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Margaret Lee

Project Portfolio

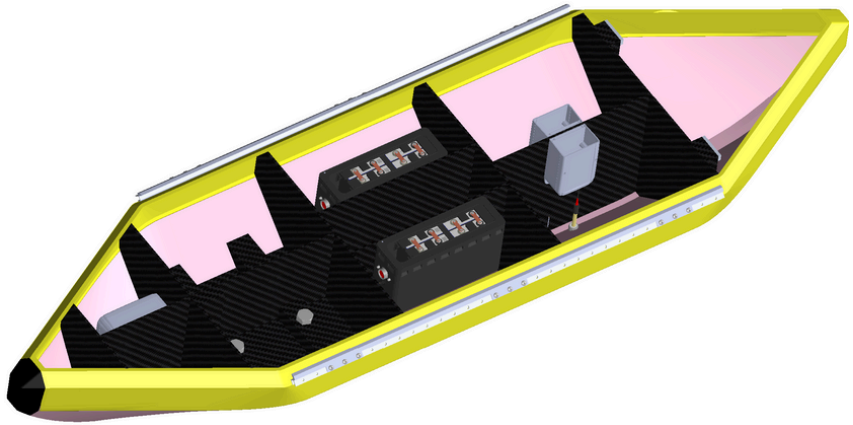
UBC Engineering Physics Student

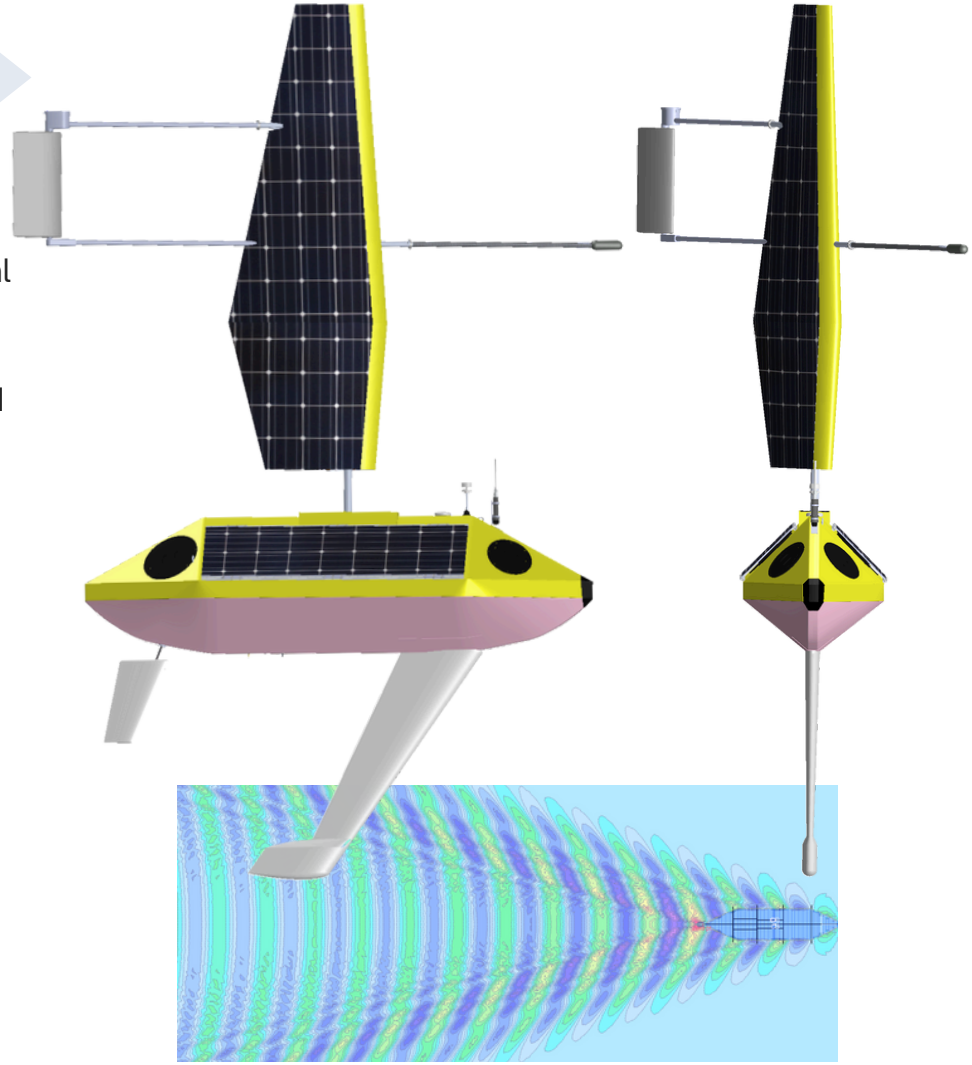
POLARIS

UBC Sailbot | 2022 - 2025

Description:
POLARIS is a fully autonomous sailboat designed to collect environmental data during weeks-long missions in the Pacific Ocean. She boasts a 3-metre long CFRP sandwich panel hull, a rigid wingsail made from solar panels, and a 70kg bulb keel, all designed by students. I have progressed from mechanical team member to rudder team lead and, finally, to hull and keel team lead since the project's conception.

Link:
https://www.ubcsailbot.org/projects/#polaris



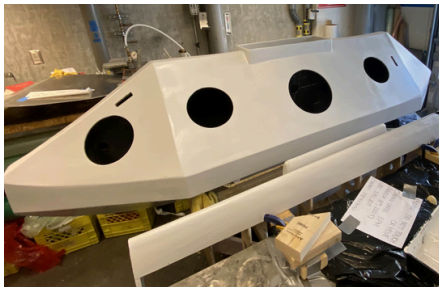


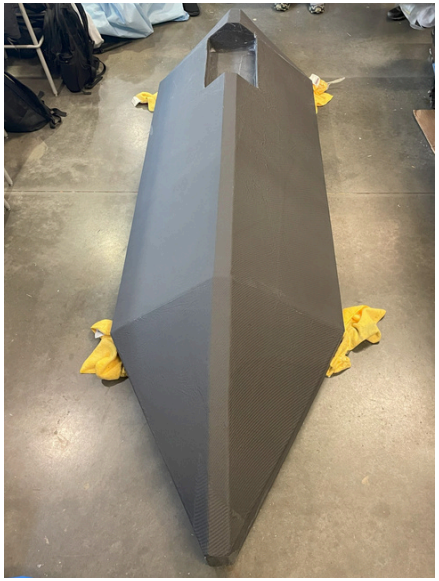
POLARIS

UBC Sailbot | 2022 - 2025

My contributions:

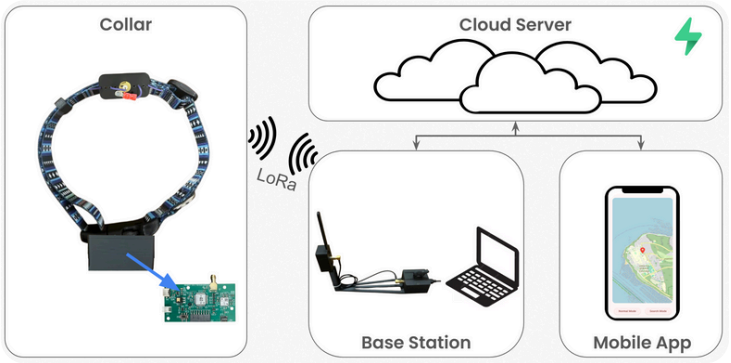
- Directed a team of 10 engineering students in the design and manufacturing of the hull and keel
- Optimized hull resistance and stability through Maxsurf hydrostatic and hydrodynamic analysis and simulations
- Determined sandwich panel core thickness, carbon fibre ply count, and lay-up pattern via Ansys structural analysis
- Organized and led large-scale manufacturing sessions, including teaching, supervising, and on-the-fly problem solving
- Manufactured hull and keel employing woodworking, CNC machining, waterjet cutting, and carbon fibre hand-layups and vacuum bagging
- Machined steel shafts on the lathe for rudder assembly
- Led rudder planform design using Excel for parameter optimization and Ansys for CFD analysis
- Coordinated with suppliers to purchase materials and secure sponsorships
- Oversaw organization and documentation of a 700+ part team-wide SolidWorks assembly





LoRa Pet Tracker

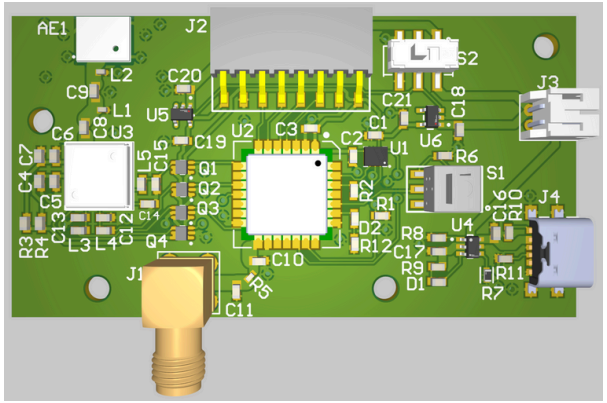
UBC ENPH 479 | 09/2024 - 04/2025

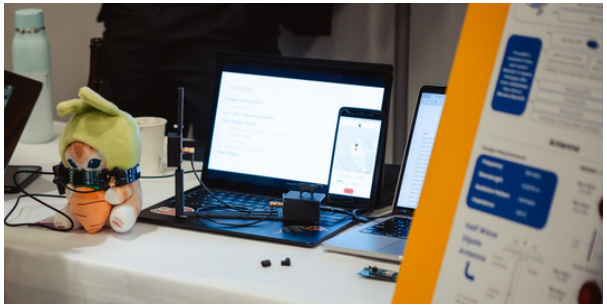


Description:
In a team of four, we designed a compact, LiPo-powered PCB and collar that sends tracking updates to a custom mobile app. The PCB integrates LoRa (long range) communication, GPS, and IMU modules with a custom antenna to provide real-time, responsive monitoring of your pet.

My contributions:

- Wrote C and C++ firmware to communicate with and control GPS and IMU peripherals and integrated LoRa module from the STM32 MCU through I2C, SPI, and UART protocols
- Developed collar and base station communication logic, including message structures, parsing routines, and main control loops
- Selected battery and designed charging circuitry in Altium based on power consumption analysis
- Deconstructed and simulated LoRa modulation scheme to fundamentally understand key signal parameters





Awarded the **Roy Nodwell Memorial Prize** for high professional standard and industry relevance.

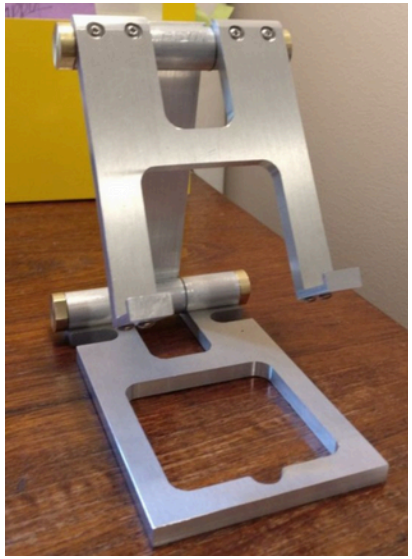
TMS Cobot

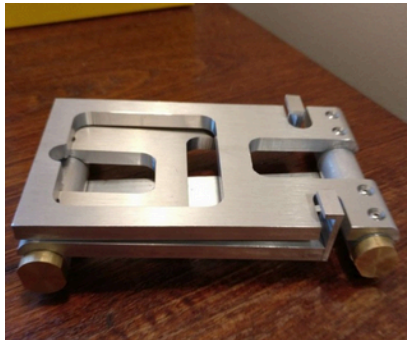
UBC ENPH 459 | 09/2023 - 04/2024

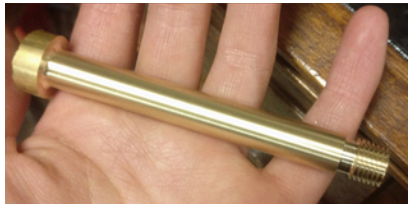
Description:
Using a UR3e collaborative robot arm, we developed a robotic system designed to autonomously compensate for patient movement while stimulating the brain during transcranial magnetic stimulation (TMS), a procedure to treat drug-resistant depression. The system accounts for translation and rotation of the patient's head using an OptiTrack IR stereo camera and retroreflective markers.

My contributions:

- Implemented ROS pipeline to control and monitor cobot with Python
- Analyzed performance of joint position-based vs. velocity-based control and UR vs custom inverse kinematics
- Programmed spatial transformations using tf2 to convert between robot base frame, tool frame, and camera frame
- Derived equations to determine cobot tool linear and angular velocities required to maintain precise relative position to the patient's head
- Integrated force/torque sensing for compliant control and safety







Collapsible Cellphone Holder

Description:
To learn to machine, I made a collapsible cellphone holder out of aluminum plate and brass and aluminum round stock. I created steel lathe tool bits using a grinder, then faced, turned, and threaded on the lathe to create partially threaded rods, threaded end caps, and tubes. After waterjet cutting the aluminum plate, I used the milling machine to finish the sides and faces. Finally, I tapped holes for screws and completed the final assembly.

Food Delivery Drone CAD

Description:
Competing in UBC's Designathon, my team designed, modelled in SolidWorks, and presented this hexacopter drone within 24 hours. We analyzed power and weight trade-offs to ensure the drone could fly for 30 minutes with its delivery load. I specced controller and sensor electronics, and designed a compact, light-weight enclosure for the batteries and all internals.