PORTFOLIO

Kyle Tam

Mechanical Design Engineer

University of Waterloo - Mechatronics Engineering 2023

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QUANSER
INNOVATE·EDUCATE

Automated Smart Factory Project

Dec 2023 – Aug 2024

Background

- Custom applications project to develop an automated smart factory that combines robotic manipulators, autonomous ground robots, and 3D printing

Contributions

- Worked on the design and manufacturing of multiple products in this factory including the actuated shelves, QArm manipulators, and QBot ground robots
- Researched and developed novel concepts for a custom packaging dispenser
- Designed parts to integrate electrical hardware and wiring into the actuated shelves
- Led manufacturing and integration of customized QBot ground robots to interact with self-charging stations and shelves

Skills

- CAD, DFM, DFA, Electrical Harnessing, CNC/Sheet Metal/3D Printing Design, Adobe Photoshop/Illustrator, Technical Presentations

Results

- A multi-million dollar, fully functioning, automated smart factory ready to teach future engineers of tomorrow

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QUANSER
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Improved QArm Gripper Design

Sept 2023 – Jan 2024

Background

- Used extensively in the Automated Smart Factory, this is a core Quanser product usually sold in large quantities for both undergraduate settings and for robotics & controls research
- Gripper was previously designed under a tight budget and constraint timelines

Contributions

- Redesigned the gripper to provide improved strength and additional joint dexterity
- Adapted outer appearance to match the visual aesthetics of the base of the arm and other Quanser core products to improve marketability
- Improved manufacturability and assembly leading to reduced building times and part counts by more than 50%

Skills

- CAD, R&D, Rapid Prototyping, DFMA, Tolerance Analysis, Overseas Suppliers, Mass Production

Results

- New gripper design that unifies the QArm product vision while improving performance and reducing manufacturing costs

Note: Pictures show old design (redesign has yet to be officially marketed to the public)

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Intuitive Machines (IM-2) Flight Camera Testing

May – Aug 2022

Background

- Developed under the Artemis program, Canadensys Aerospace has been collaborating with Intuitive Machines to send private spacecraft to the moon that will be used for a lunar astronomical observatory
- As the follow-up mission to IM-1, these cameras will be some of the first Canadian space hardware to be operated on the Moon since the Apollo missions.

Contributions

- Conducted thermal and vibrational testing campaigns for two cameras to ensure they can withstand launch and orbital conditions
- Conducted failure analysis to determine the root causes of production/operation issues in camera manufacturing discovered during testing
- Developed an optical test jig to determine lens focus degradation under vacuum

Skills

- Thermal Testing, Vibration Testing, MATLAB, Camera Color/Focus Calibrations, Root Cause Analysis, Failure Analysis, CAD

Results

- Two space hardened cameras awaiting flight on IM-2 in early 2025

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TRIUMF Particle Accelerator Co-Axial Cavity Research and Test Platform

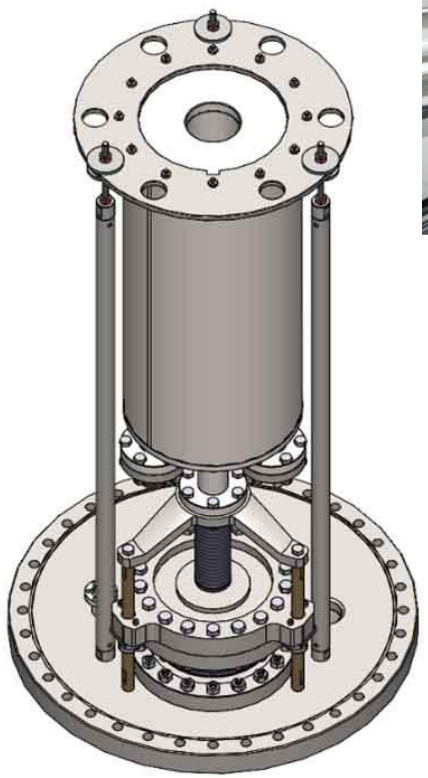
Jan 2022 – Apr 2022

Background

- SRF cavities are the heart of most modern particle accelerators
- The performance and characteristics of accelerator cavities from around the world need to be tested and qualified
- Further tests on cavities can provide insight in superconductive radiofrequency research and improve future accelerators

Contributions

- Worked on the conceptual and detailed design of a test platform
- Designed to submerge cavities in a pressure vessel filled with cryogenic liquid helium at 2°K and isolated by a vacuum
- Learned a lot about different materials and their interactions at different temperatures and pressures
- Designs validated using ASME BPVS calculations and ANSYS Mechanical



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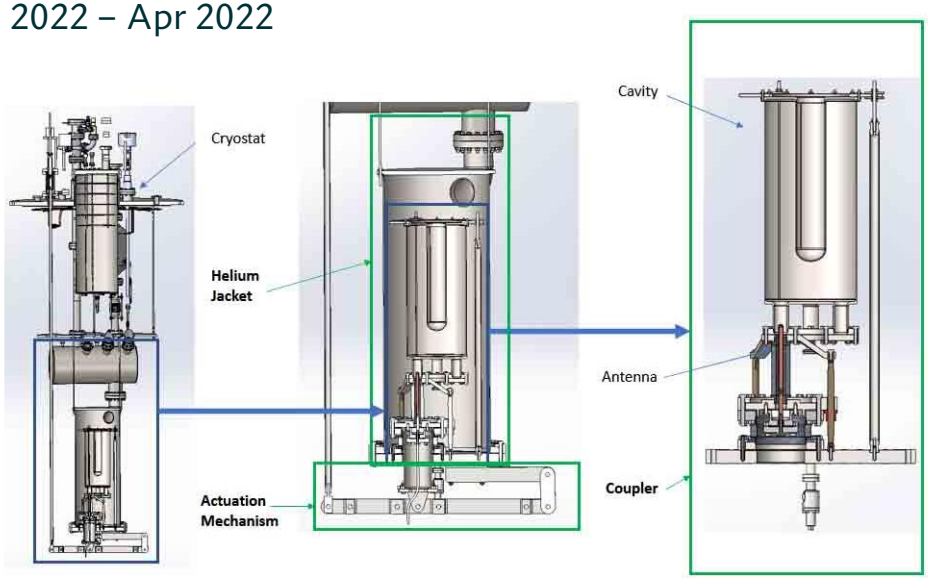
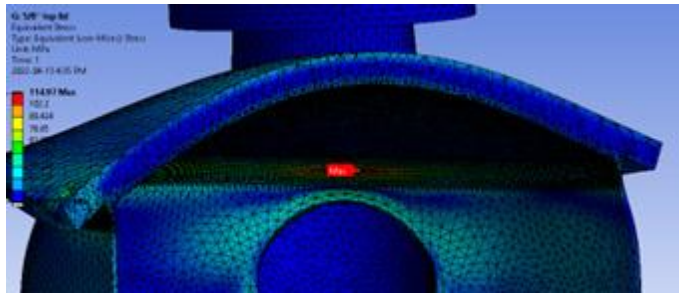
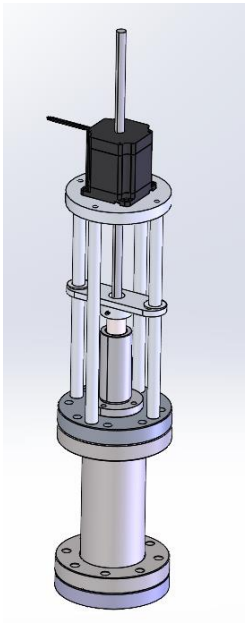
TRIUMF Particle Accelerator Co-Axial Cavity Research and Test Platform

Jan 2022 – Apr 2022







Contributions

- Consulted with different teams including physicists, material specialists, and machinists to design for operations in Class 100 and Class 10 cleanroom environment
- The cavity test platform hangs from the lid of a 10 ft tall cryostat and can be broken up into 3 sections:
  - Co-Axial Coupler
  - Actuation Mechanism
  - Helium Jacket Pressure Vessel

Skills

- CAD, DFMA, ANSYS FEA, Materials, Tolerance Analysis

Results

- Completed conceptual design of the test platform and technical drawings ready for manufacturing!

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WATERLOO ROCKETRY

Leviathan of the Sky (LotS)

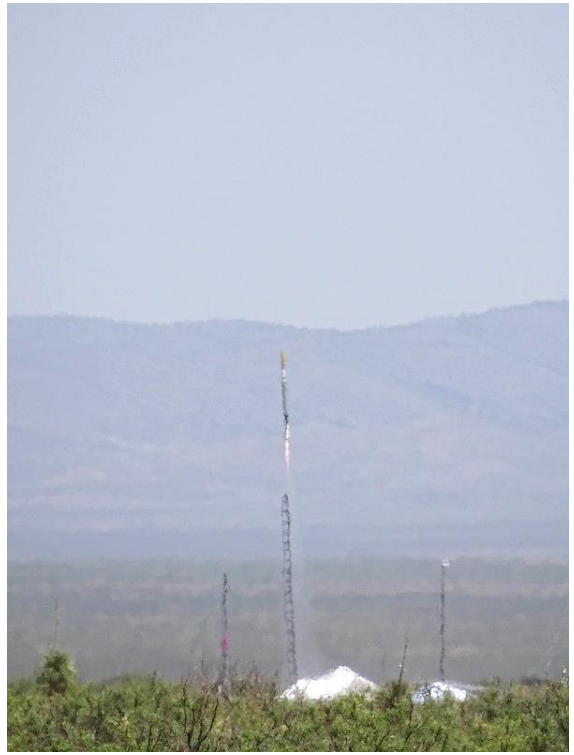
Sept 2022 – Jun 2023

Background

- Each year Waterloo Rocketry designs and builds a high-powered sounding rocket for competition at the Spaceport America Cup
- During the majority of my university career, I participated in a number of roles including Team Lead, Payload Subteam Lead, Core Member, and Finance/Marketing Member
- Here are some statistics from our 2023 award-winning hybrid rocket Leviathan of the Sky:

Wet Mass: 57 kg / 126 lb
Length: 4.5 m / 14.5 ft
Motor Classification: O motor
Maximum Altitude: 31,000 ft
Propellants: Liquid N2O, Solid HTPB

2nd Place in the 30,000 ft hybrid division at the 2023 Spaceport America Cup



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WATERLOO ROCKETRY

Payload CubeSats (Nanosatellites)

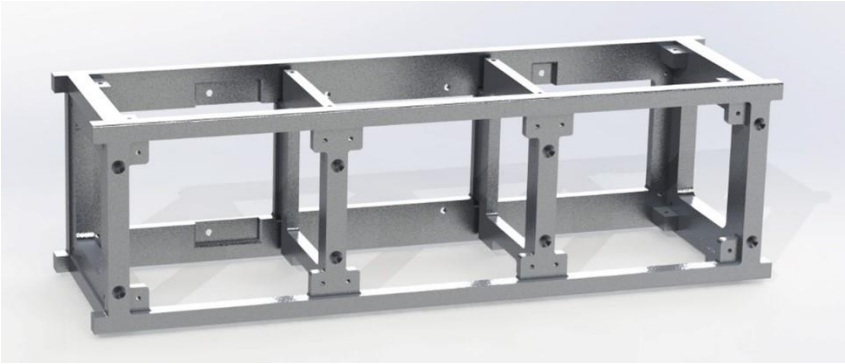
Sept 2018 – Jun 2023

Background

- Payloads developed by the team are scientific experiments that take advantage of the high altitudes, extreme launch forces, and micro-gravity experienced during flight
- Led the design of a 3U CubeSat and radiation sensor suite to test material samples and detect secondary cosmic radiation passing through our rocket
- In other years, I supported the development of payloads focusing on creating a magnetic ferrofluid pump and the hypergravity effects of sourdough starters

Contributions

- Led the mechanical design of the team's CubeSats and payloads following the CubeSat Standard Specification
- The overall structure design was standardized and adopted for all Waterloo Rocketry payloads from 2019 onwards



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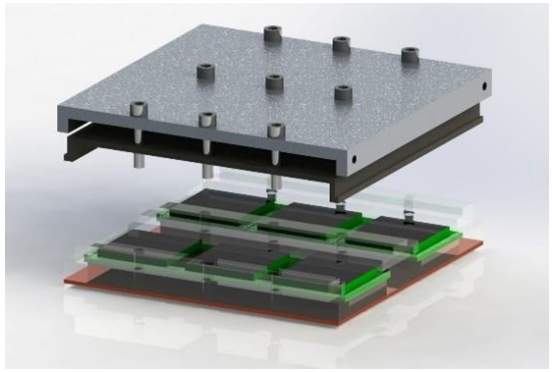
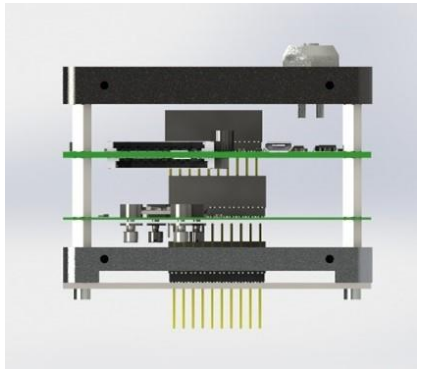
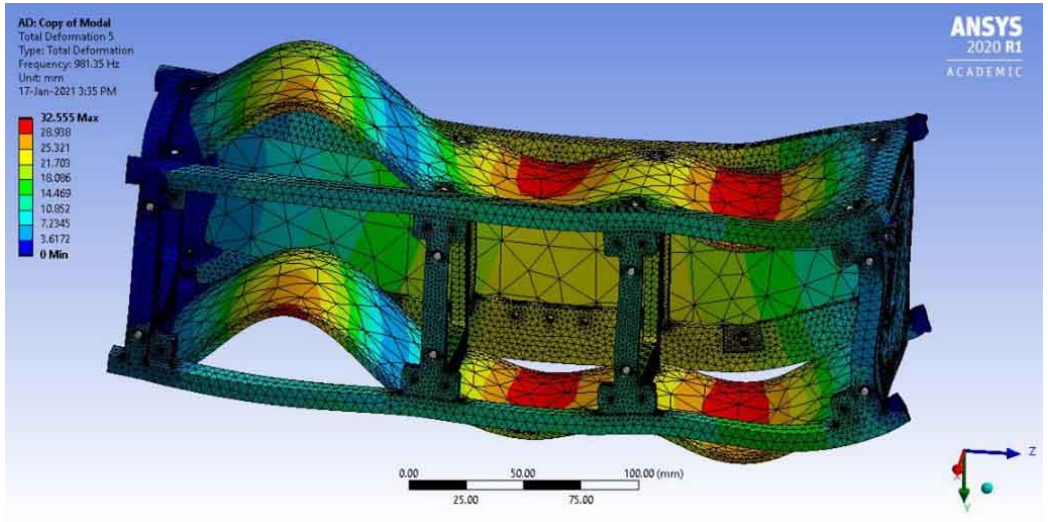
WATERLOO ROCKETRY

Payload CubeSat (Nanosatellite)

Sept 2018 – Jun 2023







Contributions

- CubeSat structure was designed to be a modular assembly that can easily swap out different modules every year
- Part count was minimized to facilitate assembly and decrease cost while the assembly was designed for easy access and operation in the field
- Testing and analysis were done to validate the performance of the system (structural and vibrational)
- Different coatings were explored including anodizing, powder coating, and alodining

Skills

- CAD, Electrical Integration, ANSYS FEA, DFMA, Project Management, Team Leadership, Communication

Results

- Top 10 Payload in the SDL Payload Challenge and won the prize for Most Professional Design at the Spaceport America Cup 2021/2022 competition

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WATERLOO ROCKETRY

Airframe Manufacturing

Jan 2019 – Dec 2019

Background

- Airframes are the main structure of the rocket
- As a large contributor to the overall weight of the rocket, great efforts were made to reduce the weight of the airframe while keeping it strong

Contributions

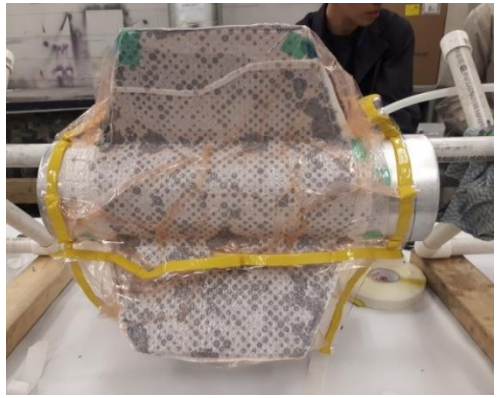
- Design and manufacture of carbon and fiberglass parts like a Von Kármán nosecone and fin can
- Vacuum bag layups were conducted extensively to perfect the manufacturing of these parts

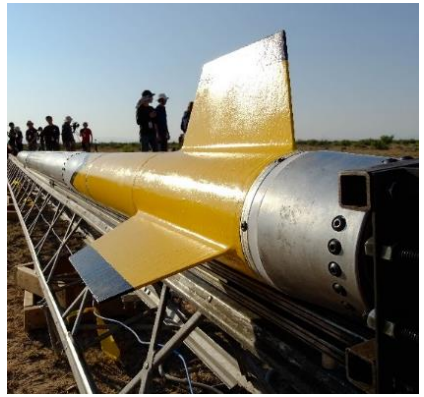
Skills

- Composites, Wet Layups, DFM, Materials Testing

Results

- Completed airframe of with rocket parts flown in 2019, 2022, and 2023!





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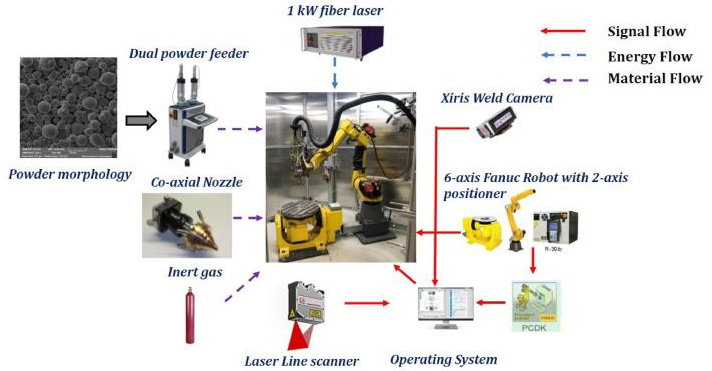
MSAM Peer-Reviewed Paper: 5-Axis Laser Metal Deposition (LMD) 3D Printing Process Planning Algorithms

May – Aug 2021 (Co-op), Sept 2021 – Feb 2022 (Part-Time)

Background

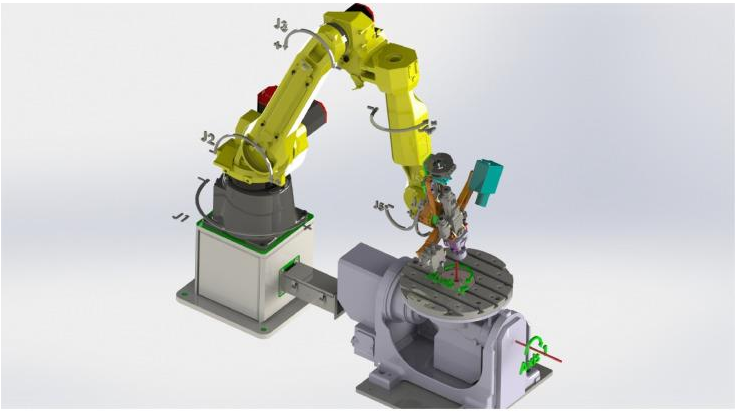
- The focus of this paper was on process planning algorithms of 5-Axis Laser Metal Deposition (LMD), a type of 3D printing that uses a powder feed and high-powered laser to deposit layers using a 5-axis Fanuc robot.
- This process can be used in conjunction with CNC milling techniques to combine additive and subtractive manufacturing.
- Importance is to ensure no tool path collisions occur while both systems are in operation



(a)

Contributions

- My focus was on developing experiments to test the capabilities of LMD 3D printing and analyzing for voids and manufacturing defects post-production
- Development of a machine vision-based data acquisition and controls system using LabVIEW to track layer heights to aid studies used in the paper
- Implemented a laser scanner quality control system to detect 5+ µm defects in metal 3D-printed parts



(b)

Skills

- Technical Paper Writing, Technical Presentations, Industry Collaboration, R&D, LabVIEW, C++

Results

- Co-authored a peer-reviewed paper in the April 2022 edition of Additive Manufacturing Letters

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PLANTER A Holistic Automated Hydroponics System – Final Year Undergraduate Capstone Project

Sept 2022 – Mar 2023

Background

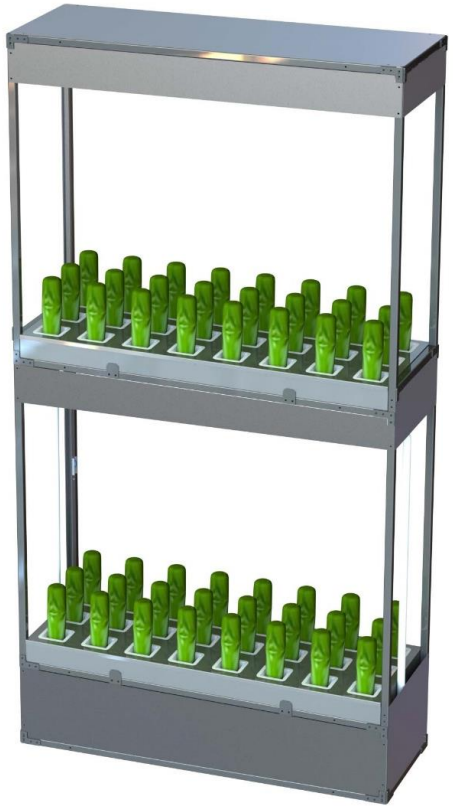
- Hydroponics systems that exist on the market today lack automation and have a high barrier to entry for small-scale users
- Planter's mission is to build a system that fully automates all the key parts of a plant's growth lifecycle in user-friendly approach!

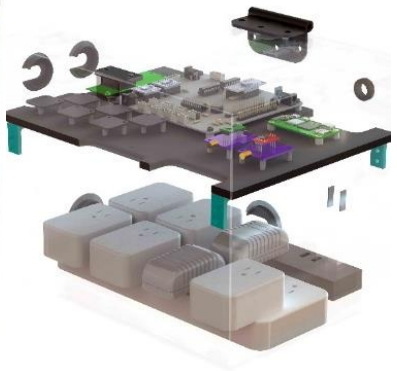
Contributions

- Focused on the mechanical design and electro-mechanical integration
- Design for manufacturing & assembly of the structure, electronics enclosure, and peripheries
- Structure was optimized to be strong & durable while easy to assemble in minutes; electronics module designed for easy access and display; full failure and tipping analysis conducted for overall system

Skills

- CAD, DFMA, Machining (Milling, Sheet Metal), Assembly, Technical Presentations





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LamperLabs Autonomous Robotic Fish Project

May 2021 – Sept 2021

Background

- Objective was to develop a robotic fish capable of gathering data in shallow ocean environments while blending into its environment for marine biology research
- Robotic fish is autonomous and wirelessly controlled and features a range of sensors and instrumentation to facilitate research purposes

Contributions

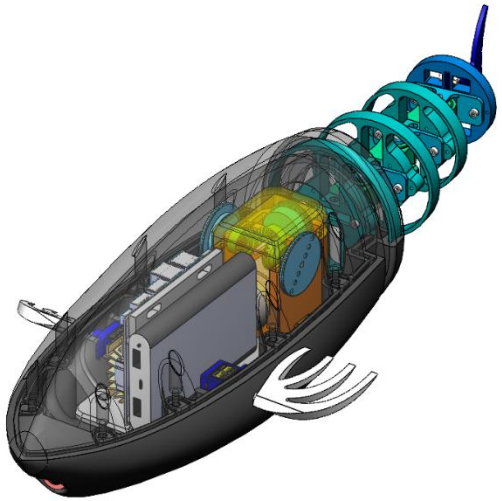
- Led mechanical design of system
- Development of a propulsion system that mimics the natural movement of fish – multiple design iterations to fine-tune the caudal fin propulsion system

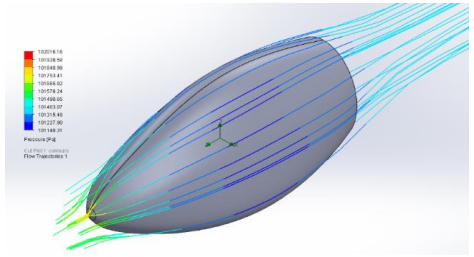
Skills

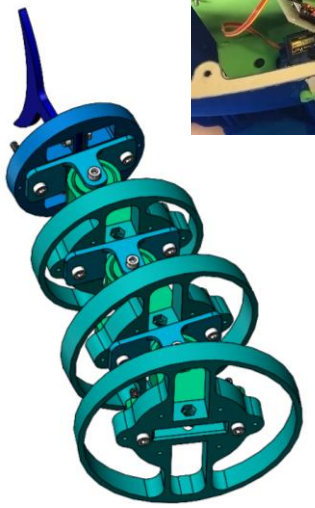
- R&D, Rapid Prototyping, CAD, Testing

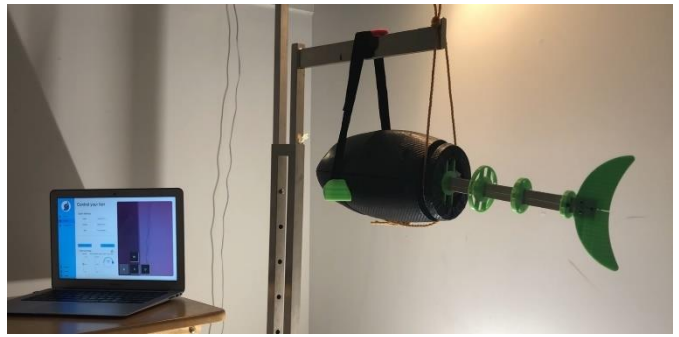
Results

- Functional prototype capable of autonomous propulsion in water 🐟









The propulsion system is a continuous-rotating system where two oppositely rotating turntables (green box) pull on a set of wires routed through the ribs of the tail seen on the left.

As the turntables rotate opposite of each other, each wire will alternate being in tension while the other remains slack, oscillating the tail similar to the movements of a tuna when swimming.

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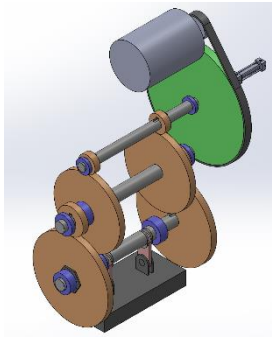
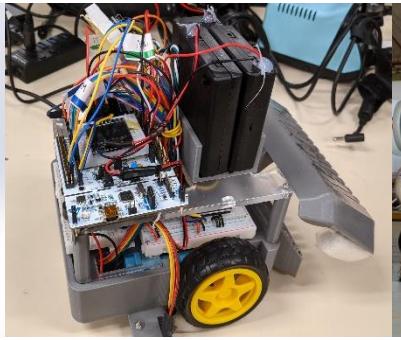
And Much More...

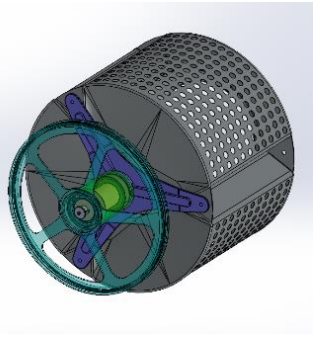


Double-Geared Twin-End Drive Stamping Press Design & Analysis

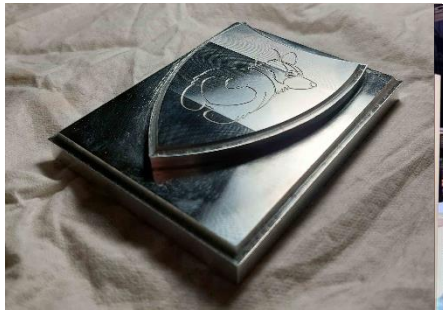


Autonomous Navigation & Rescue Robot Design Project

Canadian Reduced Gravity Experiment – Microgravity Fluids Experiment and Flight Campaign



Front Load Washing Machine Drive Assembly – Bearing, Shaft, and Seal Design & Analysis

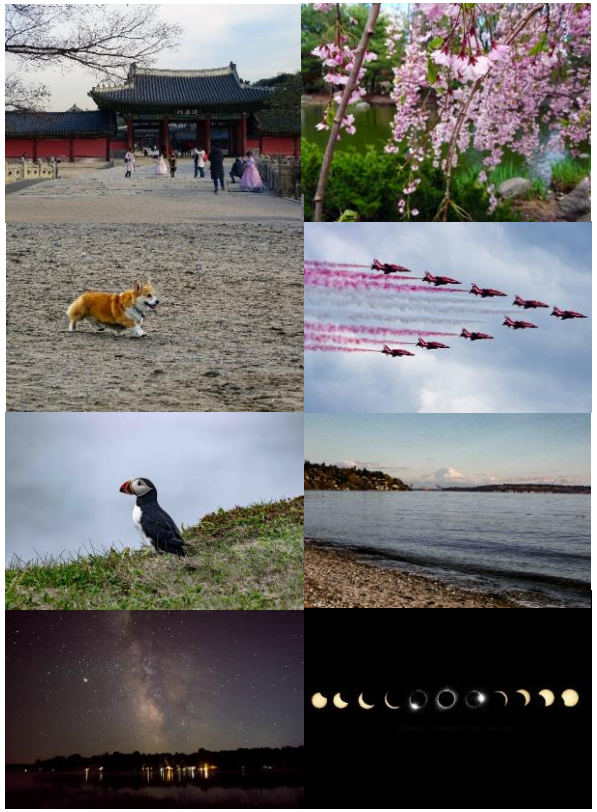


MasterCAM CNC Programmed and Machined Aluminum Shield

Quanser – Custom Autonomous Self-Driving Car Demonstrations for Conferences/Labs

Hatch – Large, High-Speed Bearing and Damper System in Collaboration with General Fusion

Flash Forest – Semi-Automated Seed Pod Manufacturing and Design of Drone Planting System



Digital and Film Photography – Nature, Landscapes, Astrophotography (Nikon D5300, Nikon FG)