Professional Portfolio

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1 Background

My name is Abdul Fourteia, and I have a passion for engineering and working on state-of-art technologies. I graduated from the University of Victoria (UVic), with a bachelor's degree in mechanical engineering, in October 2017. While, at school I worked on several projects spanning multiple industries including robotics, automotive, and aerospace. I have more than a year of co-op experience, which includes working as a data analyst for a renewable energy research group (8 months) and as a machine shop assistant for the engineering faculty at UVic (4 months). After graduation, I worked as a robotics engineer in a research lab at UVic, where I built autonomous robots.

The main purpose of this document is to demonstrate some key technical skills and knowledge I possess, and my ability to contribute to teams with various technical background and technological challenges. The following report mentions several major projects I contributed to (see Figure 1). This report is not intended to be analytical. Therefore, the graphs included are mainly used for the purpose of representing the work done, and some labels and texts on the graphs may not be legible. This portfolio includes projects that was either part of university course work or extracurricular activities of which I can freely discuss.

Figure 1: Sample of the projects I have been part of. Starting from right, they are UVic Rocketry, senior design project, UVic Formula Hybrid, UVic Sattelite, UVic AERO.

I highlight six different team-based multidisciplinary projects. They are ordered in chronological order with the most recently updated project listed first. Some of these projects were performed concurrently and with the oldest dating back to my sophomore year at the university (2013). The work timelines range from 3 months up to two years. The list of the project includes:

Table 1: Project name and the date periods when I was involved

Project	*My Main Contribution*	*Timeline*
UVic Formula Hybrid Team	Control System Design and Signal Analysis	Nov 2018- Oct 2019 & Sept 2014– April 2015
University Capstone Project	Mechanical Design and System Integration	May 2017 – Aug 2017
UVic Rocketry Team	Mechanical Design and Project Management	Sept 2015 – Oct 2017
Popsicle Bridge Crusher Machine	Mechanical Design	Jan 2017 – April 2017
UVic Satellite Design Team	Mechanical Design	Sept 2015 – Aug 2016
UVic AERO Team	Mechanical Design and System Integration	Sept 2013 – Aug 2016

2 Project: UVic Formula Hybrid Team

2.1 About the Project

The UVic Hybrid Team is a group of engineering students that design and build hybrid vehicles. A model of the vehicle is shown in below Figure 2. The focus of the team is to research and implement powertrain technologies in a hybrid setting. The current powertrain architecture on the vehicle is a parallel hybrid design implementing a 250cc motorcycle engine from [KTM](KTM) and a brushed DC electric motor. A diagram of the implemented architecture is shown below in Figure 3.

Figure 2: Early CAD render of the vehicle in SolidWorks (2015)

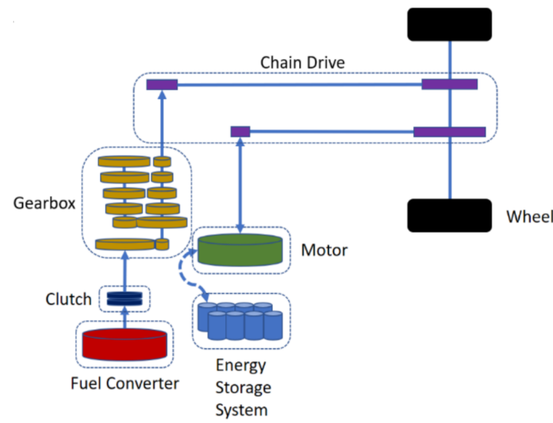


Figure 3: UVic Formula Hybrid parrallel power train architecture

2.2 My Contribution

In the end of my 2nd year as an undergraduate student, I joined UVic Hybrid and played an early role in the vehicle development as shown in Figure 2 and Figure 4. Most of the work I completed was focused on mechanical integration and lending a hand where needed. I helped lay out the mechanical and electrical components on the vehicle. Which included designing mounting brackets and a chain guard for the powertrain.

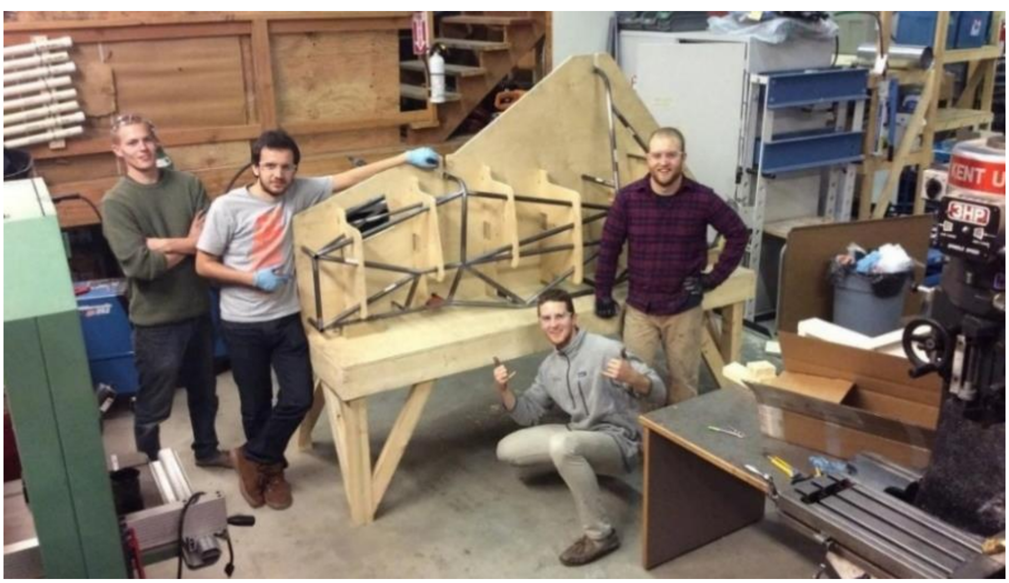


Figure 4: Helpling the team mount the frame to the Jig for welding

2.2.1 Control System Development

After graduating, I joined the team once again with the focus being the control system. The supervisory controller the team uses for the vehicle is a MicroAutoBox II (Shorthand - MABx) from [dSPACE](). This controller is intended for rapid prototyping and not for long term deployment. Due to its size and weight, the team wanted to explore other alternatives. I used the vehicle as a platform to learn the dSPACE software tools and develop a new control scheme (using Simulink) that can be deployed to a smaller and lighter controller that is based on the Texas Instruments [TMS320F28379D]() chip. Figure 5 provides a summary of the work I have done in a visual form. Figure 6 below shows a prototype I built of the new controller next to the MABx (previous controller).

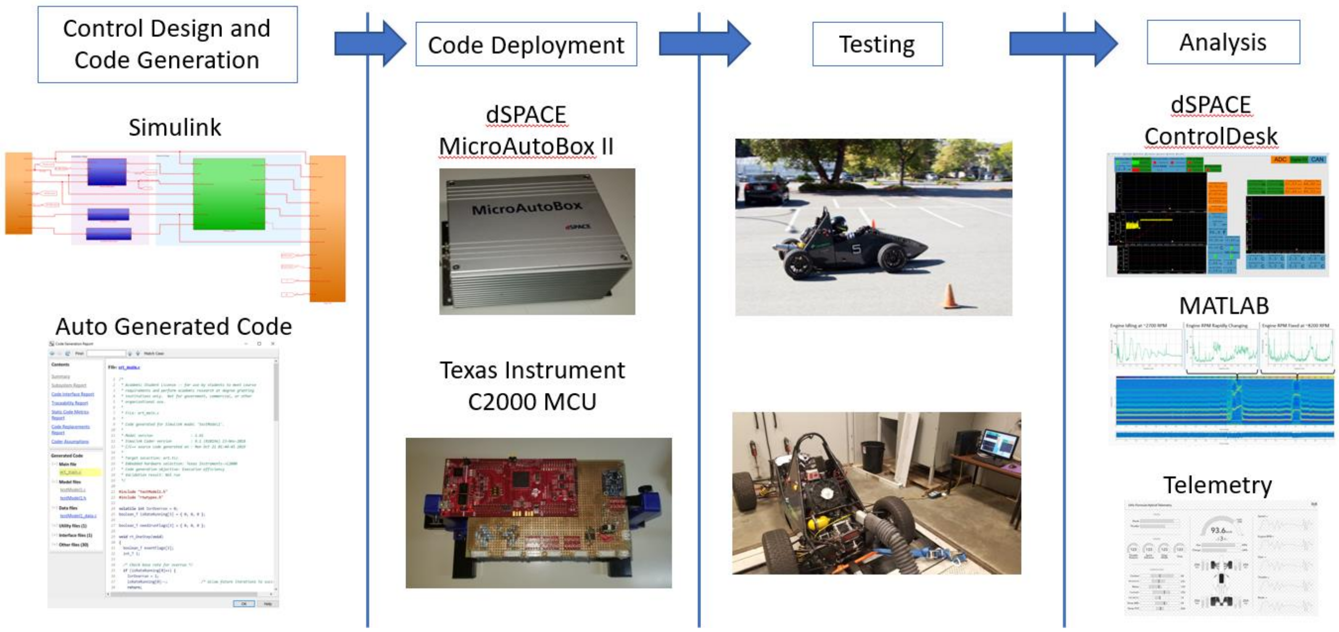


Figure 5: Visual layout showing the work flow and design cycle that I gone through to develop the control system

Figure 6: A prototype of the new vehicle supervisory controller next to the MicroAutoBox II (MABx), which it replaces. Compared to the MABx, the new controller is lighter and smaller making packaging easier. It also includes other features like IMU, GPS, and Wifi communication.

Similar to the MABx controller, the new controller algorithm is developed using Simulink. A sample of the control algorithm is presented in Figure 7. The code is autogenerated from the model using MATLAB Embedded Coder and Texas Instruments hardware support, which is then deployed into the target hardware.

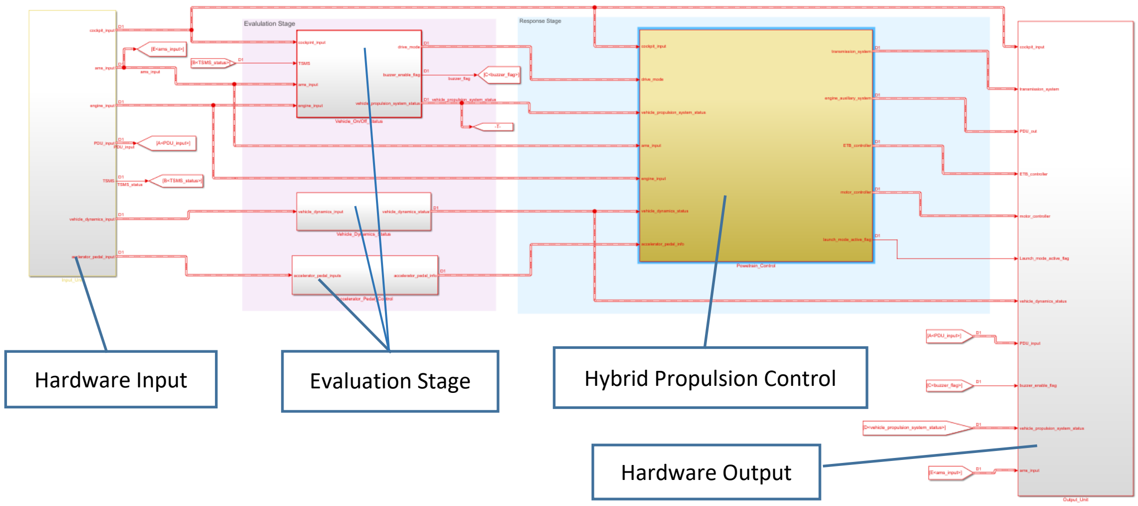


Figure 7: The new control model designed for the TI controller

While developing the logic for the new controller, I reverse engineered the old control scheme developed for the MABx. I used [ControlDesk] as a instrumentation tool to record sensor and logic data while the car is being operated. Figure 8 to Figure 10 provide images of the vehicle being tested and the graphical user interface made in ControlDesk, which is used as an instrumentation tool to monitor and record the data.

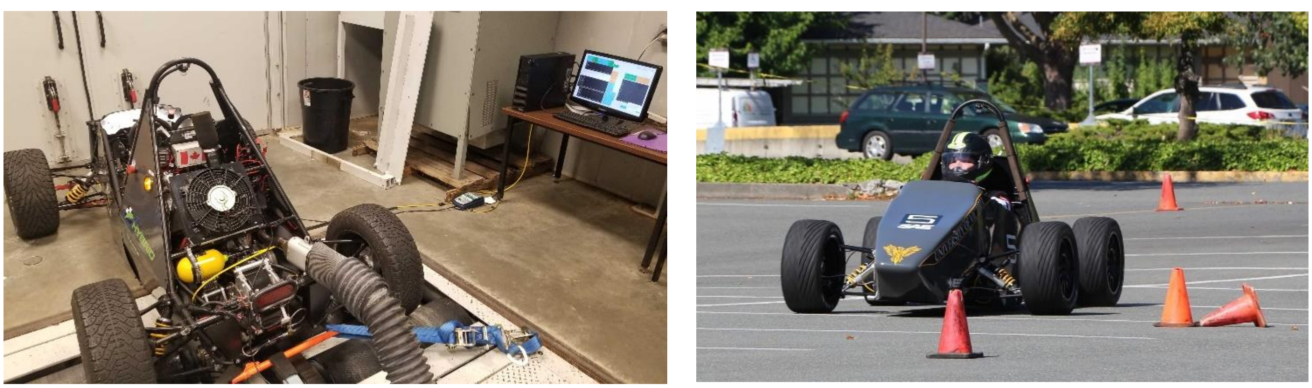


Figure 8: Dyno and track testing the vehicle. It is worth noting the dynomometer hasn't been fixed at the time of testing and we were only using the rollers on a moving surface (no load). Therefore, data regarding torque and horsepower from the dyno can't be measured.

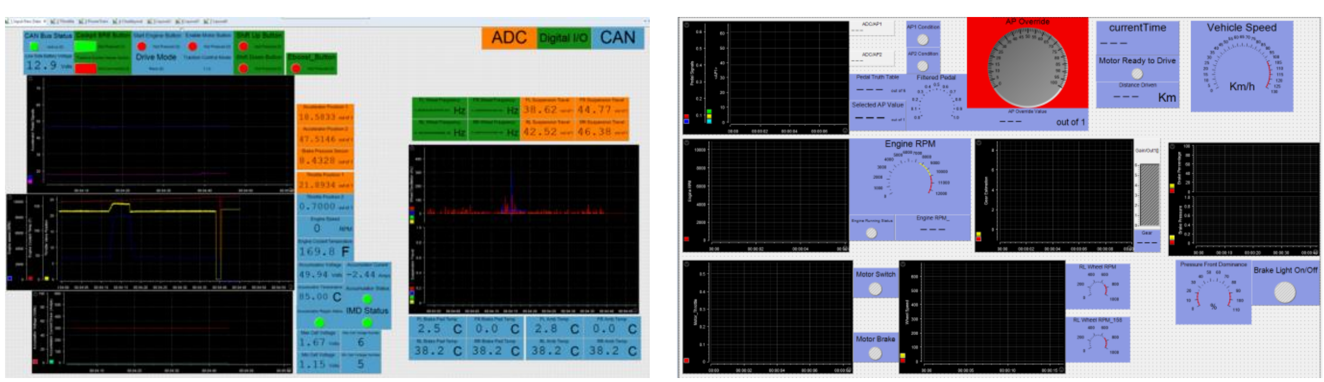


Figure 9: Examples the layouts I created in ControlDesk to monitor and record data (temperature sensors are not calibrated so they are sending wrong values)

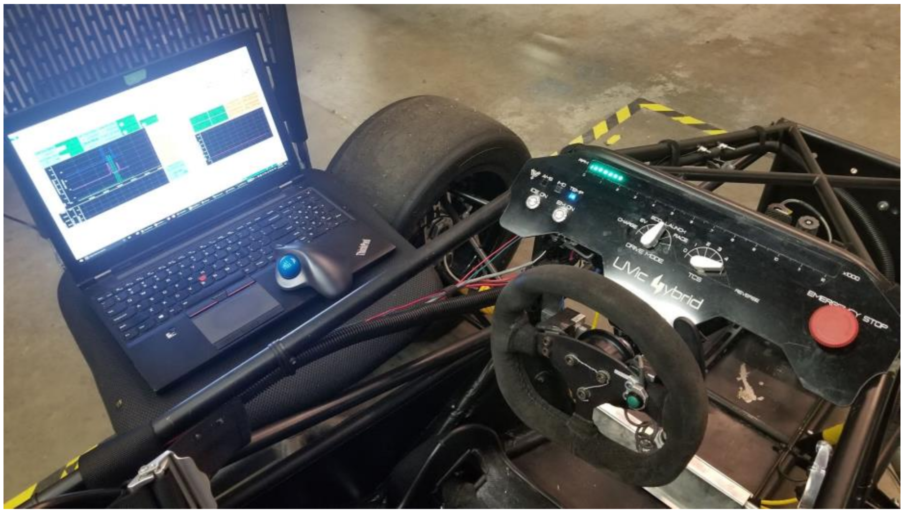


Figure 10: Calibrating the sensor values for the accelerator and brake pedal

The team was also lacking a model of the vehicle for MIL, PIL and HIL simulations. Therefore, I used data to create an approximate plant model to the vehicle using [Simscape](). This model will allow the team to use the model-based design approach for future control development as shown in Figure 11.

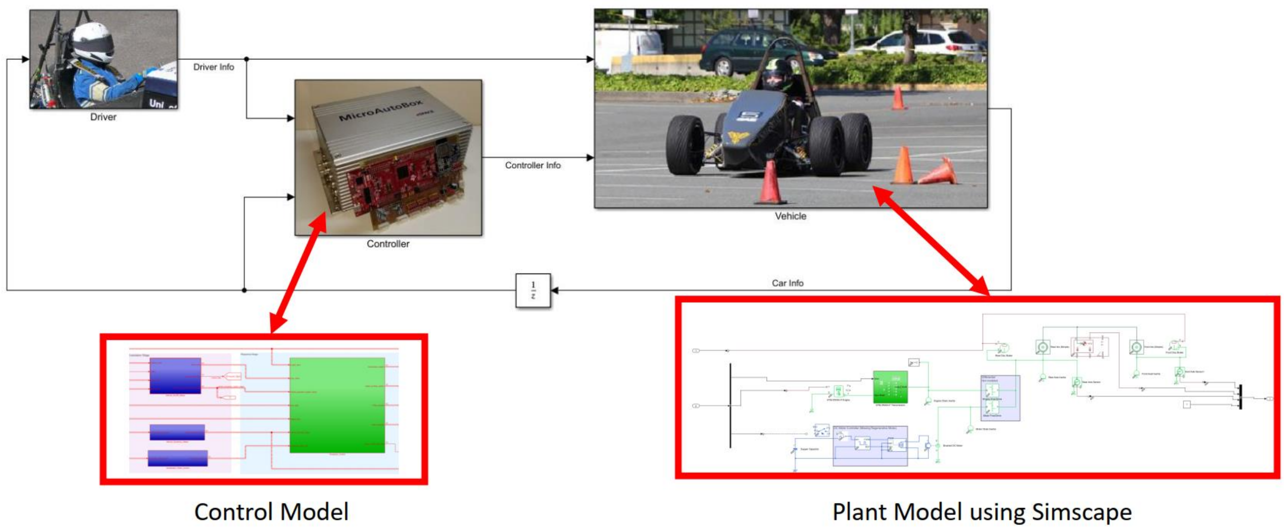


Figure 11: A Simulink model that includes plant model of the vehicle, which is made using Simscape. This model is underdevelopment and will be used for for future MIL, PIL and HIL simulations.

Figure 12 illustrates an example of reverse engineering and control design done on the shift mechanism. The old algorithm implements a hybrid of [Stateflow]() charts, Switch blocks, and logical operators. This layout made debugging very challenging, therefore I redesigned it completely by putting the whole algorithm is a single Stateflow chart. I was still able to preserve previous algorithm's outcome. In addition, I implemented extra features like detecting mis-shifts, and enabling automated shifting based on the set drive mode.

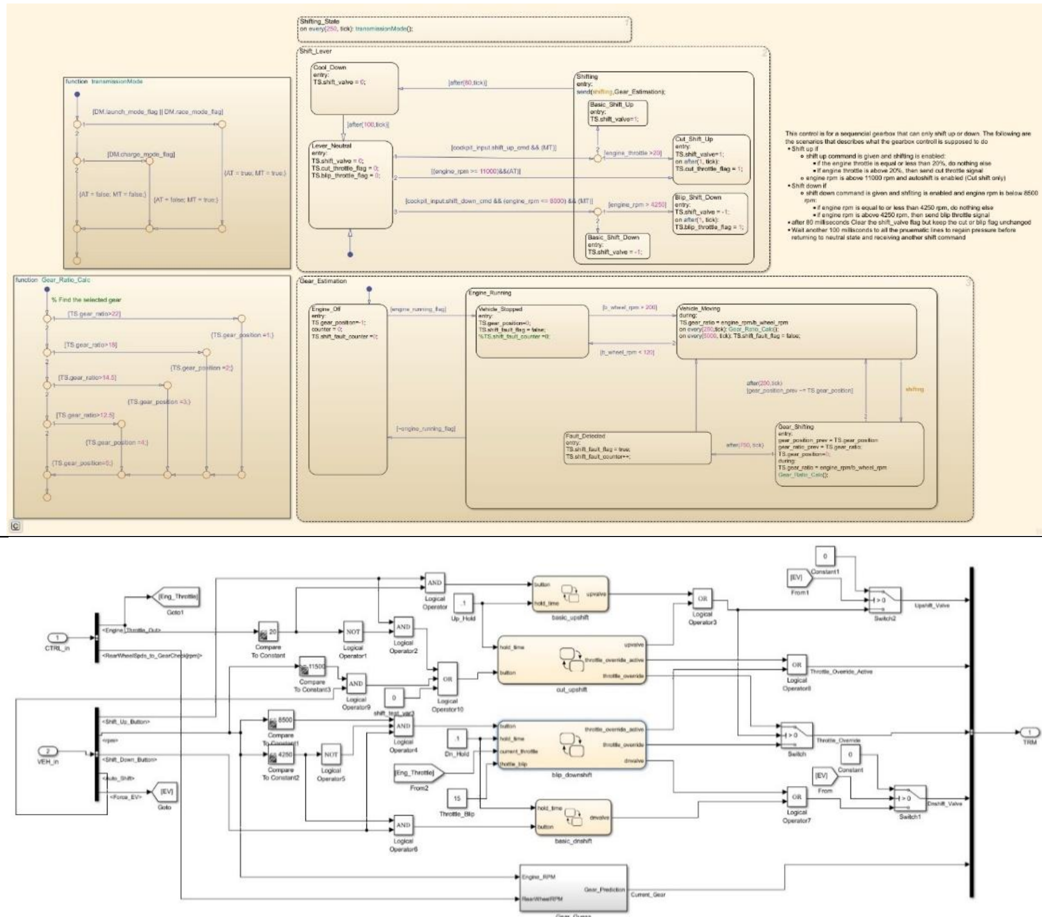


Figure 12 Comparison of the new (top) control scheme for the shift mechanism with the old one (button). The new algorithm is completely implemented in a single Stateflow chart, making it easier to debug and track the various states the shift mechanism can be in.

2.2.2 Signal Processing

For signal post-processing, I used MATLAB to analyse and visualize the data. I have conducted analysis on various components of the car like the engine unit, the electric storage system, the suspension system, and the CAN bus. I reported this analysis to the team to help make decisions on what needs improvement and what we should avoid when designing the next vehicle.

Figure 15 provide an example of this analysis, which is done on the engine section of the powertrain. While doing my analysis to calculate the gearing ratio, I noticed that the engine speed, when compared to the driven wheels speed, did not follow a defined straight line while accelerating. This is usually an indication of slip occurring in the system. As a primary suspect, the auto-clutch was inspected, and the Teflon pads on the auto-clutch were found to be worn out (see Figure 14). After servicing the clutch, the driver felt the engine responded better to throttle demands. I couldn't get data to confirm that the issue is resolved. A mechanical failure occurred on the front wheels when it was tested for the first time, and the data recorder wasn't running then. The car has been inoperable since.

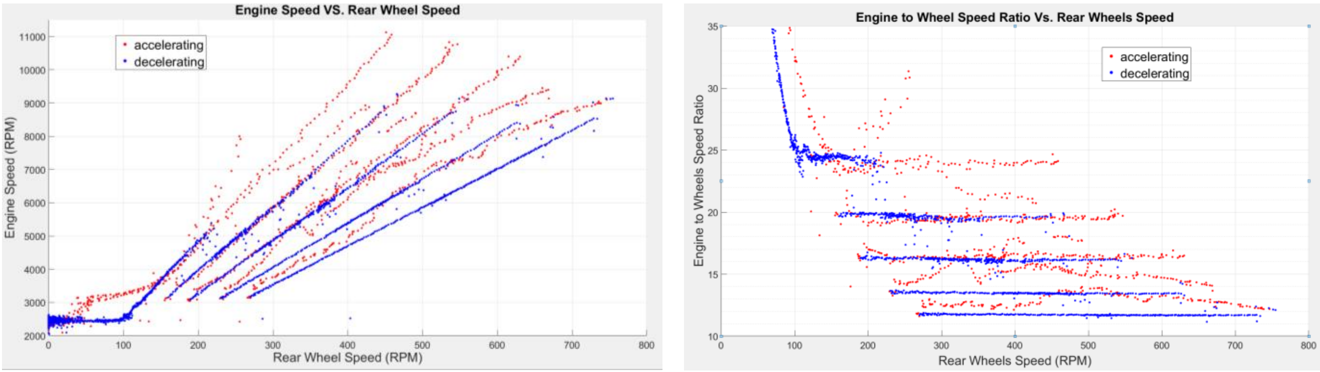


Figure 13: Two graphs representing the same data; one in form of the engine speed in RPM with respect to the driven rear wheels speed (right), and the other in form calculated speed ratio plotted agaist the rear wheels speed. The engine transmission has five gear ratios, which are individually represented by a line in the plot. The acceleration points deviate from those lines, which is an indication of slip occuring in the system. Upon further investigation into the auto-clutch's condition, it was found that it had worn out.

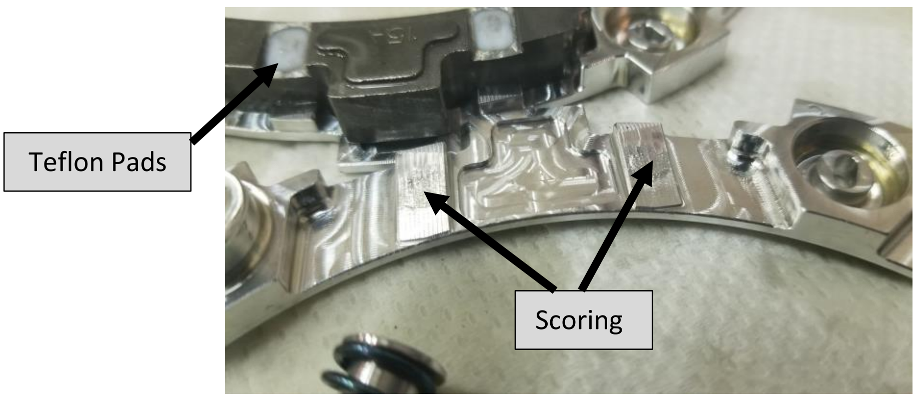


Figure 14: The teflon pads on the auto-clutch were worn out, causing scoring on aluminum mating surface. This affected the clutch engagment parameters allowing for slip to occur at rpm levels where it was supposed to be fully engaged.

Another highlight of my analysis is finding odd steady-state changes in the reading of the all analog sensors that were measured by the MABx when the vehicle is in operation. These changes were not driven by the physical parameters they measure. This investigation started when we noticed that the engine stalls in idle if the radiator fan is turned on. Our engine control unit (MicroSquirt) uses a feedback system to determine the amount of fuel based on the reading of the throttle position sensor (TPS) instead of the air to fuel ratio (AFR). When the radiator fan turns on, it draws about 5 amps. The return path for this current is the frame, which is shared with the analog data lines. This amount of current causes a voltage-drop across the frame that gets detected on the TPS line. This reduces TPS measured value, causing the MicroSquirt to deliver less fuel for the same amount of air. Hence, the engine leans out and stalls. This was eventually fixed by creating a dedicated return path for the radiator fan. However, similar effects are still caused by other loads like the fuel pump. With the root cause determined, the team decided to implement dedicated ground paths for all analog and communication lines in the future car design.

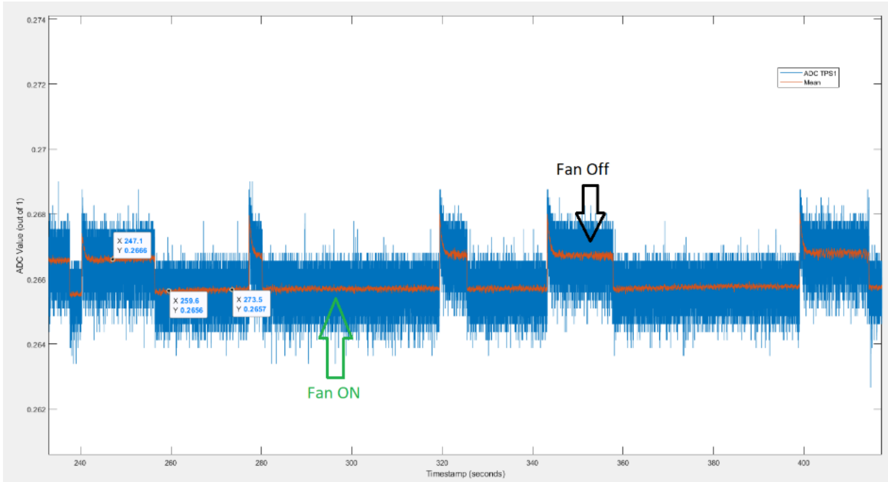


Figure 15: Analysis on the analog signals recorded by the MABx shows a change in the steady state value of a signal depending if certain power units like the fan motor is enabled. The vehicle frame is being used a common return path for all signals, and certain load units consume enough current to cause a votlage-drop across the frame that is measurable by the ADC units.

Figure 15 provides an indication on the amount of noise that we are dealing with on the car. I worked on creating better digital filters for the signals. I used a combination of the Signal Analyzer and Filter Designer apps on MATLAB to design these filters. The old control scheme used 200-point moving average filters. Giving the sample rate is 1 millisecond, this made the car relatively slow at responding to throttle commands. I switched to using IIR filter because it's computationally faster as it requires fewer samples compared to a FIR filter with similar frequency response characteristics. I started with a Chebyshev II filter, and I manipulated the poles and zeros in the Z domain until I reduced the overshoot to an acceptable level.

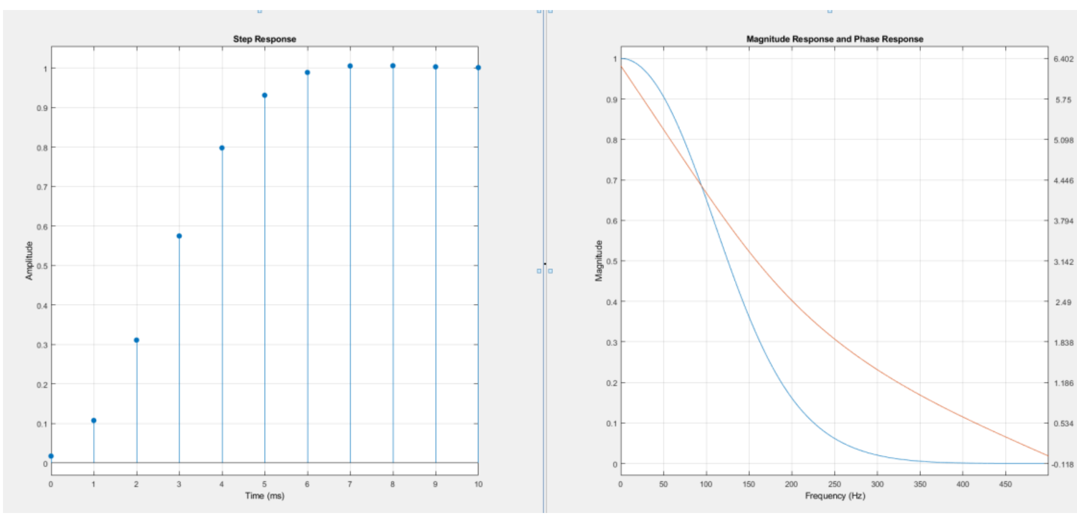


Figure 16: IIR Biquad filter properties implemented on the throttle position sensor

However, I noticed a peak at the Nyquist frequency (500 Hz) in some of the signals, so I decided to do more analysis by increasing the sample rate to 10 kHz on the MABx. It's worth noting that the MABx ADC hardware comes with a low pass filter with a corner frequency of 10 kHz, and a conversion time of 6.6 microseconds. Therefore, I kept this information in mind while performing the analysis. One of the results can be seen in Figure 17, which plots the frequency domain analysis conducted on a sensor data that informs the position of the rear left wheel suspension. The data was recorded while the car is stationary, the electric motor is disabled, and the engine is idling at ~2700 RPM. There are two regions in the data where the engine is rpm is increased, which are indicated in the graph. The spectrogram in the figure shows frequency peaks starting at ~550 Hz. This 550Hz fundamental frequency and its harmonics do get slightly attenuated when increasing the engine rpm, but other noise are introduced in the process, which are getting partly aliased. I am currently using this information to work out both the sources of this noise. In addition to some hardware filters to minimize the noise. This work will improve the effective number of ADC bits (ENOB) for the analog signals on the car, which will ultimately increase the signal to noise and distortion ratio (SINAD).

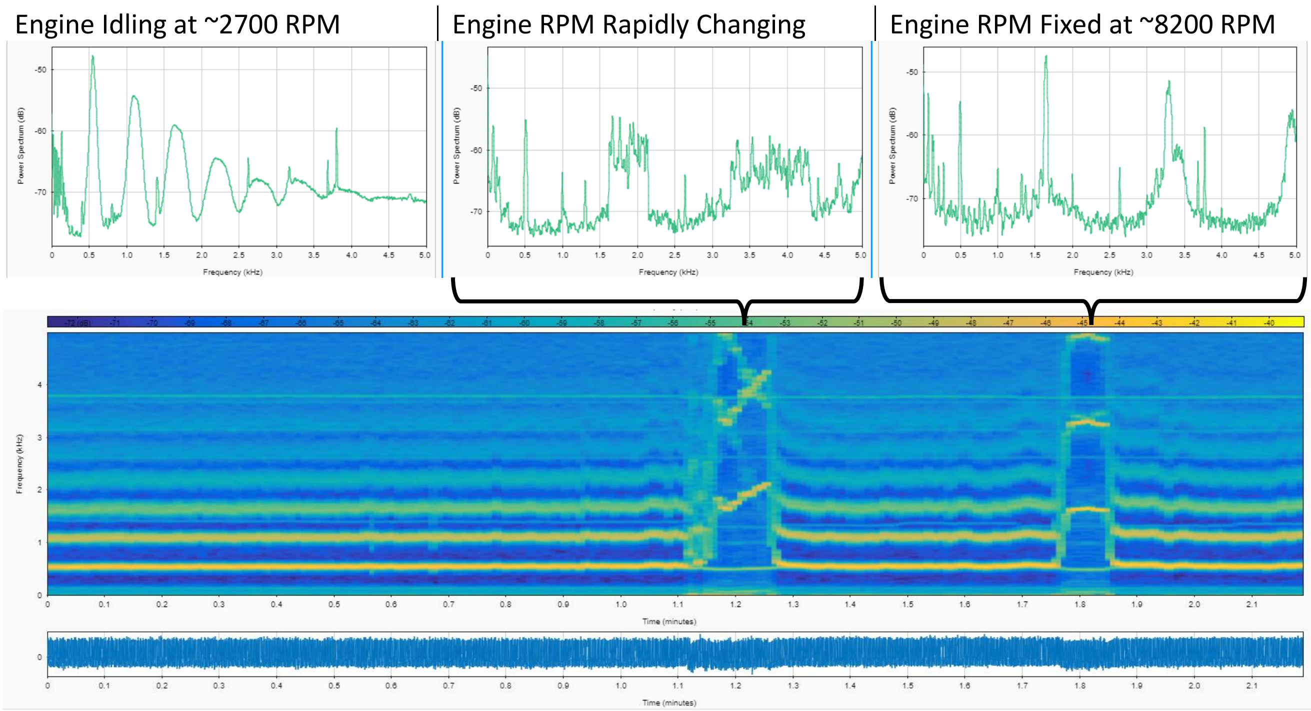


Figure 17: Spectrum analysis on the the rear left wheel suspension travel data. The car is staionary during recording, and the signal is sampled at 10 kHz, with the DC compoent of the signal removed. The graphs shown are: frequency spectrum (top), the spectrogram (middle), and the data in the time domain (buttom). There are three frequency spectrum graphs corresponding to three events in the data depending on the engine speed which are: engine at ~2700 RPM (idle), engine RPM changing, and engine at ~8200 RPM.

I have established a CAN database for the team using the CANdb++ Editor from Vector. I condensed the data as much as possible by minimizing the number of bytes reserved for each signal in a message. The number of reserved bytes depends on many factors like the max and min value of the signal, weather or not the value is signed, and if the value is scaled by a factor.

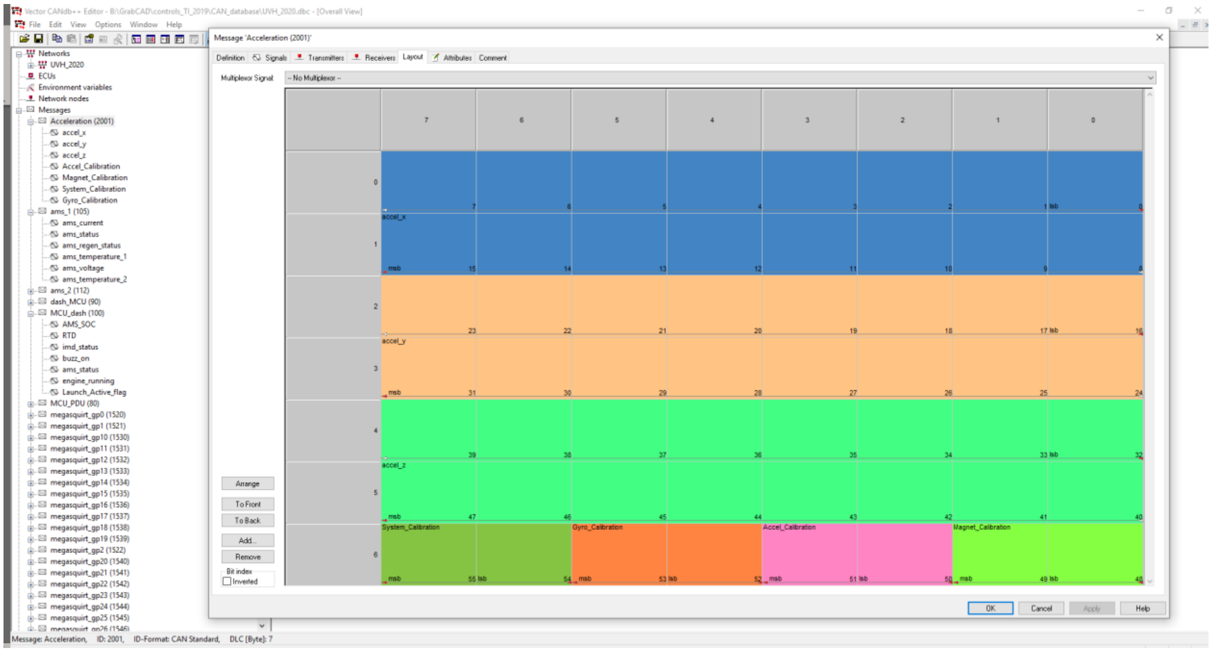


Figure 18: View of the Acceleration message content in the CAN database mde for the car

2.3 Project Conclusion

I was able to develop a new control scheme for the vehicle with new and improved features like better digital signal processing capabilities, launch control, optimized CAN database, battery protection system, and drive modes. This control scheme was ported to and tested with the new TI hardware. The MABx will remain in use for control development before getting ported to the TI board. For this reason, I created a workflow for recording data from the MABx and made MATLAB scripts for importing, post processing, and visualizing the data.

3 Project: Capstone Project (MICA Robot)

3.1 About the Project

For my senior design project course, I assembled a team to build a mobile robot to assist a client, who is quadriplegic, with taking photos with his DSLR cameras. The client used to pursue photography as a hobby before his injury. The goal of the project was to build a gimbal system on a mobile robot that can follow the end-user autonomously. The client wanted an independent mobile robot system as opposed to attaching the gimbal to the powered-wheel chair. This will allow the system to be modular so it can serve difference purposes other than just photography. The presented prototype can be seen in Figure 19.

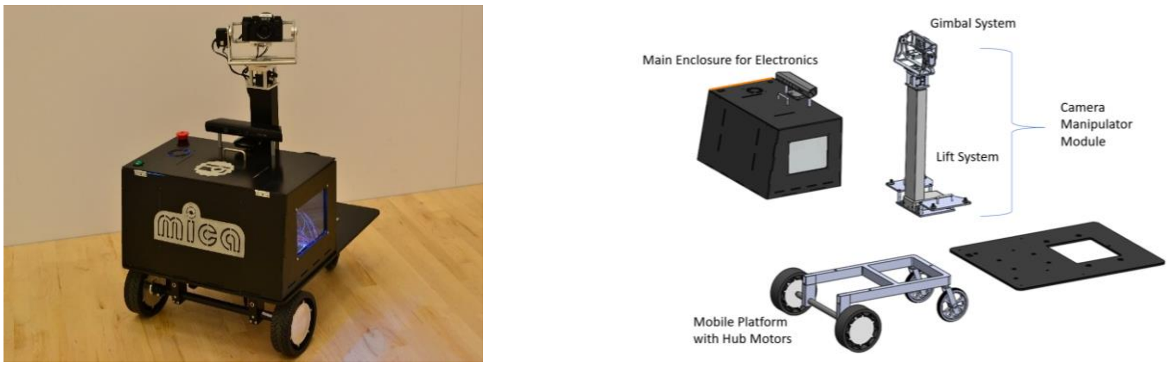


Figure 19: This robot is built as part of the capstone project course

3.2 My Contribution

My focus in this project was on the mechanical aspect of the system. My contribution can be divided into three parts. First, on a holistic level, I utilized my experience from my engineering team activities to manage this project by coordinating among team members on the tasks and keeping track of deadlines.

Second, on the concept generation and market research side, I was able to come up with various design concepts and find off-the-shelf components to achieve our objectives. Figure 20 & Figure 21 show one of the concepts for the lift mechanism and the analysis done on it. This design did not make to the final product. Instead, a lift from a standing desk was selected that can be seen in the image above.

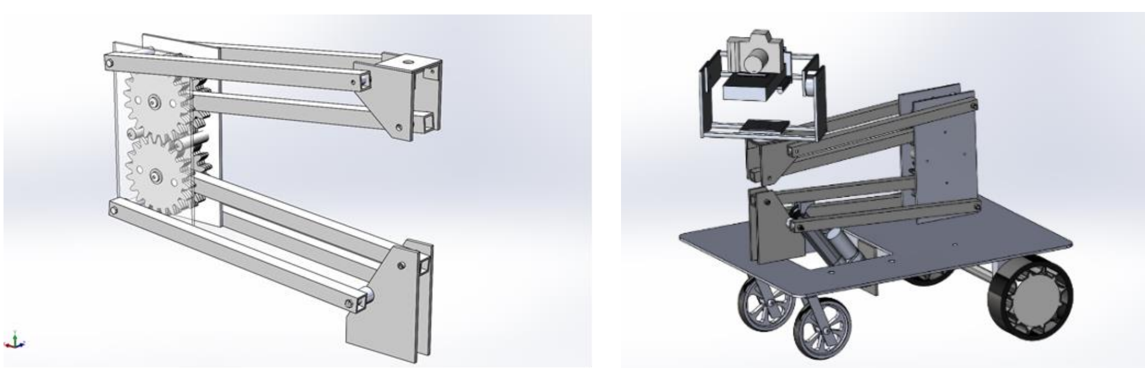


Figure 20: One of the preliminary concepts I proposed for the lift system. Utilmately, we decided to use an off-the-shelf system rather than designing our own due to time constraint.

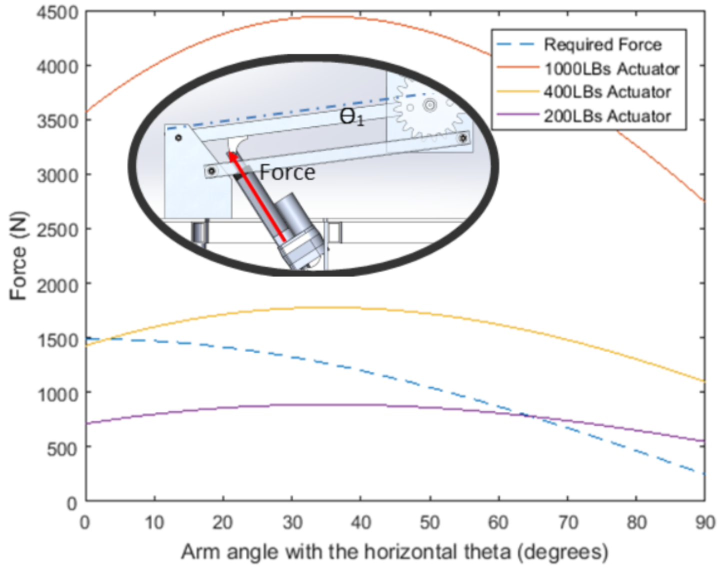


Figure 21: Analysis on the forces required to actuate the lift. The dashed blue line highlitghts the minium force required for each angle of Θ_1 in degrees. The other lines specify the maximum force each acuator can output. As an exmaple, at zero degres (horizotal), 1500 N is equired the move the lift, and only the 1000 lbs actuator can deliver that.

Figure 22 shows an image of the custom-made camera gimbal. We performed load analysis (shown in Figure 23) to ensure the maximum deflection meets our specification.

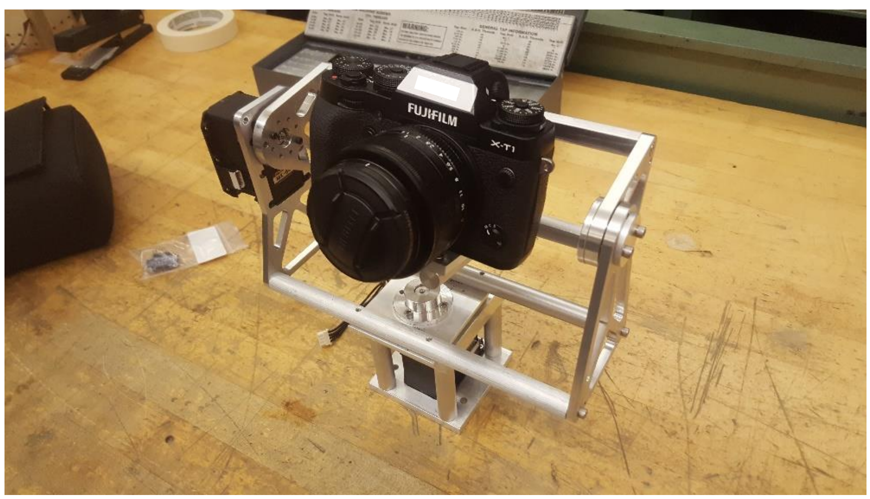


Figure 22: Machined Camera gimbal

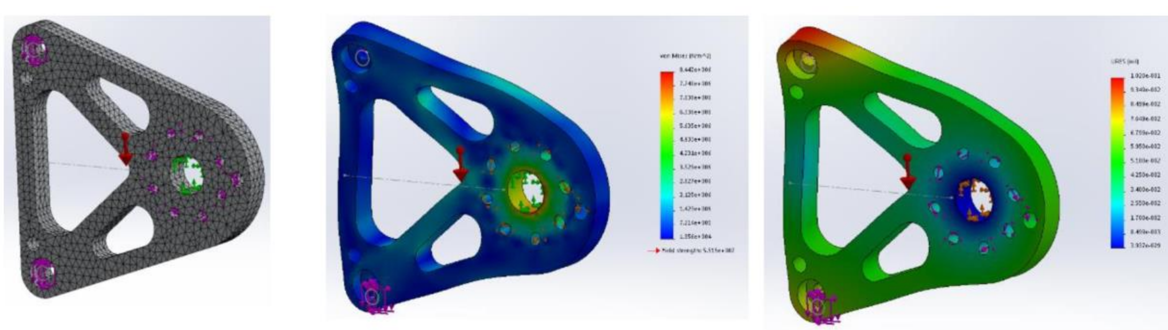


Figure 23: Example of static load analysis conducted on some parts of the gimbal system

Third, I used my machine shop experience and worked on all the mechanical designs and finalized them for machining. Figure 24 and Figure 25 show some of the drawings I created for the gimbal system. I also machined the parts that are highlighted in these drawings.

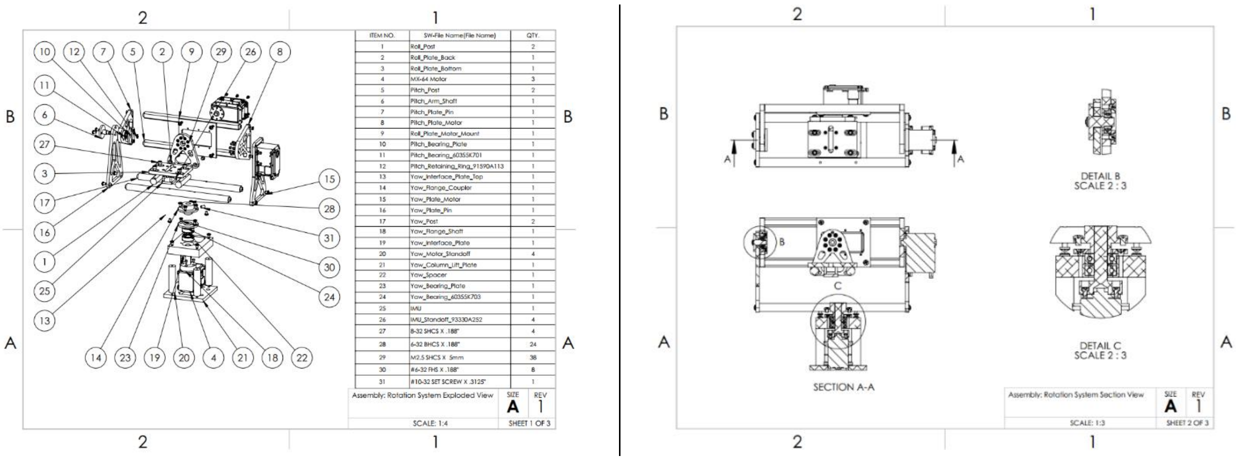


Figure 24: Images showing the exploded view drawing and projected view of camera gimbal system I machined

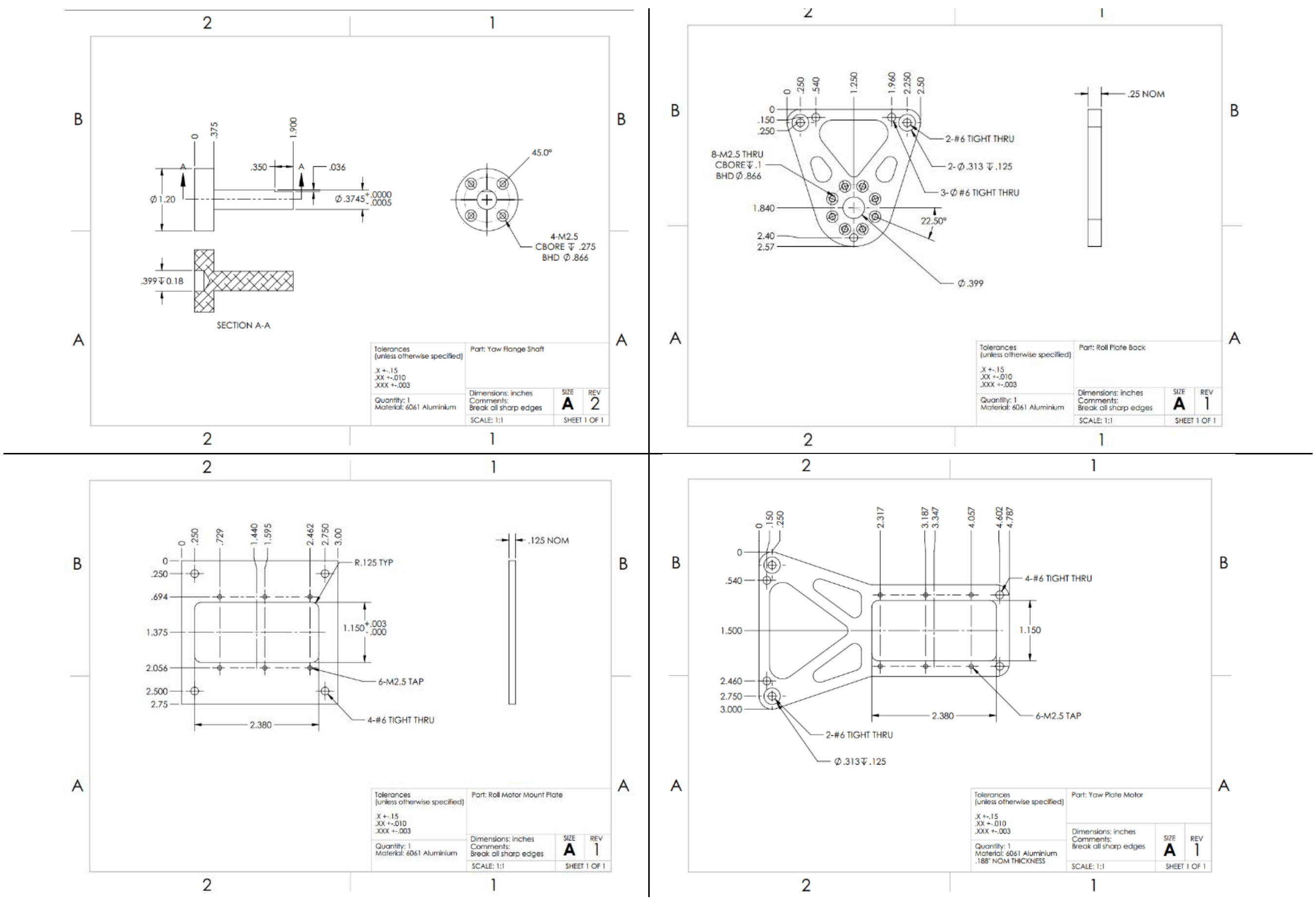
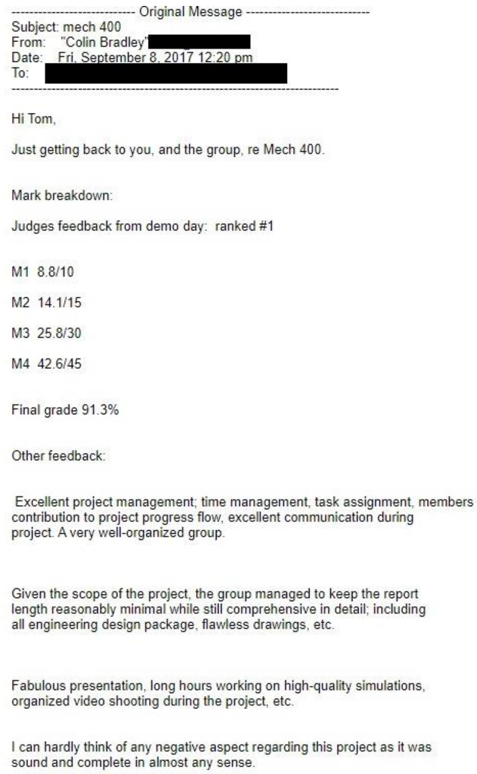


Figure 25: Sample of engineering drawings I made for machining

3.3 Project Conclusion

Our design won best project in both the mechanical and electrical category, and we were awarded the IEEE prize for best design. We also received high reviews for the work we put into this project, some of the feedback can be seen in Figure 26.



---------------------------- Original Message ----------------------------
Subject: mech 400
From: "Colin Bradley" [redacted]
Date: Fri, September 8, 2017 12:20 pm
To: [redacted]

Hi Tom,

Just getting back to you, and the group, re Mech 400.

Mark breakdown:

Judges feedback from demo day: ranked #1

M1 8.8/10

M2 14.1/15

M3 25.8/30

M4 42.6/45

Final grade 91.3%

Other feedback:

Excellent project management; time management, task assignment, members contribution to project progress flow, excellent communication during project. A very well-organized group.

Given the scope of the project, the group managed to keep the report length reasonably minimal while still comprehensive in detail; including all engineering design package, flawless drawings, etc.

Fabulous presentation, long hours working on high-quality simulations, organized video shooting during the project, etc.

I can hardly think of any negative aspect regarding this project as it was sound and complete in almost any sense.

Figure 26: Images showing the award we won and feedback we received from our instructure and the teaching assistance staff

After graduation, I pursued this project as a full-time job, where I worked on improving the original design. I had the opportunity to work on the project in multi-domain developing the electrical and software systems in addition to the mechanical components.

4 Project: UVic Rocketry Team

4.1 About the Project

The UVic Rocketry (UVR) Team is a group of driven students developing experimental rockets. These rockets range between 1.5 and 2.5 meters in length and compose of multiple subsystems. These subsystems are highlighted in Figure 27 and include propulsion, aerodynamics, GNC (guidance, navigation, and control), telemetry, recovery, and science experiment.

The team competes in the Intercollegiate Rocket Engineering Competition (IREC) hosted by the Experimental Sounding Rocket Association. The objective is to send a rocket with a 10-pound payload as close to 10,000 feet altitude as possible.

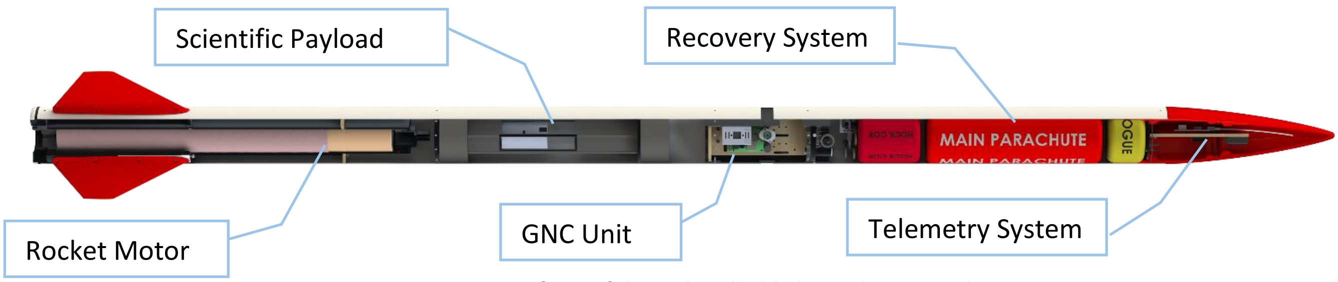


Figure 27: Section view of one of the rockets highlighting the main subsystems

4.2 My Contribution

When I initially joined the team in 2015, I contributed to the propulsion and aerodynamic development of the rocket inducing doing analysis and structural tests as well as gathering data on rockets with similar specification as ours. Figure 28 & Figure 29 show an example of the type work I have done. I also helped with the general integration and logistical challenges like funding for our first rocket (MVP-1), which is shown in Figure 30 along with the team at that time.

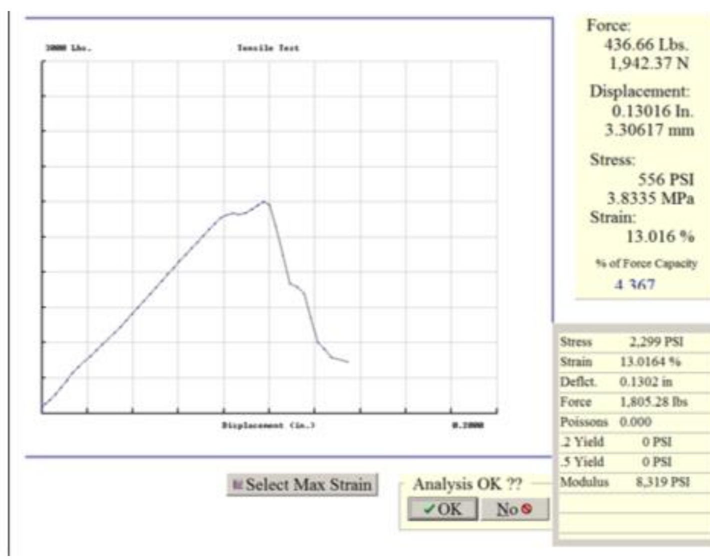


Figure 28: Tensile test conducted to determine the adequate number of layers for the carbon fuesalage.

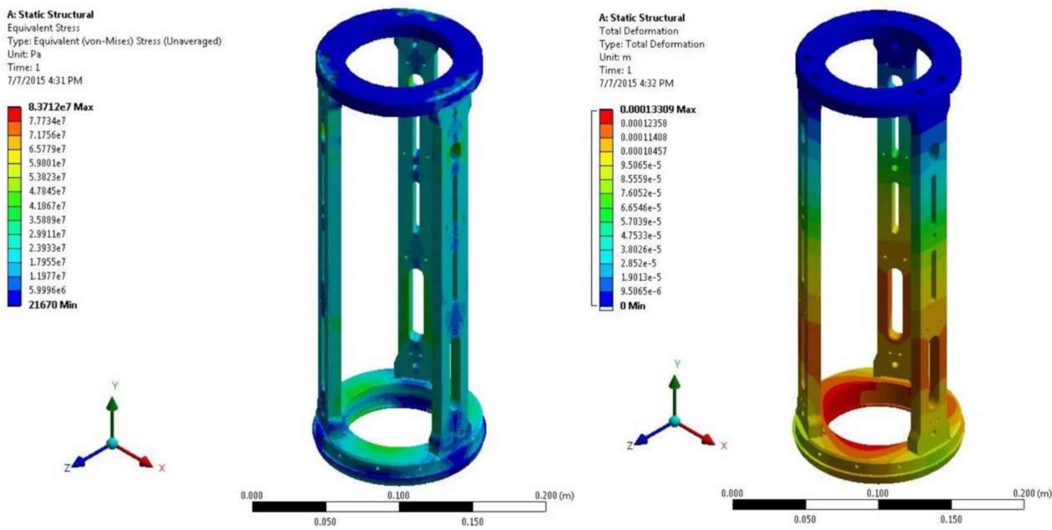


Figure 29: Impact load analysis on the rocket motor holder (shark cage)

Figure 30: MVP-1 rocket is the first functioning rocket built by the team, which lead us to our first win at IREC 2016.

In 2016, I was elected the project manager of the team, where my main goal was to expand the team's network by establishing better relationship with engineering faculty and the university in general and increase the funding available to the team for IREC-2017. On the technical aspect, since I was qualified for super-user status at the machine shop, I was able to support the team with the manufacturing and mechanical design reviews.

Coming back from a great win at IREC-2016, the team decided to develop two rockets to compete with multiple payloads. This meant more funding is required to meet the rising cost. By seeking other funding channels, we managed to increase the team's budget from $10,000, in the previous year, to $20,000. Furthermore, the team was just a year old at that time, so I worked on strengthening the relationship with our faculty to get more exposure and expand the team's network. Throughout the year, I worked on various funding proposals and had many meetings to ensure we were on track to get those two rockets done, which are shown in Figure 31.

Figure 31: The team posing with MVP-2 (left) and Skuukom-1(right) were launched at IREC-2017

In addition to logistical support, I helped design and manufacture various mechanical systems that were used in the rocket and other rocket related apparatuses. Figure 32 shows photos of the parachute release system prototype that adds redundancy to the release mechanism. Figure 33 shows an addition examples of parts that I help design and manufacture for the team.

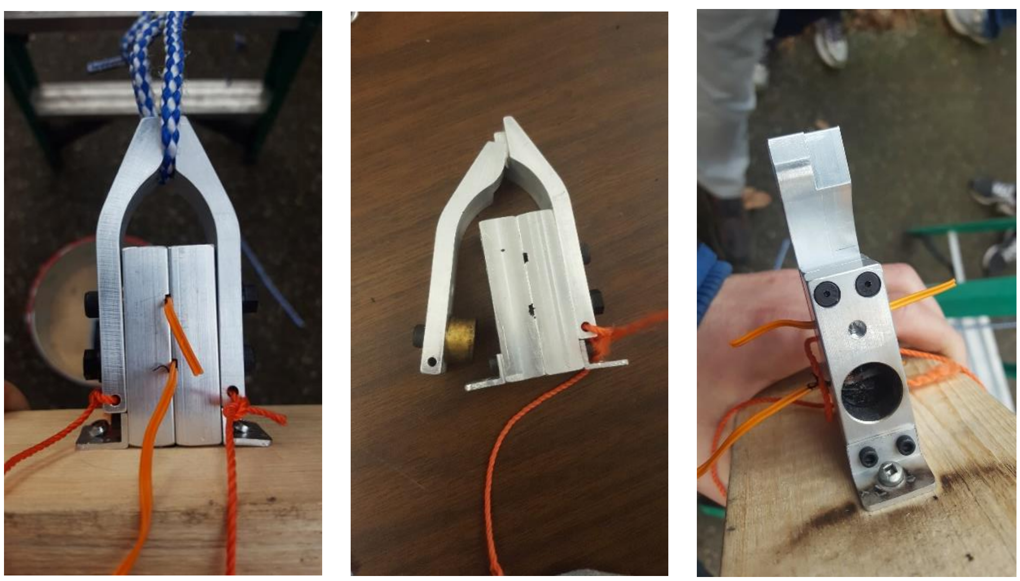


Figure 32: A parachute release system that I designed and machined. The goal of this design is to address the lack of redundacy in our older system. Each of the two hooks can be independently released by a didicated charge. Failure of one hook release mechanism

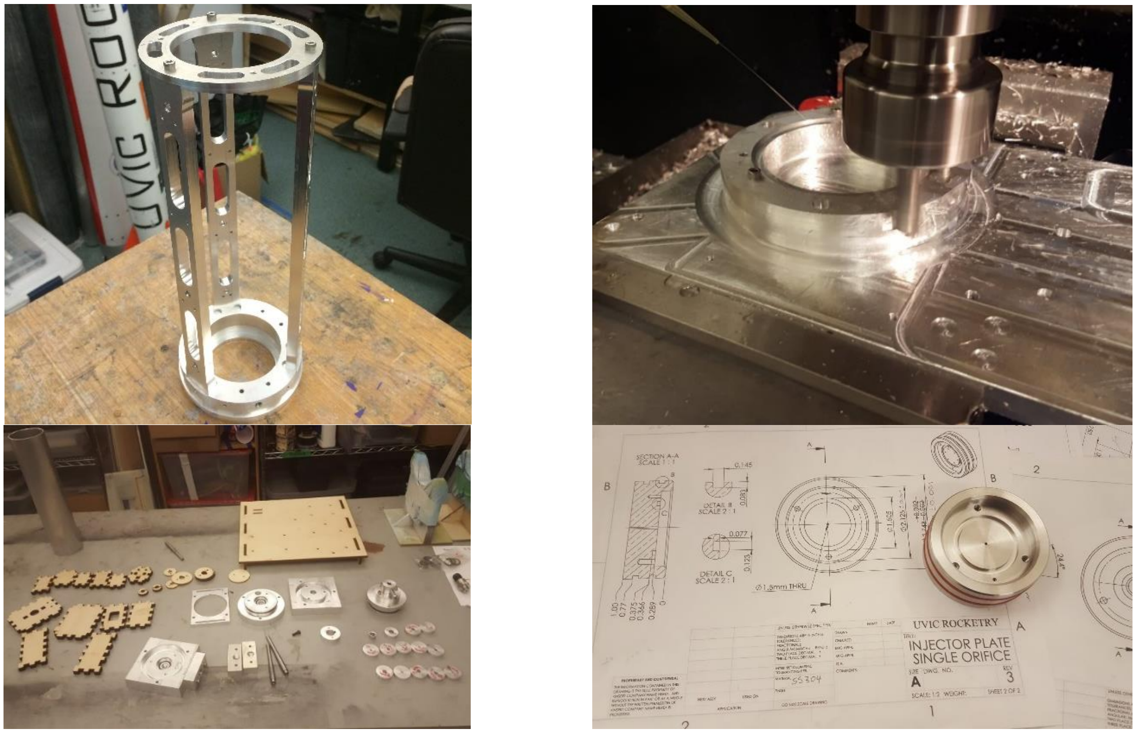


Figure 33: Some of the parts I machined for the team. These include parts for the rocket (motor mount) and other experiment equipment like the cold flow chamber and fillament winding machine.

4.3 Project Conclusion

The launch of the first rocket was very successful, and we were able to secure 3rd position out of 44 teams at IREC-2016. A video of our launch can be seen here & here. At IREC-2017, we won an award for best payload (article can be found here). However, the rockets didn't perform as we hoped with one of them crash-landing due to parachute entanglement. Figure 34 shows the awards we received, and Figure 35 shows photos of MVP-2 rocket during launch and landing.

Figure 34: The awards we won while I was part of the team

Figure 35: Images of the MVP-2 rocket during launch and after launding (2017)

I joined this project with no prior experience or knowledge of rocket science. However, I was able to make very meaningful contributions that lead me to becoming the team co-lead. The team's membership grew from 12 to 25 core members with many more as general participants. Even though our team was two years old at the time, we established a strong relationship with the university. We have been visited by notable people like the university's president Jamie Cassels, former Canadian astronaut Bjarni Tryggvason, and Canada's Minister of Science and Sport Hon. Kirsty Duncan. We were even featured in one GoPro's promos (minute 4:09).

5 Project: Popsicle Bridge Crusher Machine

5.1 About the Project

Victoria Chapter of the Engineers & Geoscientist BC Association (EGBC) approached me to finish up a project started by a couple of students to build a machine that can be used in popsicle stick bridge competitions. The goal of the machine is to measure the strength of a bridge in a fashion like a tensile test machine. We had to design the machine around a bridge envelope , which was provided to us and can be seen the rulebook.

5.2 My Contribution

The main challenge of this project was the tight timeline of 3 months. I had to recruited two other students to work on the electrical and software while I focused on the mechanical aspect of the design. The president of the Victoria chapter asked for a loading capacity of 1000 Lbs, while keeping the machine easy to transport.

I came up with three concepts, which can be seen in Figure 36. After discussion amongst the team and using weighted objectives analysis, we chose the design with the electrical-hydraulic car jack to provide the load. To measure the applied force on the bridge, we used a load cell sensor. In addition, I added a transparent cover to allow for better viewing while not requiring eye protection for the audience to observe the test.

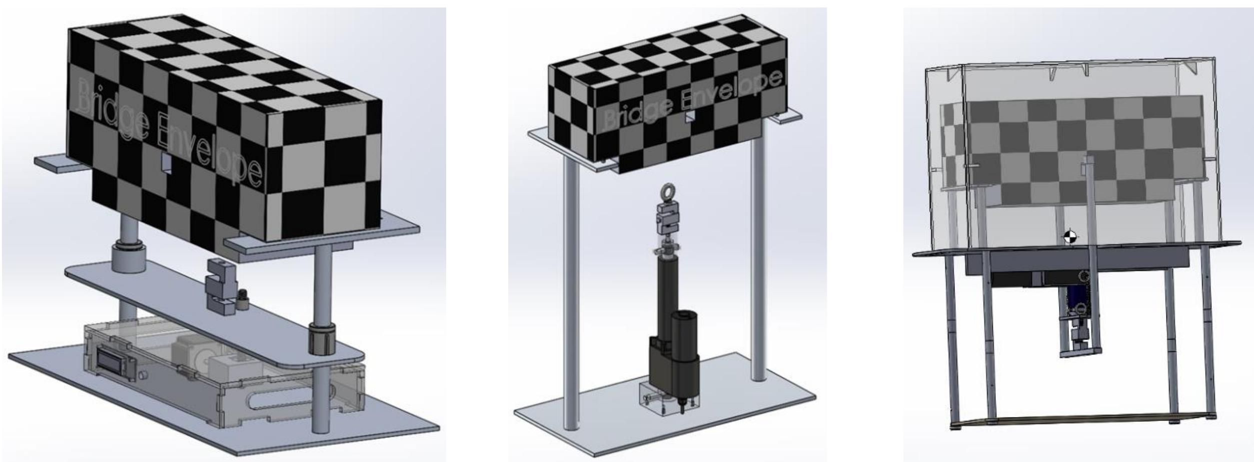


Figure 36: Three concepts were developed using different types of load actuators. The one on left uses a DC motor with a wormdrive transmission and a leadscrew. The one on the middle uses a linear actuator. The one on the right uses an electric-hydraulic jack.

After the design phase, I machined all necessary parts and helped with testing the electronics and progress updates for the client. Figure 37 and Figure 38 include images of machining, assembling and testing the machine.

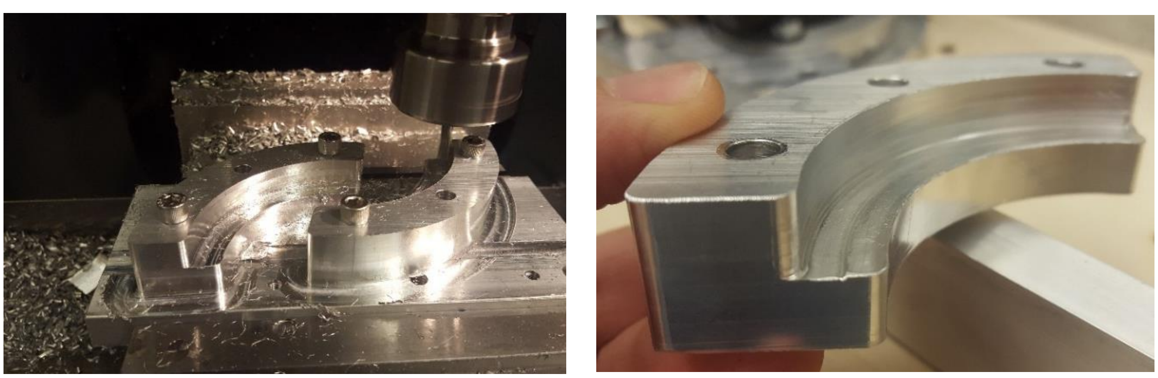


Figure 37: Brackets used to clamp the Hydraulic jack to the structure without making any permanent modification to the actuator

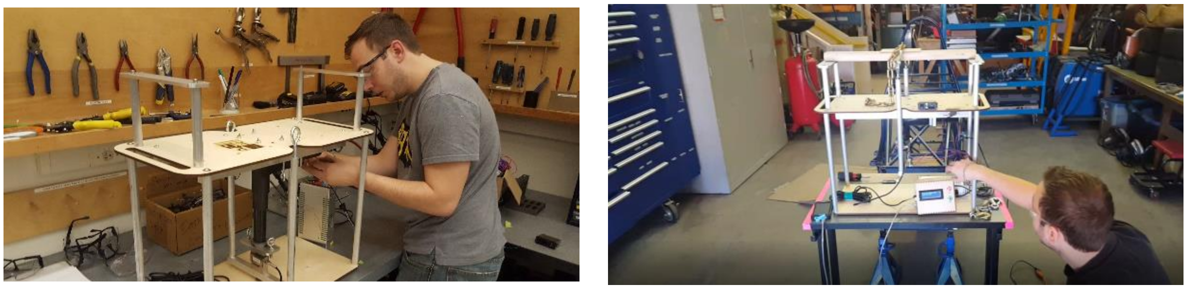


Figure 38: Construction and Testing of the first prototype to validate our design

The final product can be viewed in Figure 39, which includes the graphical user interface designed by our software team member. As a demo for the audience, we broke a 2 in. by 6 in. piece of lumber that took more than 600 lbs of force to break.

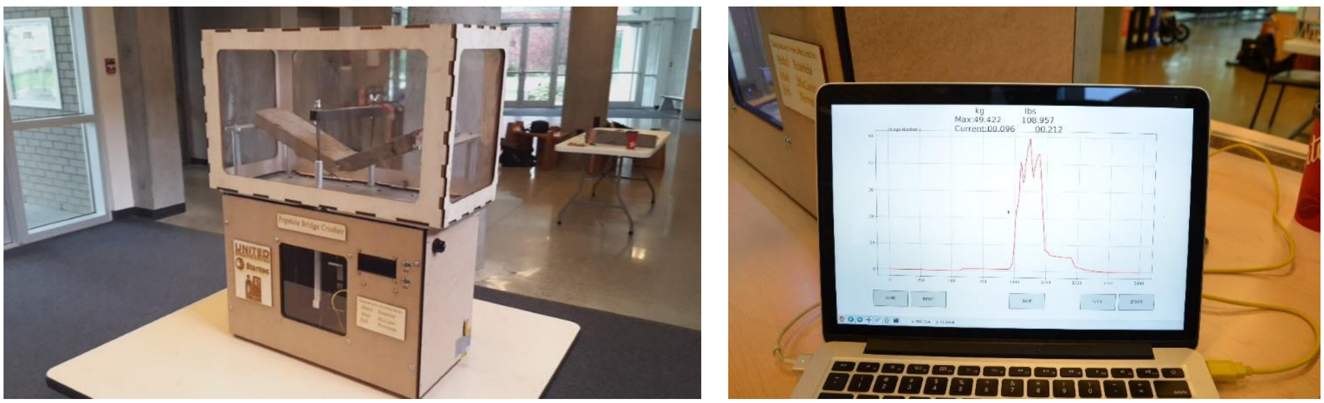


Figure 39: Images of the final product on th left with a display of the graphical user interface on the right. The graph shown on the right does not correspond to the broken lumber.

5.3 Project Conclusion

The project was a great success. The first event was held few days after the project was finished. A picture of the bridges tested can be seen in Figure 40 along with the team that built the machine. The popsicle bridge crusher has been used for multiple events throughout the years by EGBC and other local organization like the Civil Engineering Student Society.

Figure 40: The image on the left shows the machine with the team who built it, while the image on the right shows some of the popsicle stick bridges that were tested

6 Project: UVic Satellite Design Team

6.1 About the Project

The UVic Satellite Design Team is a club that participates in the Canadian Satellite Design Challenge (CSDC) by building small satellites. The CubeSat is 3U sized (10cm X 10cm X 30cm) and is designed to carry a specific payload. The payload was different for each round of the competition, and previous payloads included a hyperspectral camera, a graphite-based attitude control module, and photometric (light-measuring) calibrator.

6.2 My Contribution

I was part of the team for a year as the mechanical lead. I was responsible for developing and manufacturing all the mechanical systems for the club for ECOSAT-III shown in Figure 41. The selected payload for this CubeSat was the hyperspectral camera, which can take an image of the earth beyond just the visible spectrum. We couldn't find a camera within the allocated budget, which is why the model below doesn't include one. In addition to the camera, the components of the structure include: an attitude control system (reaction wheels), an electronics stack (batteries and microcontrollers), solar arrays, and a patch antenna array.

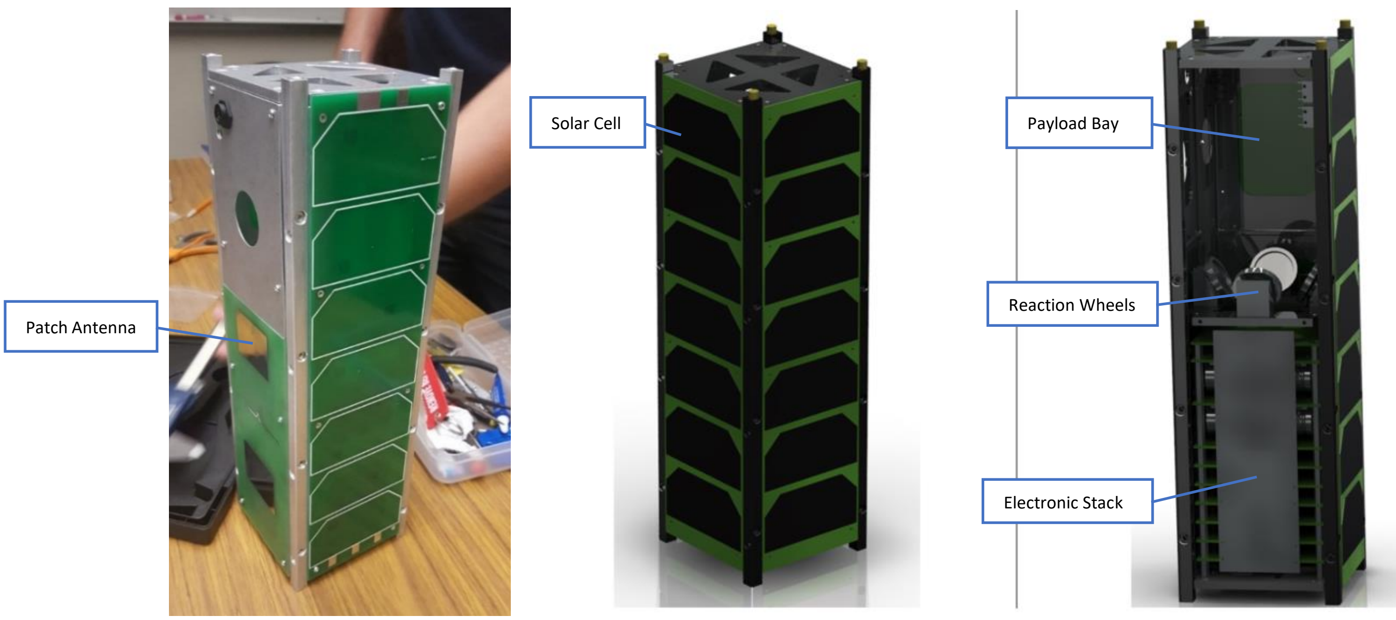


Figure 41: Image of the physical structure along with a CAD rendering in Siemends NX

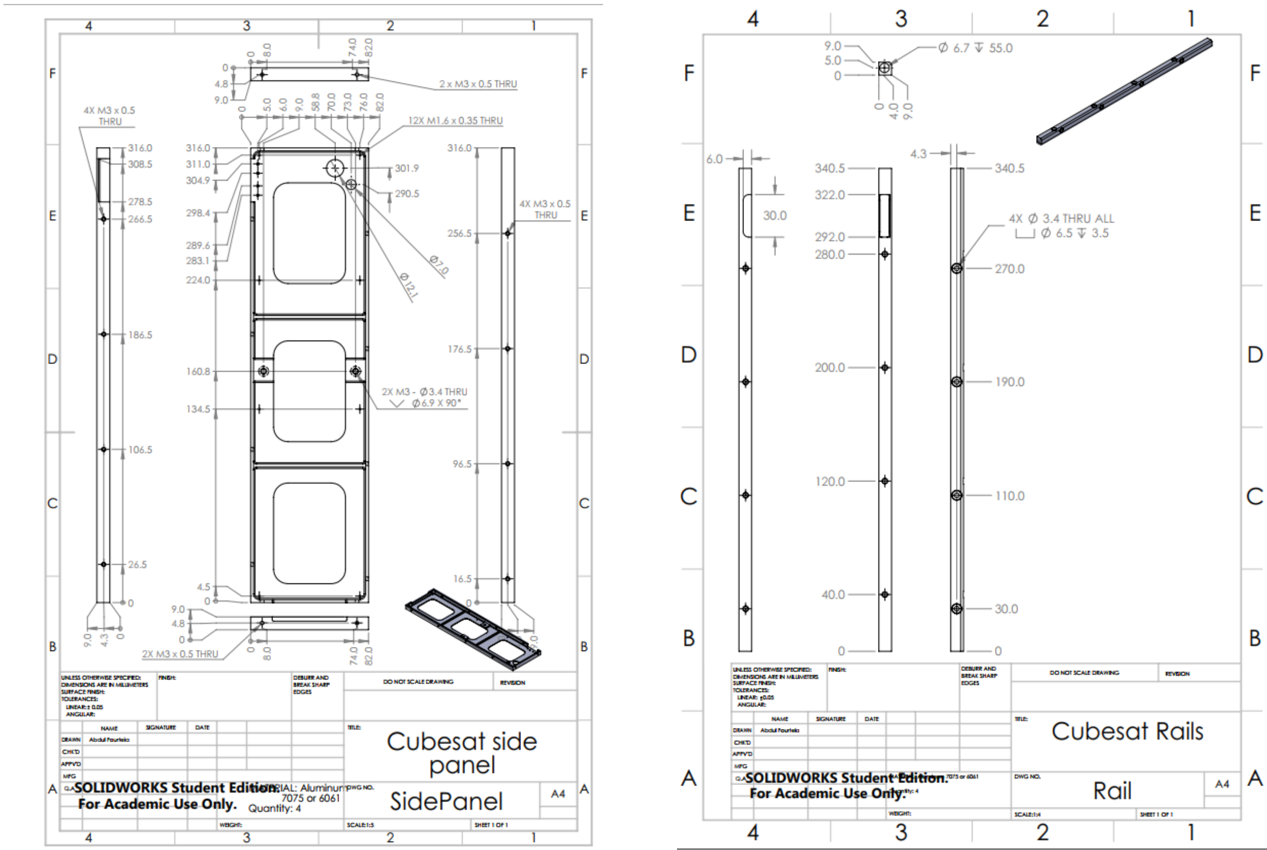


Figure 42: Sample of the engineering drawing of the CubeSat structure. Due to the tight tolerances and complexity, the manufacturing was outsourced to a local machining company.

In addition to the structure design, I worked along a post-graduate student conducting vibration analysis on the structure to estimate the modal frequencies and the max displacement and acceleration values prior to the vibration sweep test.

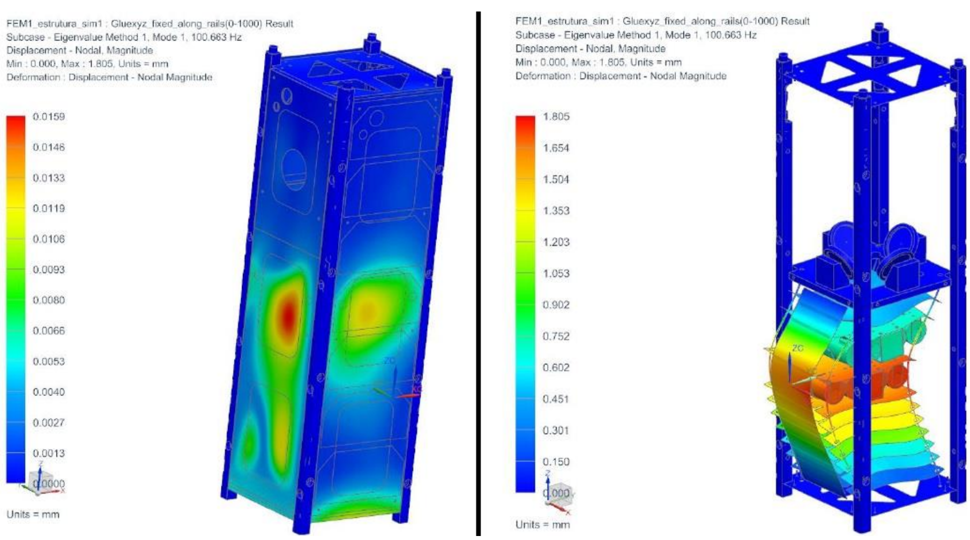


Figure 43: Some of the vibration simulation results. This one shows the displacement in the first fundamental frequency along the Y axis.

6.3 Project Conclusion

On June 15, 2016, we conducted the vibration test at David Florida Laboratory in Ottawa, Ontario. The purpose of this test is to emulate effects of a rocket launch on the CubeSat as well as to validate our vibration simulation results shown above. Because the satellite was missing some vital components, we didn't rank high in the competition that year. We were not authorized to take photos ourselves inside the laboratory, but the competition organizers were kind to provide us with two photos, which are shown in Figure 44.

Figure 44: Images taken at the David Florida Laboratory where we vibration tested the sattelite and presented our design to the judges

7 Project: UVic AERO Team

7.1 About the Project

The University of Victoria Aeronautical Research Organization (UVic AERO) is a student club that builds unmanned aerial vehicle systems for competitions organized by Unmanned Systems Canada. The team's work includes building both fixed wing and multirotor aircrafts, but it also includes equipment for ground station control like the antenna tracking system.

7.2 My Contribution

Joining the AERO team was the start of my endeavour into team-based projects that were independent of class work. For the first few months, I was mainly helping around with various tasks like wiring, assembly and testing. Eventually, I have gained enough experience to be more helpful to the team by tackling more technical jobs like creating a program for gimbal's servomotors and laser scanning the fuselage as shown in Figure 45 and Figure 46.

Figure 45: Images showing the fixed wing aircraft on the right with the fuesalage highlited on the left

Figure 46: Images demostrating our work on laserscaning the inside of the fuesalage to better organize the electronics

One of the biggest projects I assisted in at AERO was the design of an antenna tracking system that can receive high quality video stream from the airborne aircraft. I developed the structure of the antenna tracker with a focus on weight and easy of assembly for transportation. I had help from the team selecting the proper electronics such as motors, and the antenna. Figure 47 includes a spreadsheet of the link budget I made with one of the team members to help with the antenna selection. Figure 48 shows the design proposed. It contains two actuators, one for the pan axis and the other for the tilt axis. The panning rotation facilitated by a slewing bearing at the base of the structure. Given the limited budget of the team at the time, I was not able to get this project manufactured causing the project to remain at the design phase.

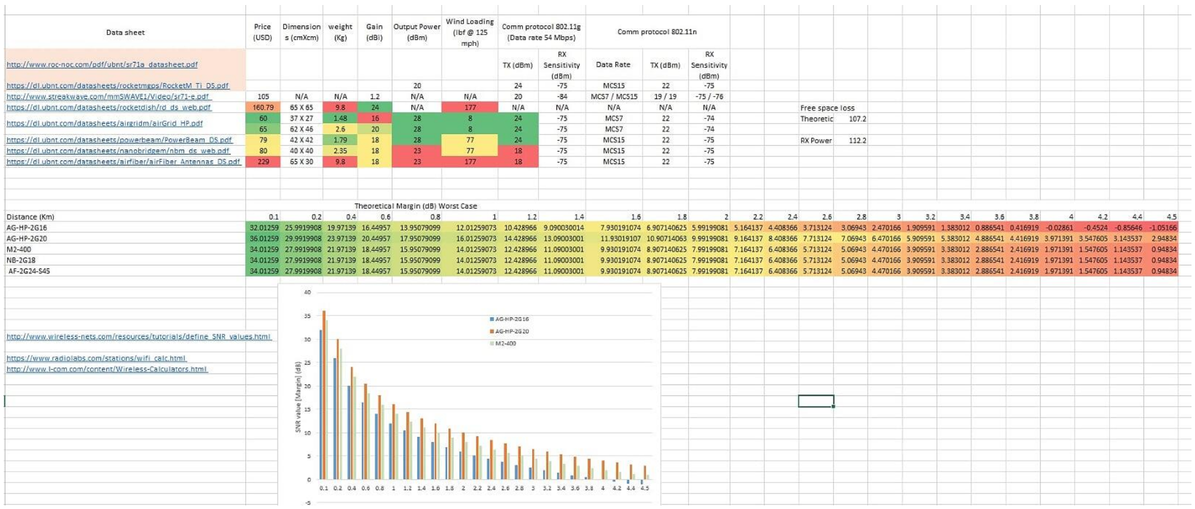


Figure 47: Link budget calculation for the antenna selection

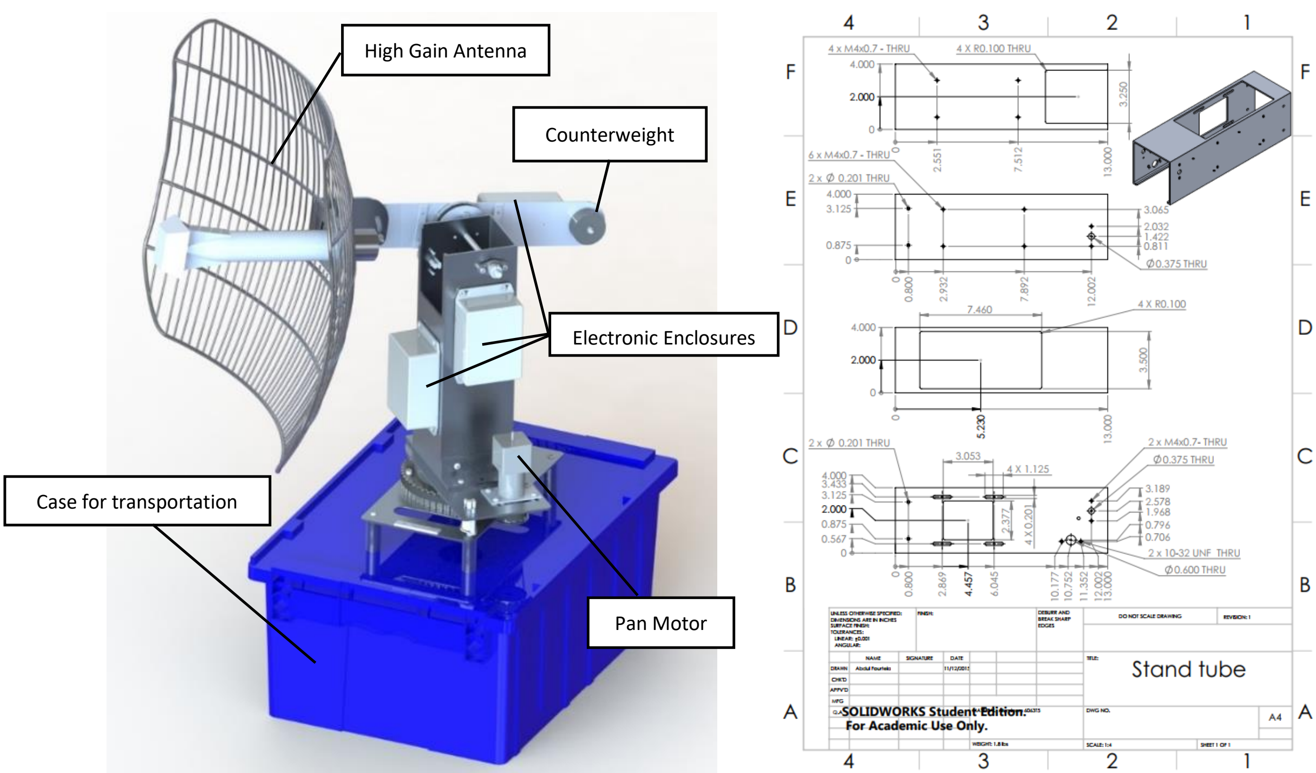


Figure 48: Render antenna tracker system I designed along with the one of the drawings I made.

7.3 Project Conclusion

UVic AERO is one of the first engineering teams I joined when I started my undergraduate degree. My engineering knowledge base was very primitive at the time. One of the first things I remember doing was learning what CAD is and modelling a LiPo battery case in SolidWorks. This is also where I was first introduced to MATLAB program and C programming language, and was exposed to concepts like PWM, interrupts, and composite manufacturing. Although I did not take a leadership position with the team, I was able to gain practical and soft skills from being part of a multidisciplinary engineering team. In terms of competition results, we were able to secure 3rd and 4th place in the three years that I was a team member.