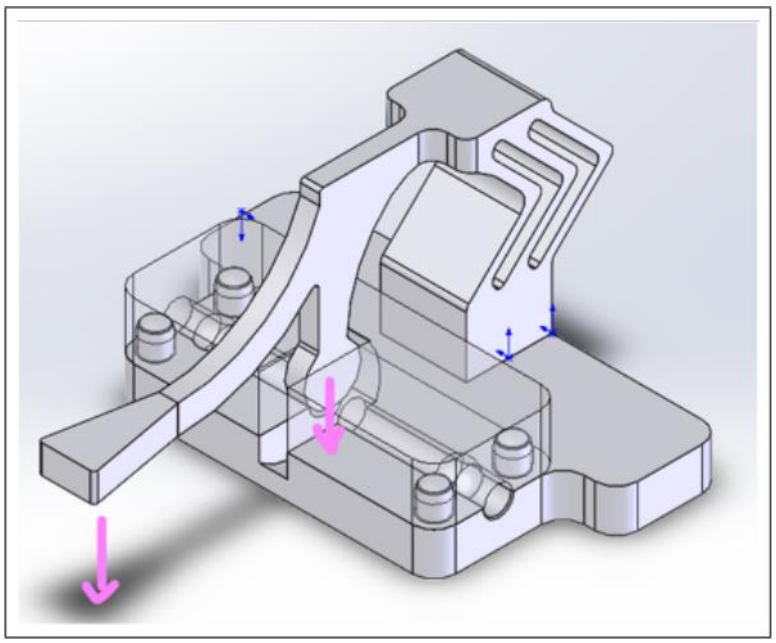
Overall Device & Individual spice dispenser



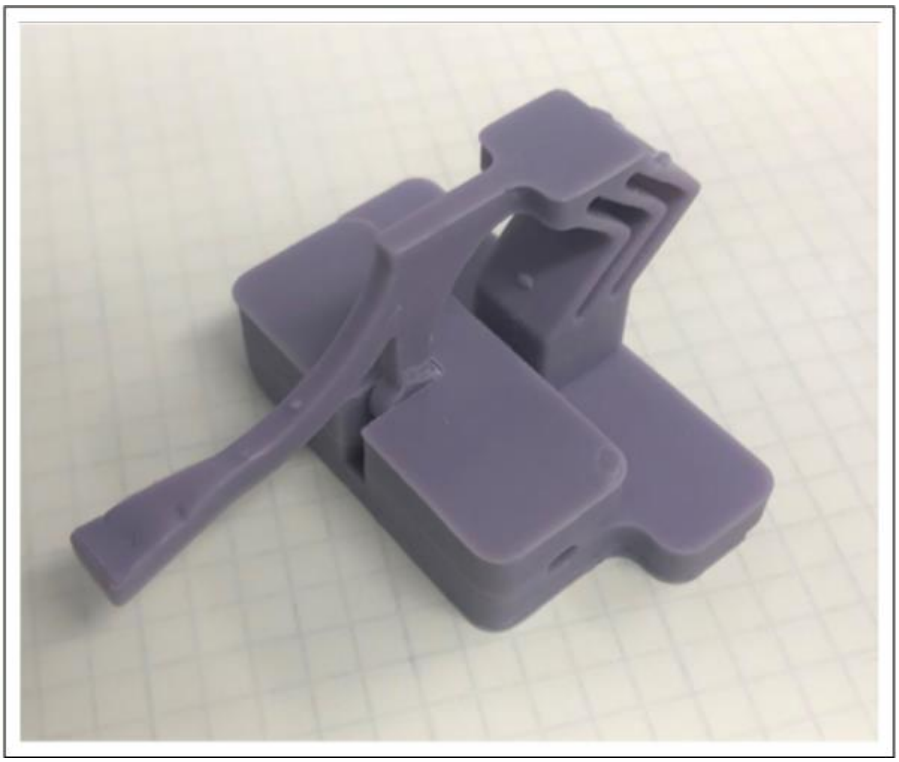
Screen to Phone Connection

LIMIT SWITCH USING A COMPLIANT MECHANISM

Aim: The neutron electric dipole moment experiment at Triumf is done by very accurately controlling the magnetic field. A limit switch is required but existing limit switch are made from steel which affects the magnetic field. An entirely non-magnetic limit switch was required.



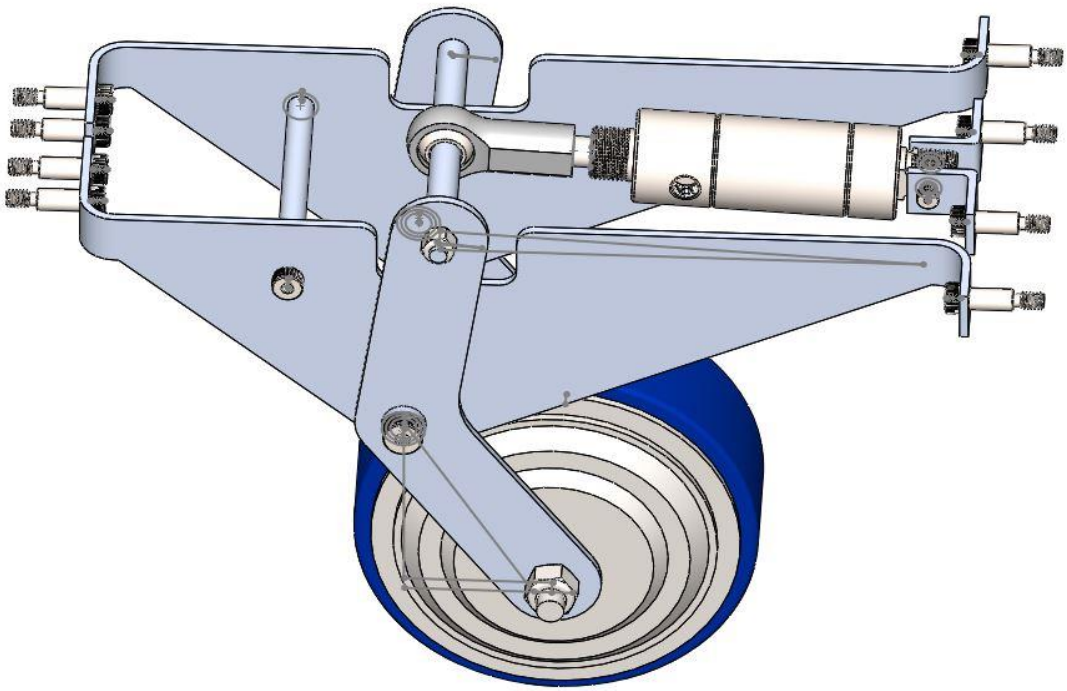
SolidWorks Design



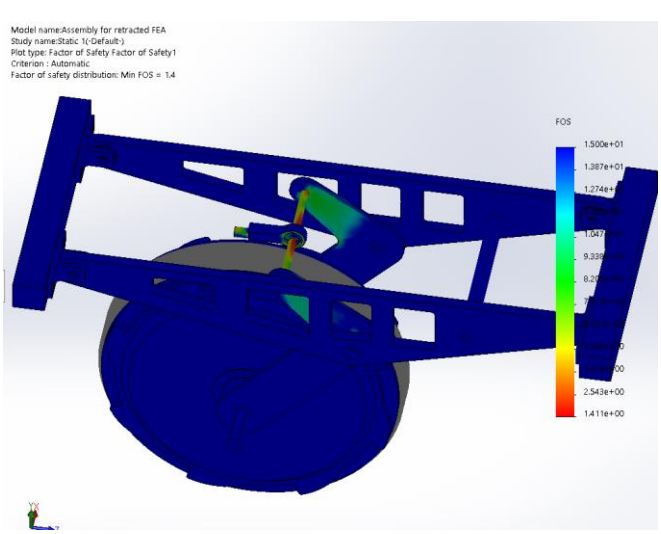
Final SLA 3D Printed Part

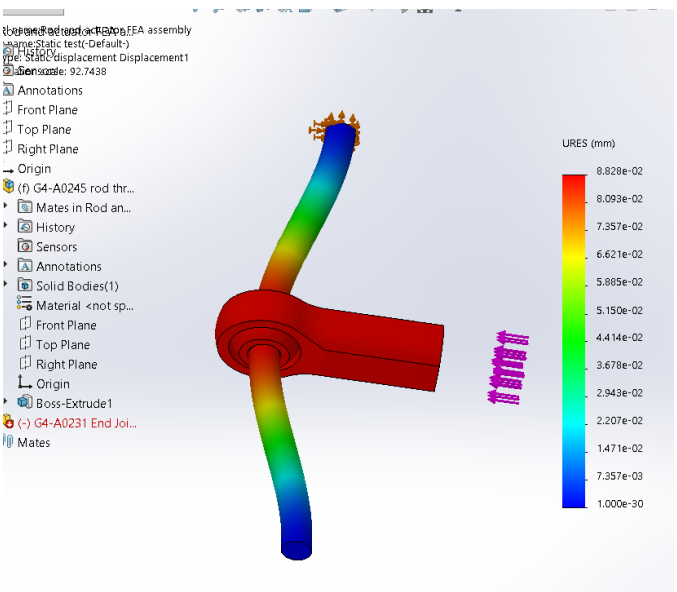
RETRACTABLE ELECTRIC DRIVE SYSTEM

Aim: Design a robust retractable drive system for the hyperloop team
Uses a Bafang hub motor actuated by a pneumatic actuator through a pivoting arm. Inspired by glider landing system design



SolidWorks Design

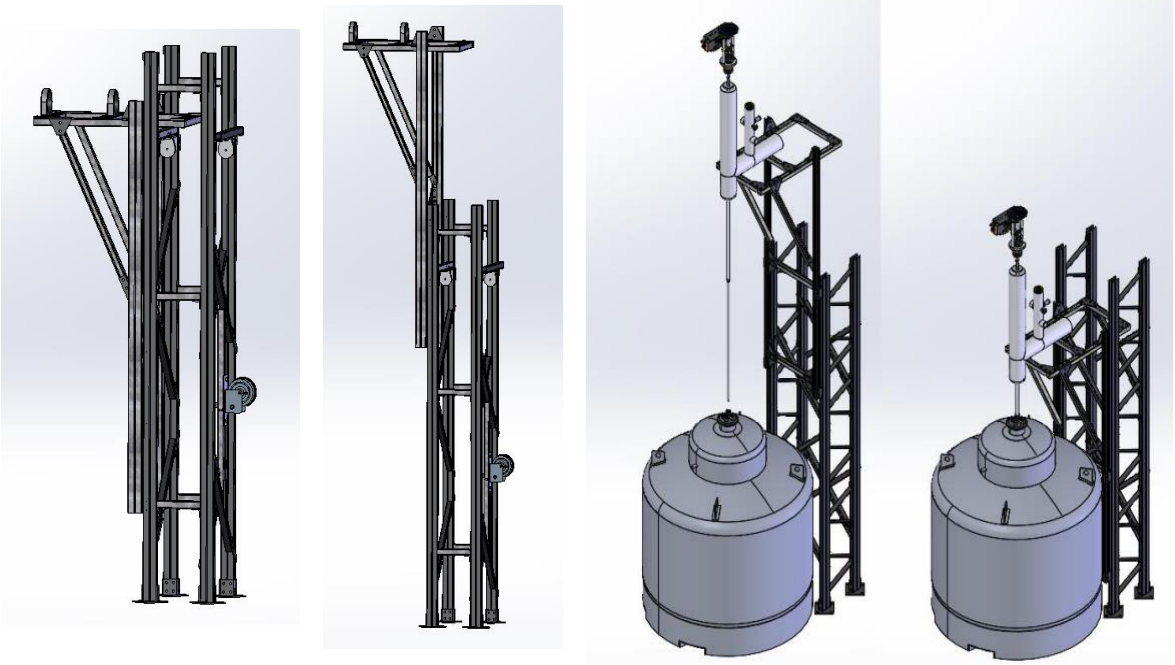




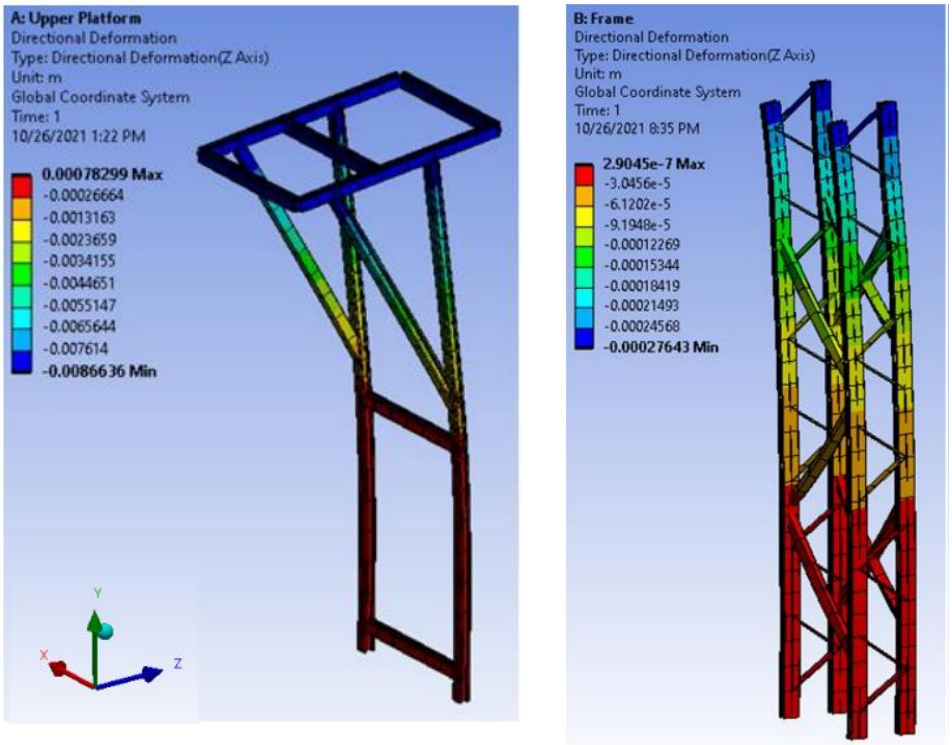
FEA Simulations

SLIDING SUPPORT STRUCTURE

Aim: Design and build a Unistrut structure capable of precisely moving a large stinger into a liquid helium tank
Uses a winch and pulley system with rails to lift and lower structure



SolidWorks Design



FEA Simulation

AUTONOMOUS ROBOTIC ARM PROJECT

Aim: Make the simplest/cheapest autonomous robotic arm using rapid prototyping techniques.
Uses an Arduino and two ultrasonic sensors to detect the height of boxes. Controlled by 4 high torque servo motors

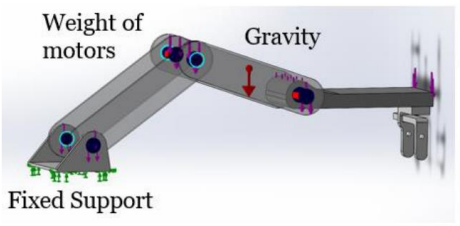
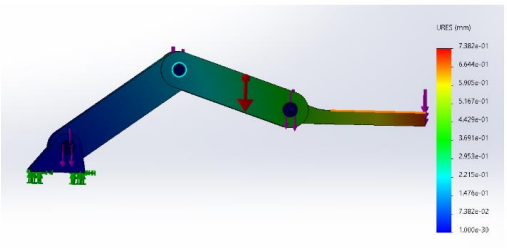
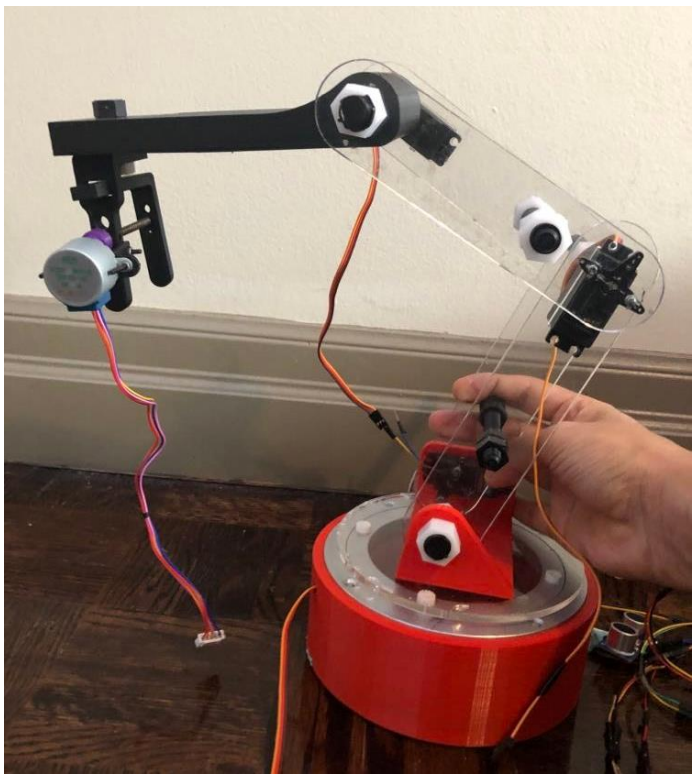


Figure 25: Forces acting on the Manipulator

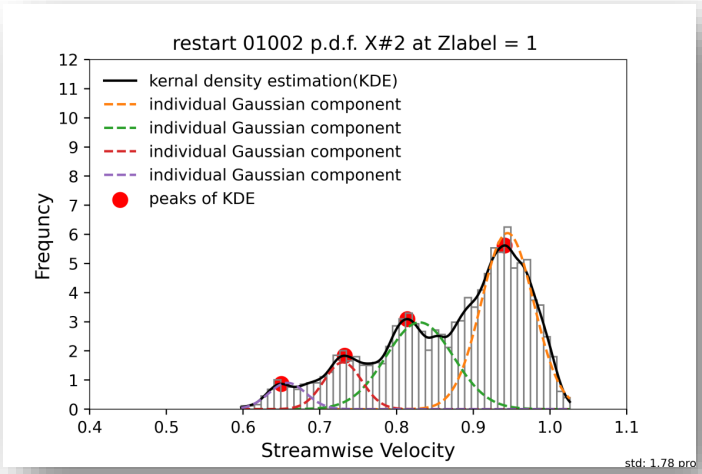


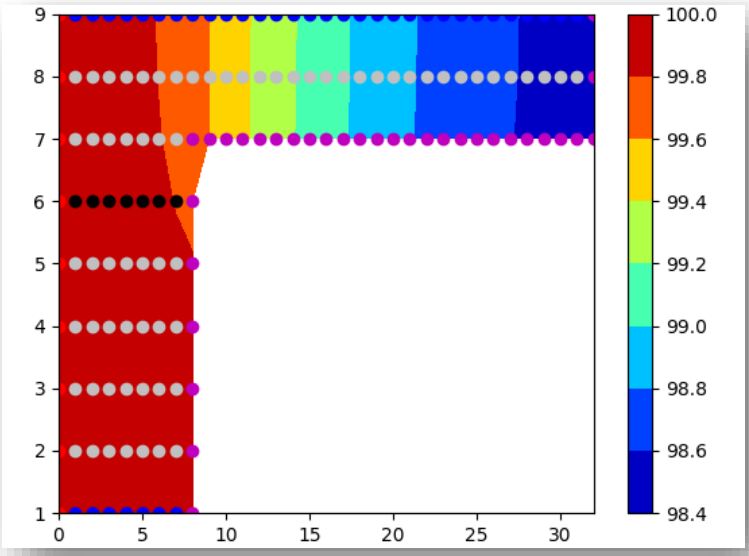
SolidWorks Design and FEA Simulation

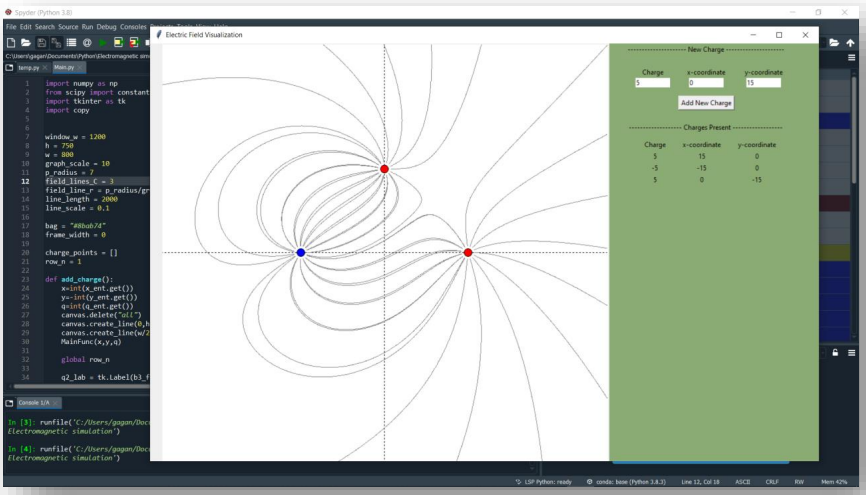


First Design Prototype

SOFTWARE PROJECTS

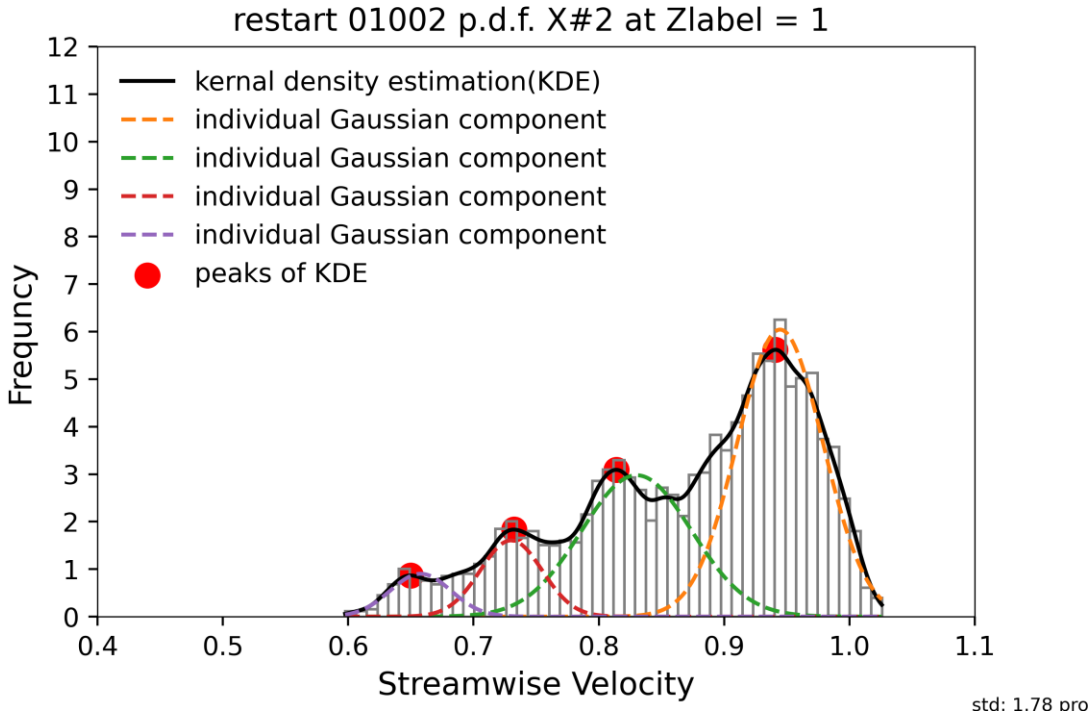




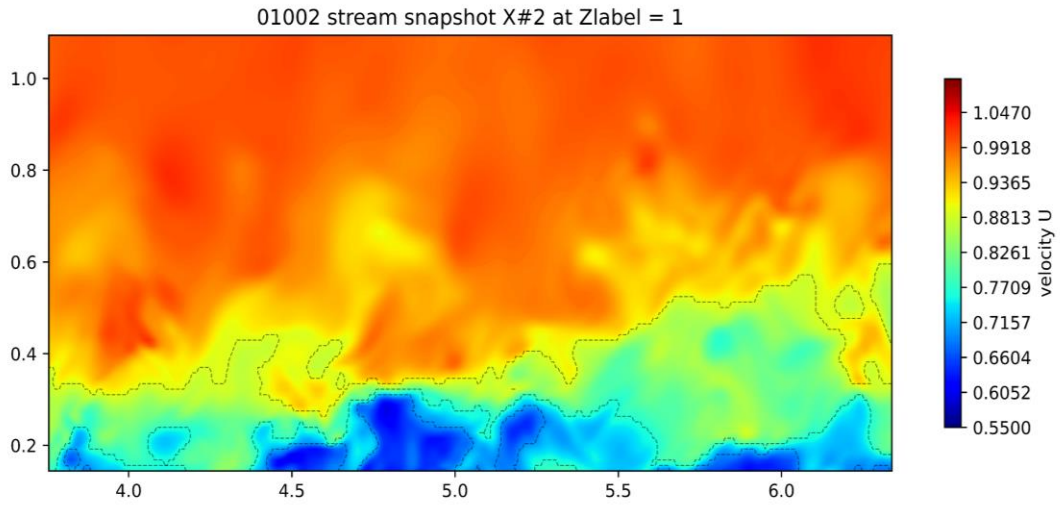


DATA-DRIVEN FLUID TURBULENCE RESEARCH

Uses the Gaussian Mixture Method ML model to deconstruct the fluid velocity distribution into separate “uniform momentum zones”. Statistics and visualizations were then obtained for the research paper
Supervisor: Prof. Jean-Pierre Hickey



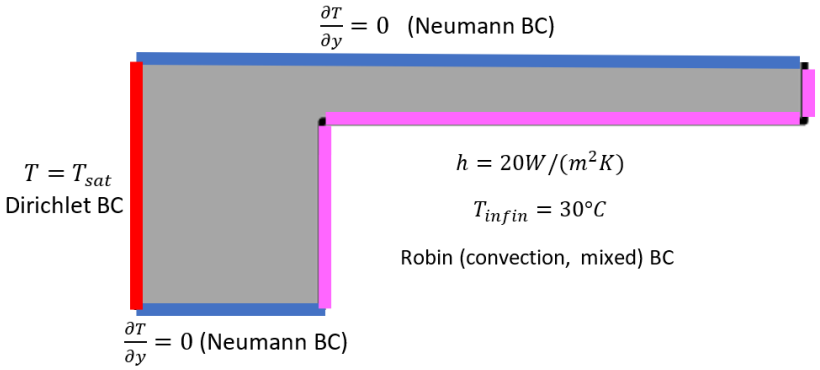
The gaussian components obtained from the algorithm



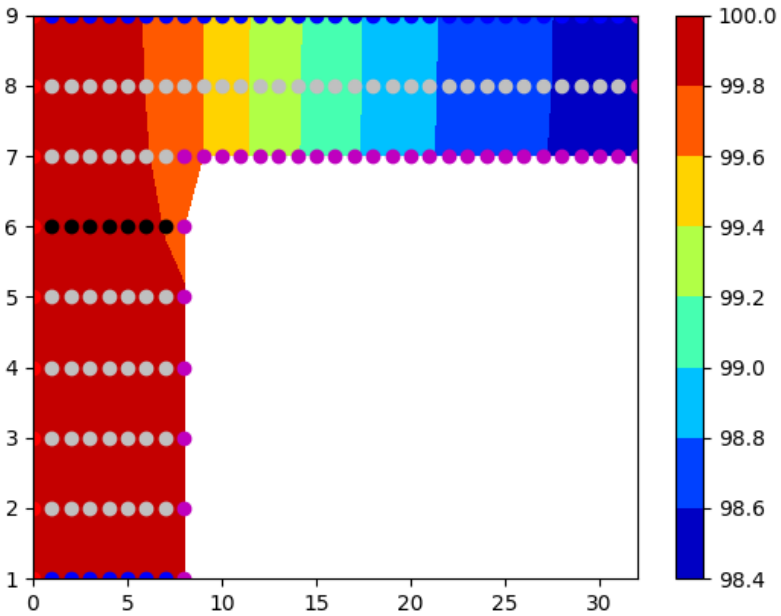
Boundary Layer Simulation Snapshot

HEAT CONDUCTION FEA CODE

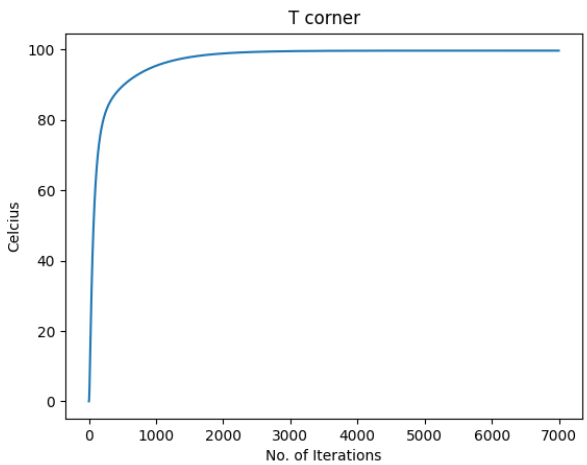
The temperature profile and total heat transfer from a fin was calculated using custom finite element code from scratch using python. The solution was validated using the analytic approach



Computational geometry and boundary conditions



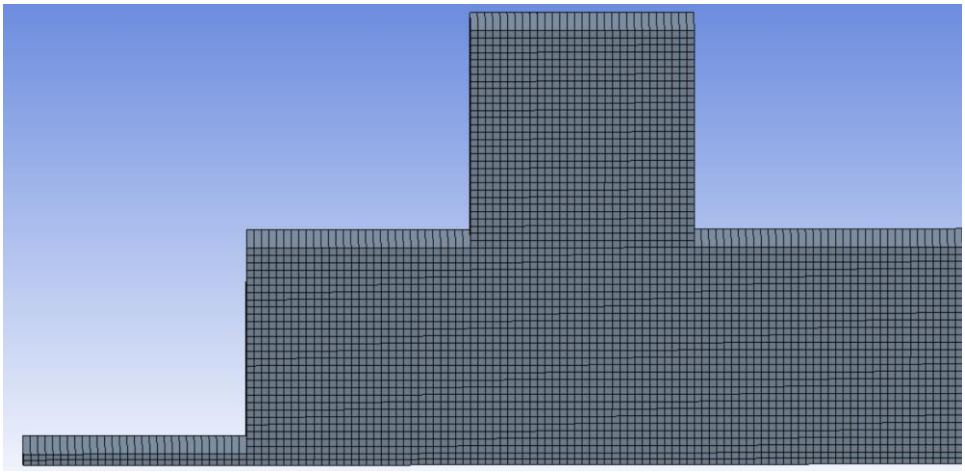
Final contour plot with node locations



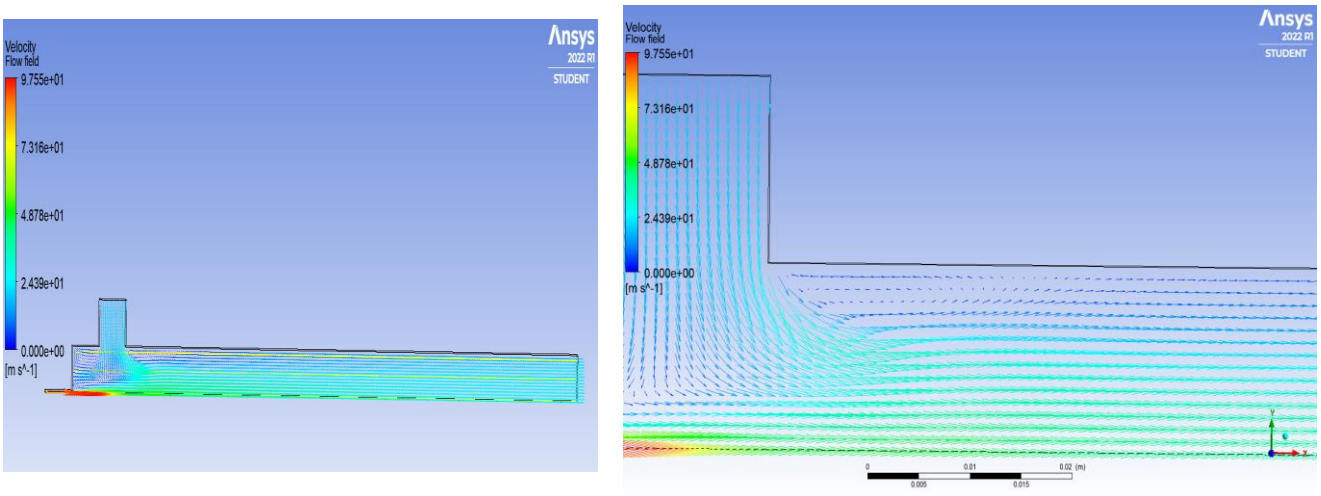
Convergence achieved

CFD OF A MIXING CHAMBER

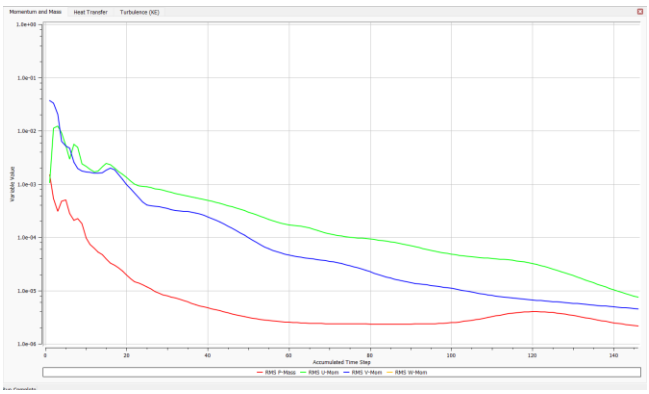
The effectiveness of mixing of fuel and air in a combustor was simulated using ANSYS CFX. The k-ε model was used as the turbulence model and temperature was used as an indicator.



Zoomed in view of mesh



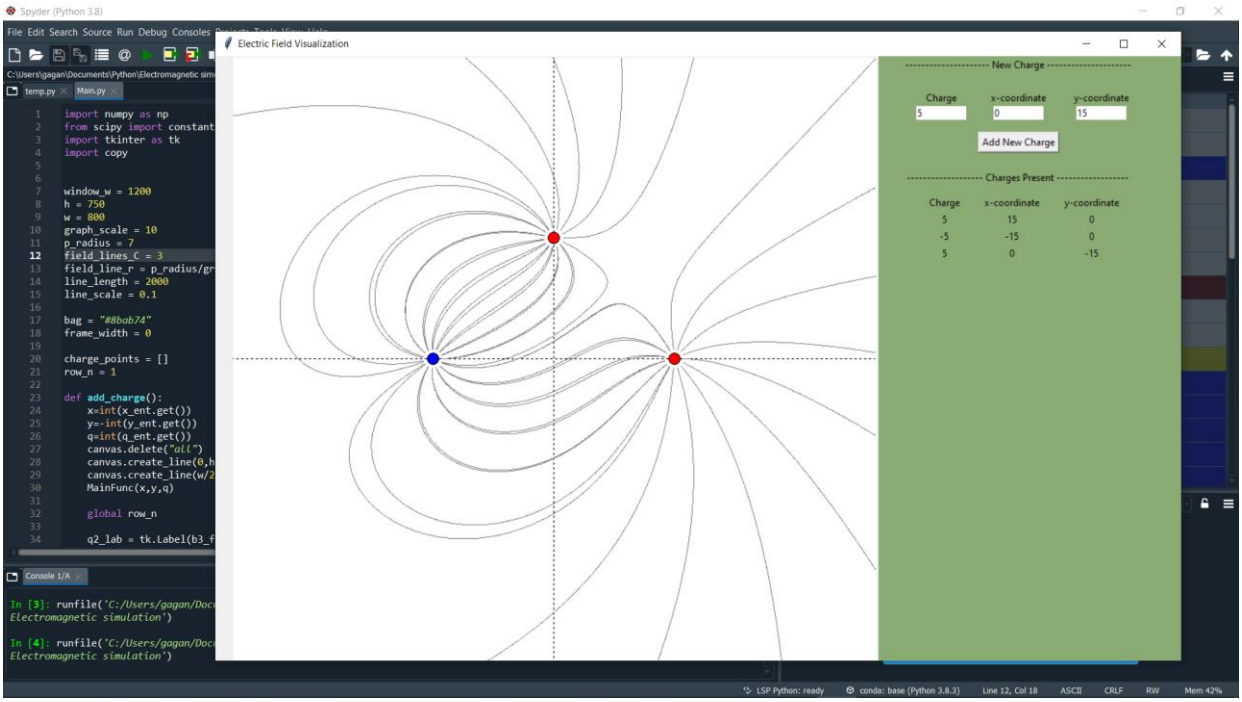
Velocity Field & zoomed in view of a separation bubble



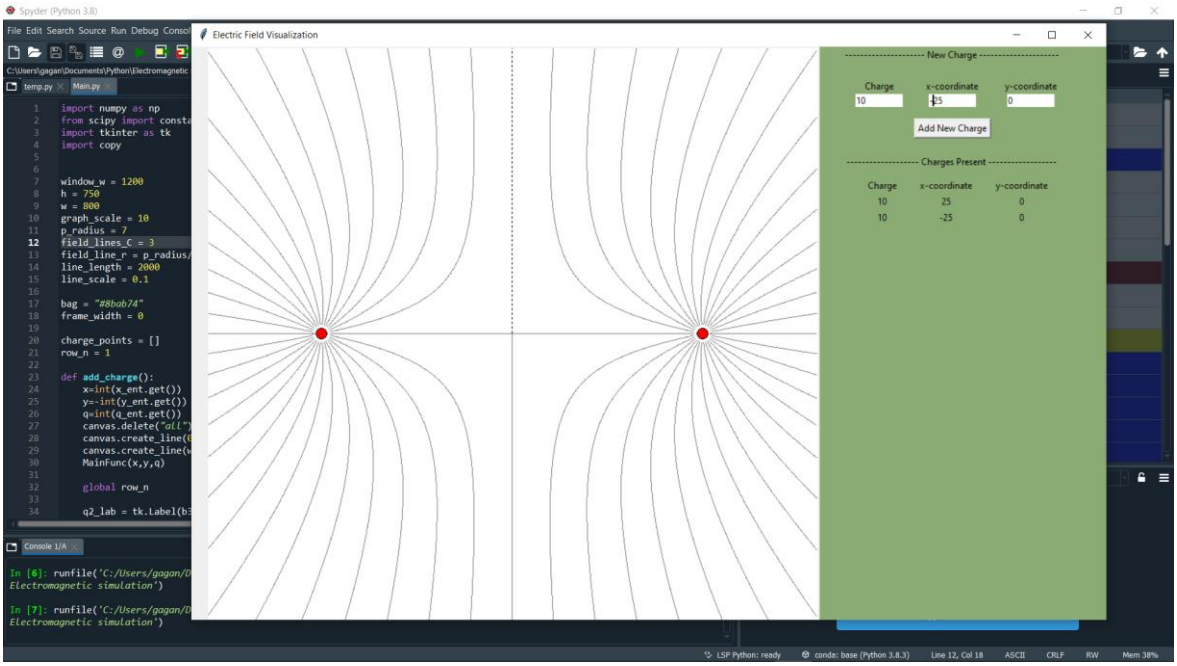
Residuals (convergence achieved)

ELECTRIC FIELD LINES SIMULATION PROJECT

Uses the Tkinter library and object oriented programming principles to allow the user to specify location and magnitude of point charges and generates the corresponding electric field lines.



Two positively charged and one negatively charged point charges



Two positively charged point charges