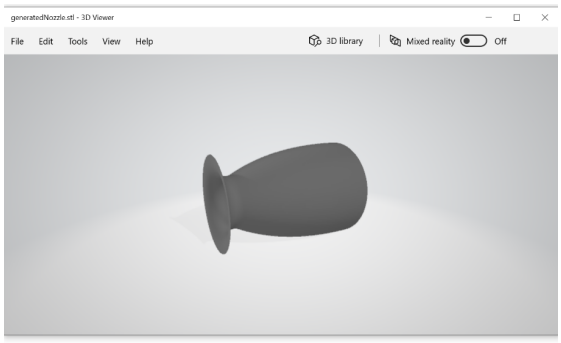
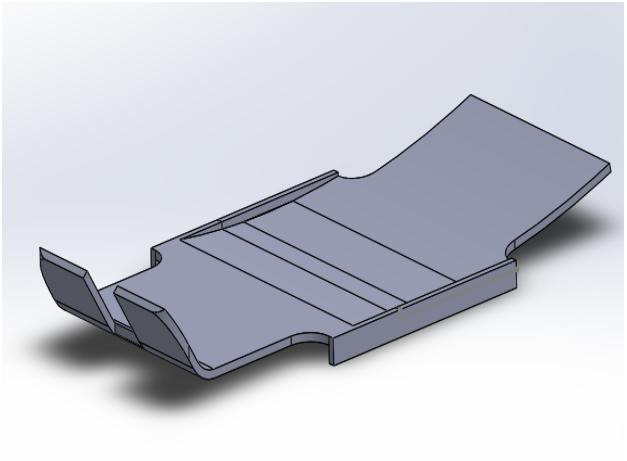
Portfolio

Supersonic Nozzle Website - cdnozzle.com

A website that uses approximate optimization and the method of characteristics to generate an .stl file of a supersonic converging-diverging nozzle given a few basic parameters. It ties together standard python, numerous python libraries, a flask framework, and basic web development skills to locally render an .stl file in seconds through your browser.



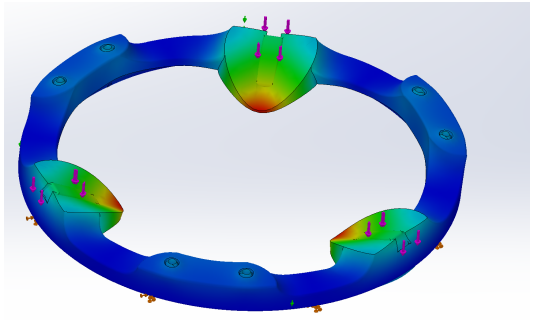
RC Car - Custom Floorboard



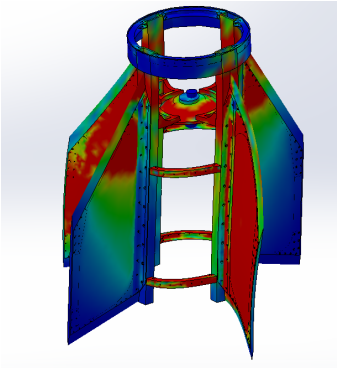
After watching the porpoising of F1 cars early in the 2022 season, I was interested in exploring the effect further. The proposing in F1 can mainly be attributed to regulation changes related to the floorboard of the car that emphasize the use of the ground effect. I was able to implement the ground effect on a smaller scale by designing and 3D printing a floorboard for my RC car that was inspired by an upside down airfoil, and the skirt of the Lotus 78. I tested my design in a make-shfit wind tunnel using a hair dryer.

Whistler-Blackcomb Rocket - Recovery Interface

This is the upper structure housing the recovery bay, roll-control system, avionics, and payload. I used topology optimization, buickling, and static simulations to test different properties of my design. It involved numerous iterations, and has since been manufactured and tested.



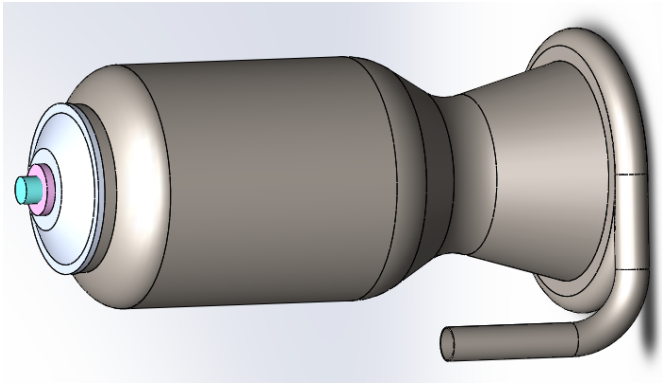
Whistler-Blackcomb Rocket - Thrust Structure and Fin Can



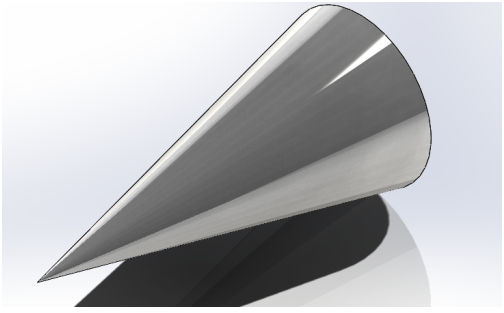
The thrust structure's purpose is to efficiently transfer the force produced by the engine to the rest of the rocket. My design has gone through various iterations to account for wind forces, and changes to the engine design. Like for the recovery interface, I have used topology, and static simulations throughout the design process to optimize for the strength-to-weight ratio of the part. Unlike a conventional thrust structure, mine takes advantage of the fin's already strong columns to transfer the thrust force.

Research Paper - Modeling Heat Flux of Rocket Engine

I presented a comparative study of heat flux modeling for our regentively-cooled liquid bipropellant rocket engine at the Canadian Combustion Institute Conference. This study was important for better understanding how much, and where heat is being produced within our engine. By having a better idea of our heat flux, we can more efficiently design our regenerative cooling system. For this study we used Cantera software to model three correlations: Bartz, Sieder-Tate, and Dittus-Boetler.



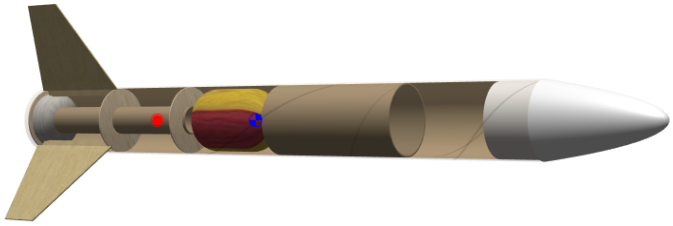
Research Paper - Testing the Efficiency of Rocket Nose Cones



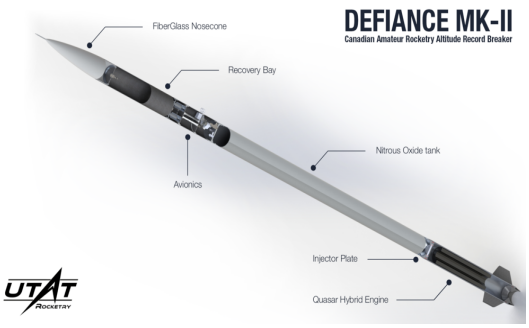
I wrote a research paper on the aerodynamics of rocket nose cones using the simulation software OpenRocket, and Aerolab. I tested six different types of nose cones at seven different fineness ratios (a length-to-radius ratio of the nose cone), and plotted my data on various graphs. While the experiments themselves were quite straightforward, the project helped me understand the aerodynamics of rockets at a fundamental level. It also taught me how the effect of drag changes when traveling at subsonic, sonic, and supersonic speeds.

Domino - L1/L2 Certification Rocket

I lead the design of the “Domino” rocket on the University of Toronto Aerospace Team. The purpose of this project was to create a rocket that was cheap, straightforward to build, and maximized reliability. In doing so, we made it seamless for new members to get their Tripoli L1 and L2 high power rocketry certification. As part of this process I also made my own L1 caliber rocket.



Defiance Mk. II - Airframe



I helped build the airframe of the hybrid rocket “Defiance Mk. II” on the University of Toronto Aerospace Team. Some of my tasks included designing different parts of the airframe, finding new methods to manufacture composites, and performing shear, and tensile tests to maximize various structural properties of our composites.

Google Big Query - Using ML To Predict Horse Racing

Google BigQuery is a serverless data warehouse that can analyze petabytes of data and generate machine learning algorithms through SQL requests. I wanted to learn more about the capabilities of cloud computing platforms and thought that learning how to use Google BigQuery would be a good place to start. Fundamentally, it taught me that when it comes to machine learning, an algorithm is only as good as the data that it uses. I was able to find a reasonably good dataset of over 200,000 data points to predict the outcome of horse races based on 33 different parameters. My program predicted the position a horse would finish in a race to a 65% accuracy.