Andrew Cote
Engineering Project Portfolio

4th Year Engineering Physics student with Electrical Engineering specialization

Skills Summary

Electrical Engineering
- Analog circuit design, signal processing, control systems, robotics
- MATLAB: scripting and data analysis
- LabView: VI's and data acquisition
- Simulink: Control systems designer toolkit
- Atmel microcontrollers for IoT sensor applications

Prototyping
- SolidWorks CAD design and mechanical integration with other subsystems
- CNC machining and 3D printing
- Machine shop skills with hands-on experience building and testing new ideas

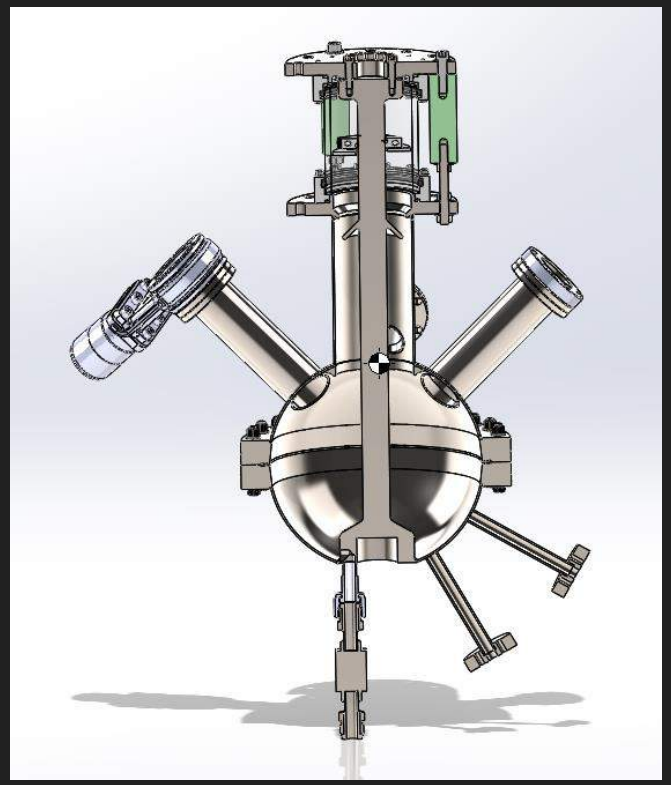
Experimental Physics
- COMSOL Multiphysics, experimental design, uncertainty analysis
- Statistical and numerical methods in computational physics

Software Development
- Working languages: Python, C++
- ML Libraries: TensorFlow, SciKit Learn
- Fundamentals of data structures and algorithms, OOP

Plasma Engineering at General Fusion

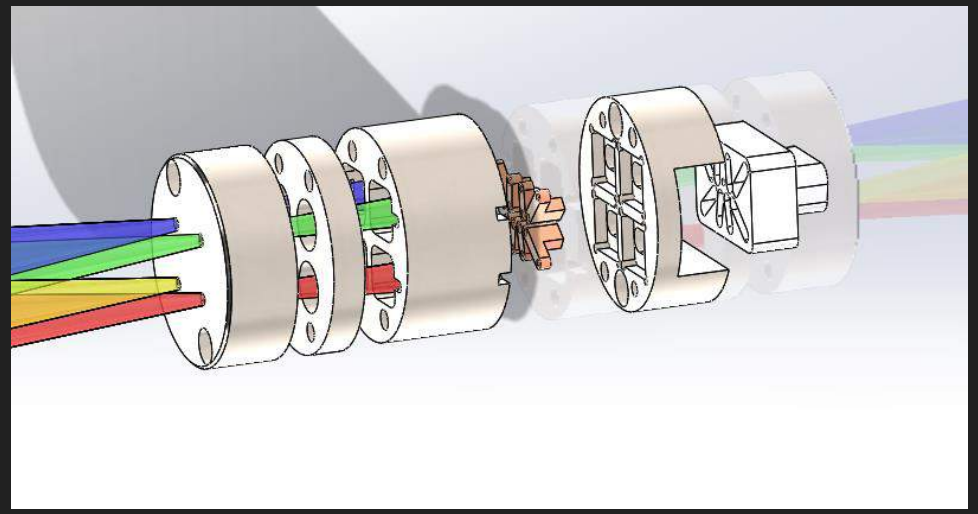
Undertook a number of research projects related to molten-liquid lithium for enhancement of plasma lifetimes and combating lithium's negative side effects on plasma diagnostics. In addition, assisted with development of a new AXUV Plasma Diagnostic resilient to large transient noise related to high current plasma shots.

Researched and experimented with improved methods of lithium-coating large diameter plasma chambers through evaporation deposition on chamber interior surfaces.



Lithium mitigation for protecting diagnostics included:

- Magnetically actuated shutters for laser diagnostic windows
- Magnetic 'deflector arrays' for reducing lithium splash and deflecting droplets during high current pulses
- Magnetic 'kicker coils' to eject lithium droplets from laser diagnostic windows

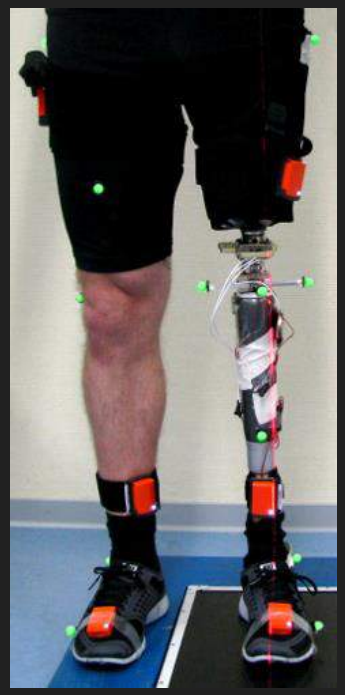


AXUV Diagnostic replaces existing photodiodes with scintillator screens for fibre-optic collection, to isolate electronics from transient noise associated with 500kA current pulse.

Inertial Measurement Unit based Gait Analysis

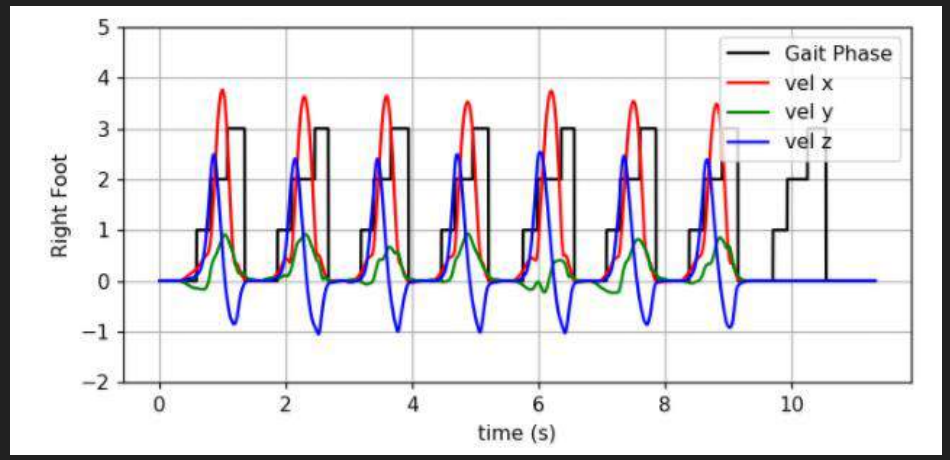
Signal Processing in C++, user interfaces and data management in Python. Developed library of algorithms to take raw IMU readings (3-axis accel, gyro, mag) and produce analysis and results usable by clinicians in treating walking disorders.

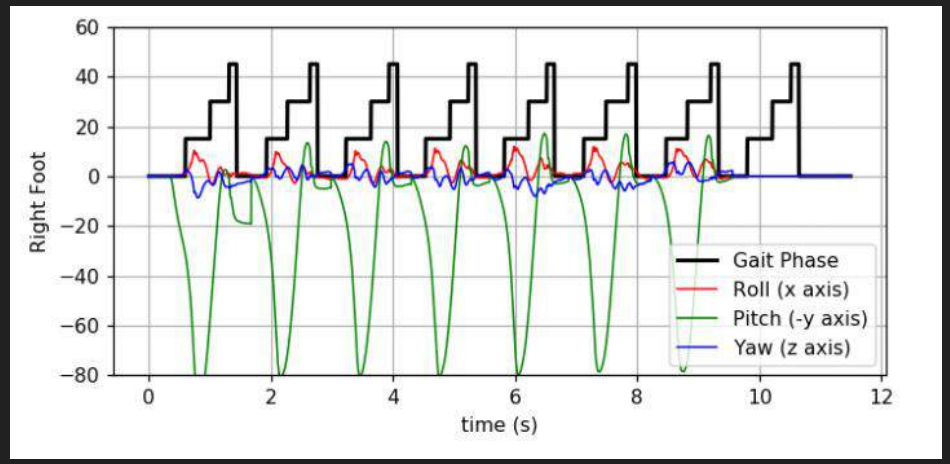
C++ library implements a sensor-fusion algorithm to establish a global frame of reference from raw IMU readings. IMU's can be placed in any orientation and rotated into the foot's frame of reference with quaternions.



Software Development:

- C++ data structures and algorithms for signal processing
- Developed Python GUI and interface to C++ library
- Automatic parameter adjustment and setting for different patients walking speed, style, sensor attachment.





High Voltage RF Transformer

Published in International Particle Accelerator Conference 2017, click here to see paper

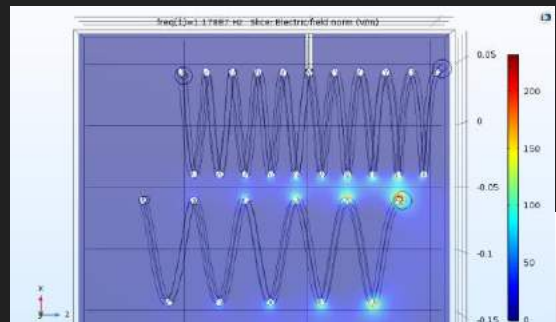
Designed, tested and fabricated High Voltage RF Transformer for TRIUMF Cyclotron's Heavy Ion Accelerator beamline. Simulations in COMSOL, circuit analysis in SPICE, design in SolidWorks, CNC machined and tested with benchtop RF equipment. Installed on beamline in April 2017.

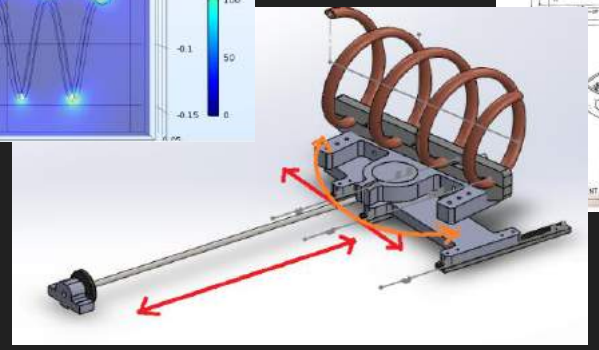
Electrical:

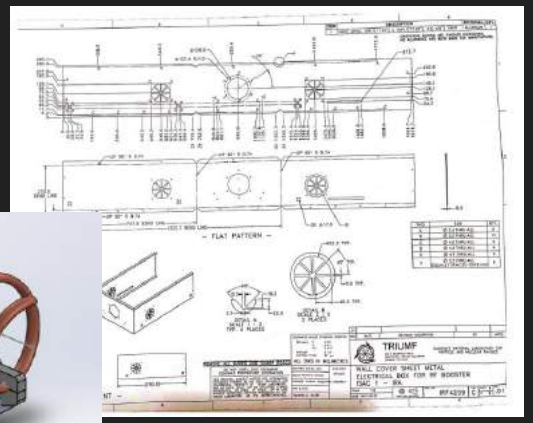
- RF fundamentals in benchtop testing with VNA, Signal Generator, VSWR as figure of merit for impedance matched transformer
  - Prototyping informed by simulations in SPICE/Micro-Cap and COMSOL for RF field of inductor coils

Mechanical:

- CAD modelling in SolidWorks to design Chassis, mounting attachments, Inductors, inductor mounts, feed-throughs, pick ups.
- Machined custom-made 3 DOF cross-table to balance EM field coupling in the Transformer after discovering parasitics through COMSOL modelling

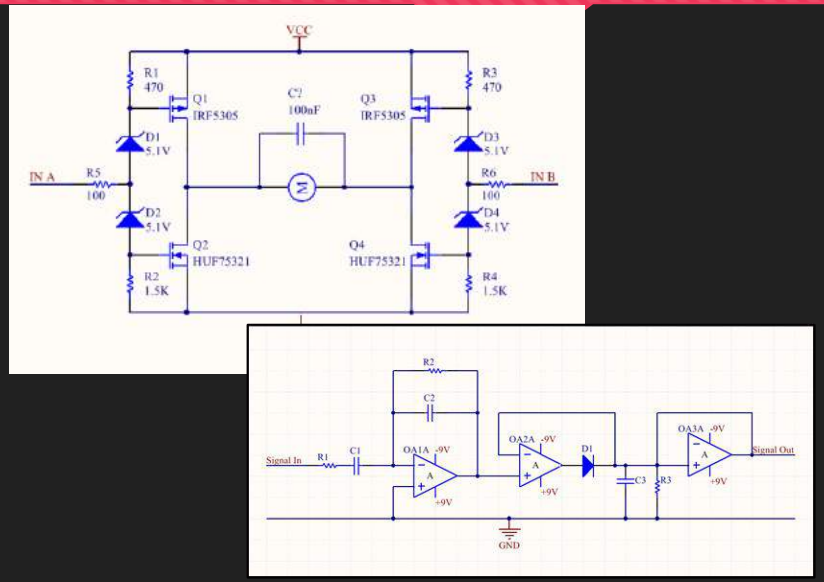






Autonomous Robot in 6 Weeks

2016 Engineering Physics Robot competition had teams of 4 go head-to-head in an "Uber Bot" challenge – to autonomously navigate a miniature city, detect passengers via 1KHz IR signals, then find the correct drop-off location. More info on our robot at: https://fighting-squid.github.io/

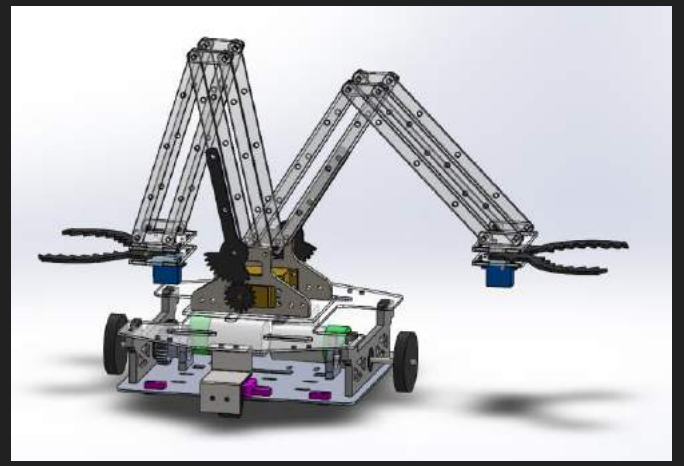


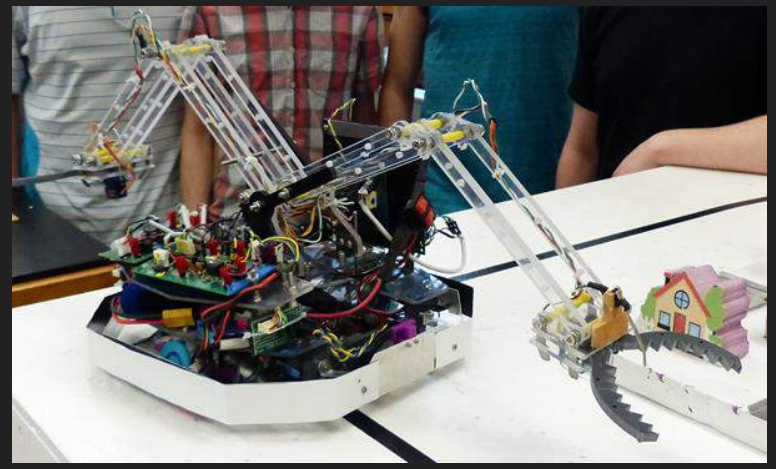
Electrical:

- Design, assembly of filtration circuit boards and power supply system
- Novel H-Bridge circuit for PWM motor control
- Sample and hold circuit with multiplexed inputs from signal filtration circuits

Mechanical:

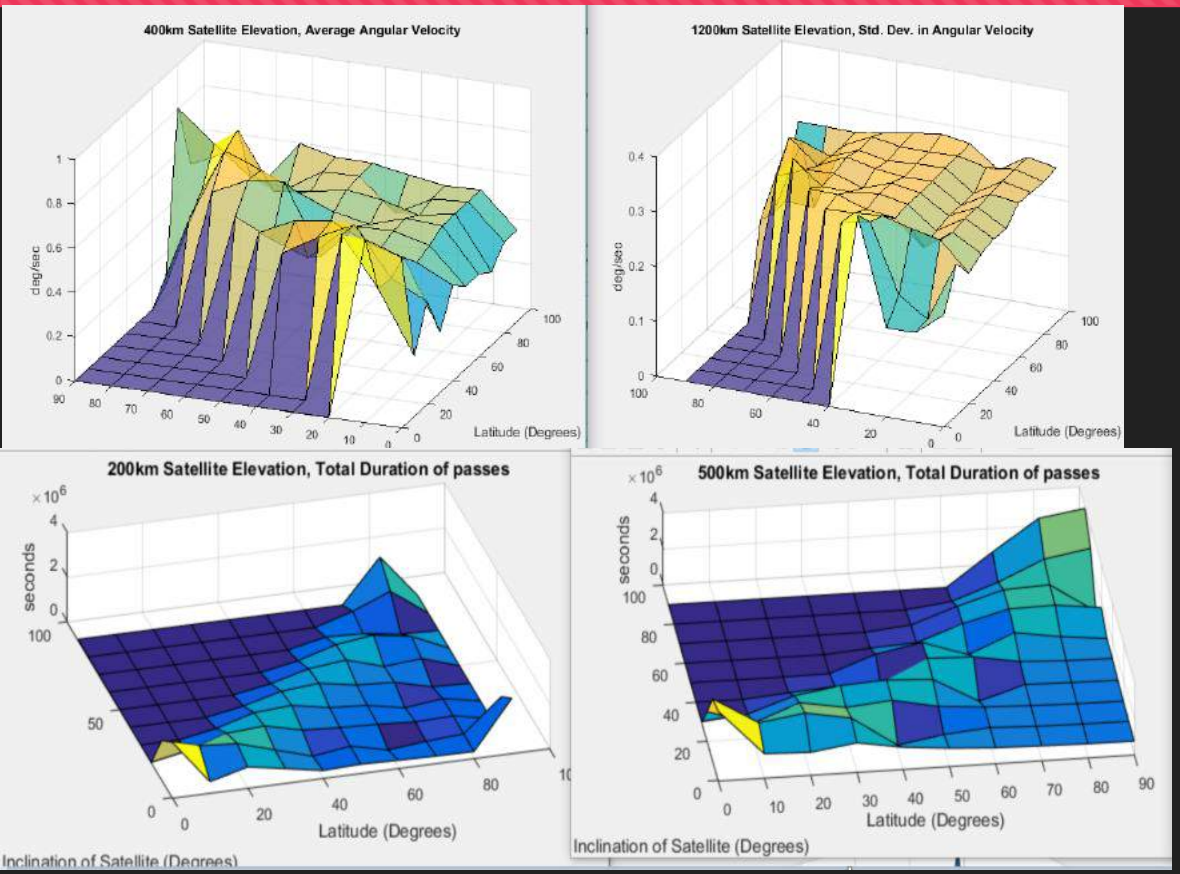
- Extensive SolidWorks CAD design
- Designed and prototyped drivetrain, mechanical arms,
  - CNC machining on OMAX Waterjet cutter, Laser Cutter





Simulating and Analyzing LEO Satellites

An independent research project under the guidance of Dr. David Michelson, Radio Science Laboratory UBC, to simulate 50 LEO satellites at a variety of orbital inclinations and altitudes across 10 ground stations to collect statistical information for use in Ka-Band Radio Science studies.



Example of plots auto-generated by data analysis software package

Ran Orbital Simulations in Systems Tool Kit, generating Access, Elevation and Range reports at 60 second time intervals over 1 year.

Deliverables:

- Modular data-processing pipeline to clean and sort 5 GB of .csv data
- 3x4 dimensional parameter space to analyze 500 unique satellite scenarios
- Cumulative Distribution Functions of Elevation Angle, Range, and Access time.
- 3D surface plots of aggregate statistical parameters: avg Doppler shift, viewing time, avg access angles
- 2D density plots showing Most-likely flightpath of each satellite through Az-El coordinate space

VNA Channel Sounding for Microcell Modelling

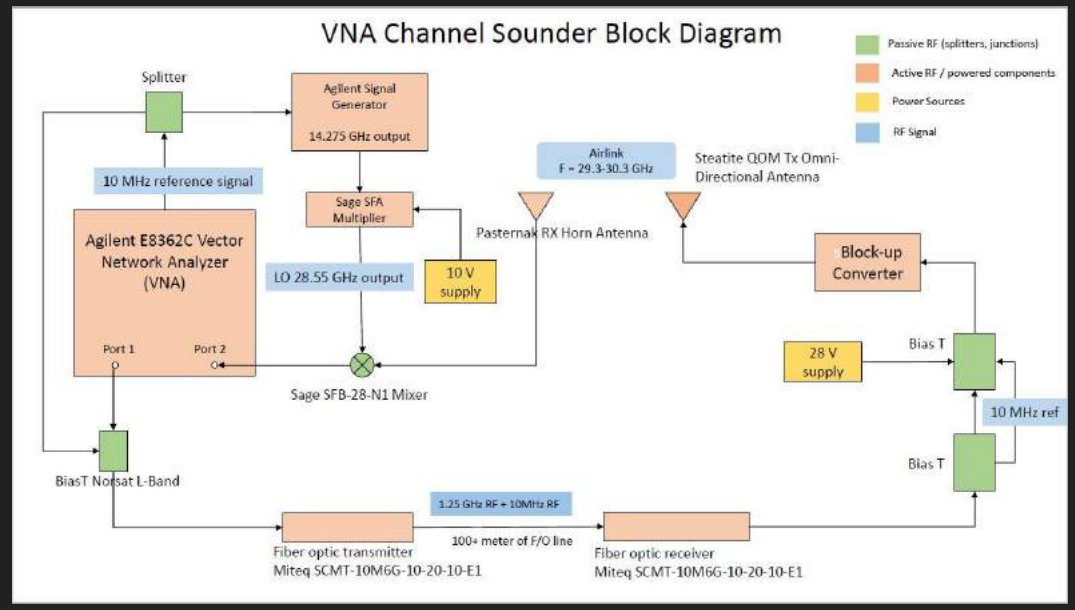
Constructed a set of mobile radio uplink platforms to utilize Vector Network Analyzer in Channel-Sounding urban environments at 30 GHz, to inform simulation models for emerging 5G technologies. Project doubled in Indoor-Insertion Loss experiments, measuring transmission parameters of interior construction materials in the millimeter wavelength.

Skills Developed

- Setup and assembly of RF systems, operation of RF equipment
- Designing experimental procedure and protocol, field operations

Deliverables:

- Two ruggedized carts with hardware mounts for Agilent equipment, Fiber Optic laser system, antenna tripods
- Alignment chassis for receiver horn and custom power supply for 30GHz mixer
- Tripod mounts with adjustable auto-level heads for Rx and Tx alignment

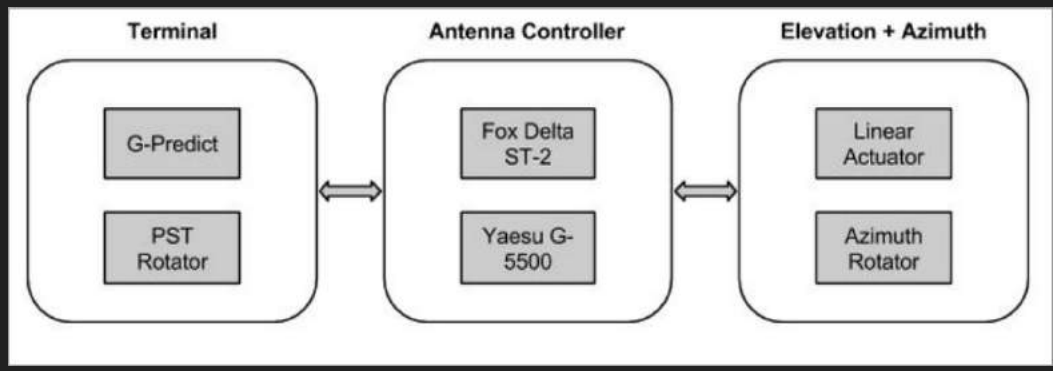


Low-Cost Ground Station for Ka-Band Uplink

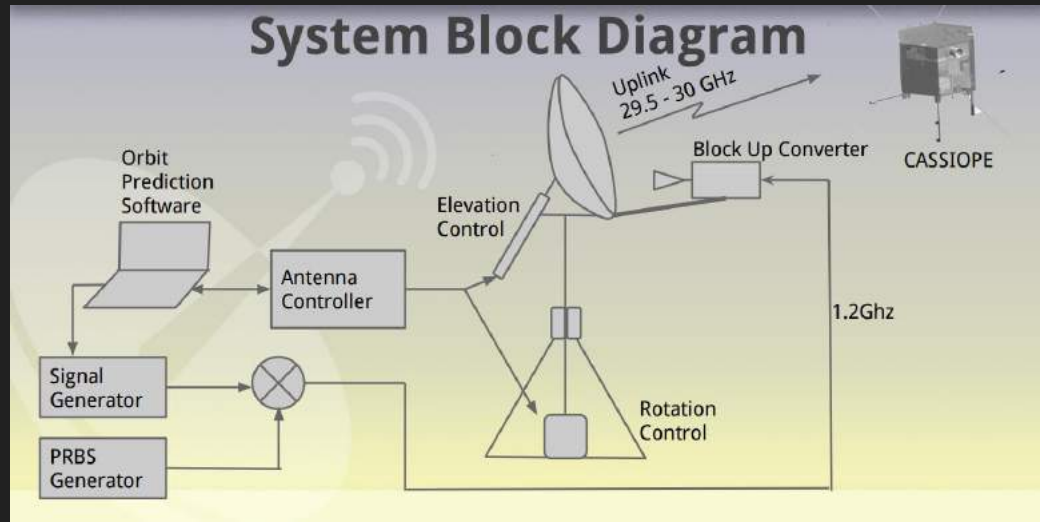
Ground station antenna with satellite prediction + tracking software interfaced with control motors to accurately characterize the Rain-Fade phenomena in microwave satellite communications research. Work was sponsored by MDA and Radio Science Laboratory

Project Milestones

- Assembled and tested satellite tracking ability to within 1 degree pointing accuracy
- Installation of RF related hardware: Signal Generator, Block Up Converter
- Characterized tracking performance and pointing error in using NI DAQ and MATLAB
- Ruggedized and waterproofed electronics for sustained operations outdoors



Conceptual layout for software-hardware interface to control motors

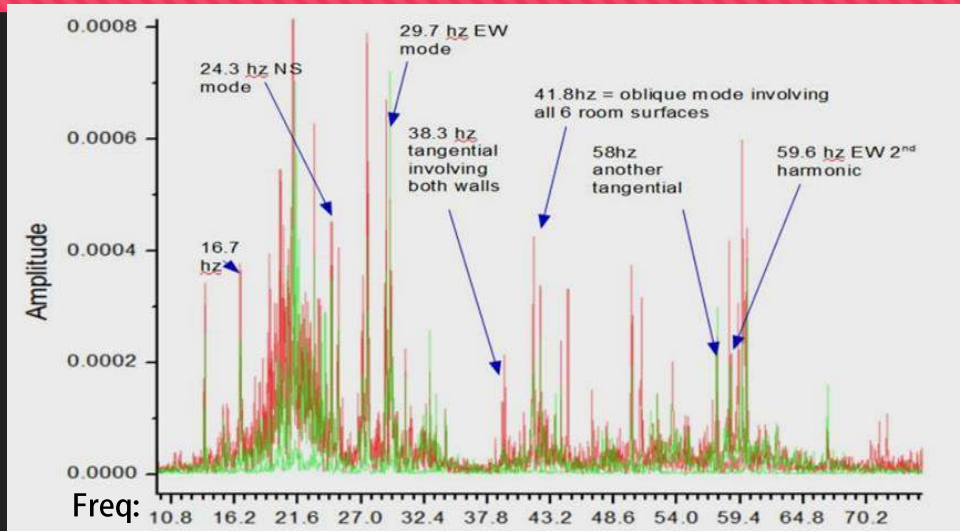


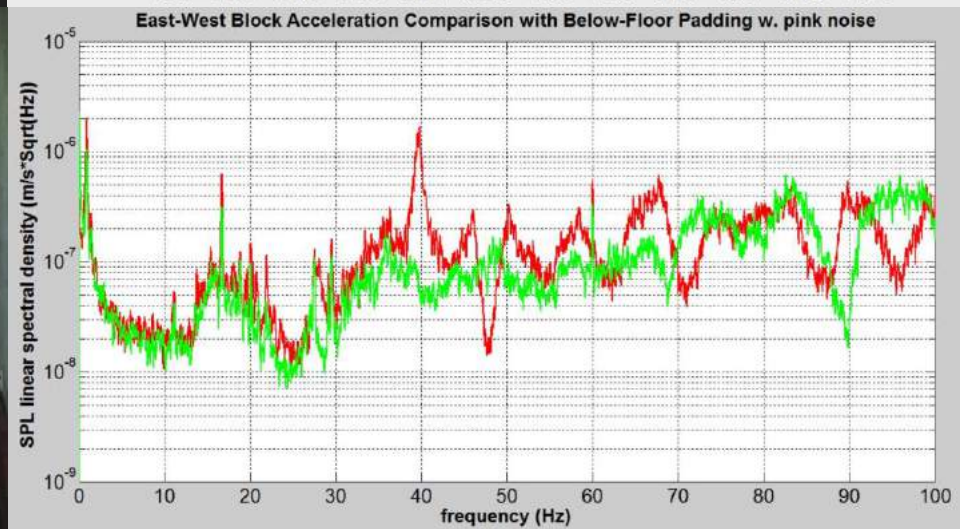
Acoustic damping in Tunneling Microscopy

Characterized acoustic properties of two Scanning Tunneling Microscopy ultra-low G rooms, identified problematic room modes affecting atomic resolution experiments. Researched, designed, fabricated and installed custom broadband low-frequency acoustic dampeners to enhance seismic isolation of experimental equipment.

Deliverables

- 20 cubic meters of low frequency absorber
- Installation at Sound Pressure and Air Velocity maximums in room mode nodes for maximum effect
- Extensive measurement campaign under ambient and excited conditions to characterize effects of absorbers
- Full report and presentation with raw data, processing MATLAB scripts, and documentation.



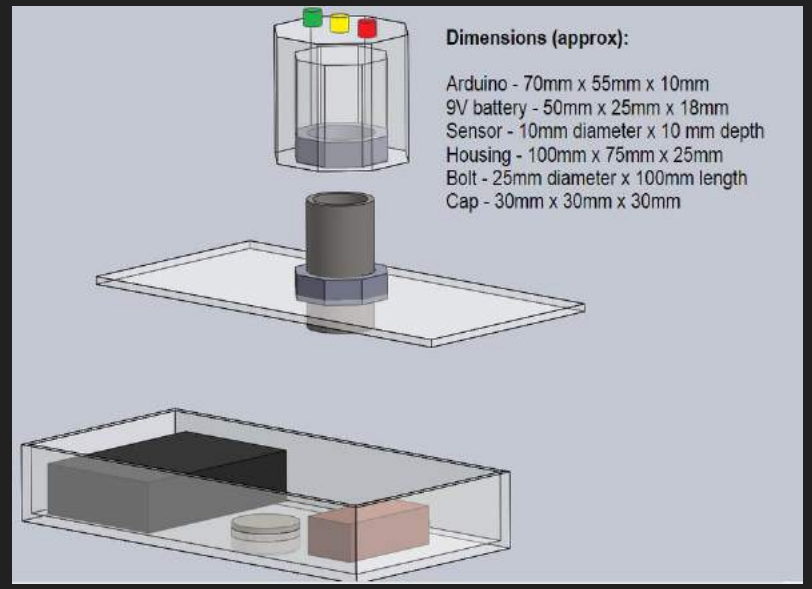


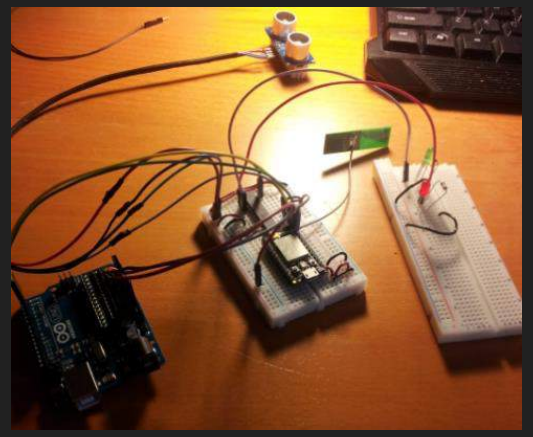
Wi-Fi Enabled UltraSonic Volume Monitor

Developed a low-cost portable sensor to fit inside waste receptacles across UBC campus. Sensor uses ultrasound to probe container contents, then uploads reading into a AT-Mega 328 P/PU which communicates with a Wi-Fi enabled SparkCore over I2C. Module connects via local Wi-Fi to publish reading into a publically viewable Google Sheet. Provides real-time monitoring of garbage cans.

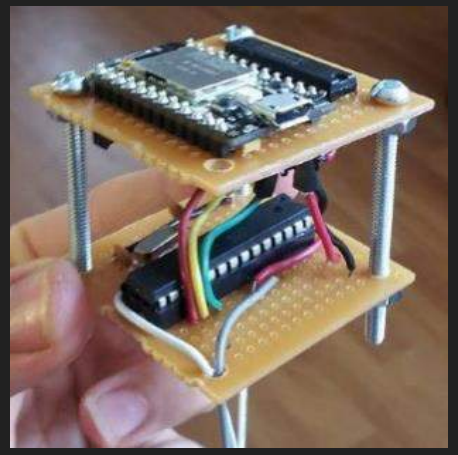
Delivered Product Features

- Relay lights that alert nearby staff to waste bin's level of storage capacity
- Sleep-Wake cycle on high power consumption Wi-Fi module, 90% of the time runs on tens of miliAmps.
- Wi-Fi module connects through local network to upload readings into an accessible Google Sheet





Version 1



Version 2

Skills Developed

- Electrical circuit design and layout
- Programming in Wire/C for Arduino
- Time management and project scheduling via Gantt charts and deliverable deadlining.