Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

PROJECT PORTFOLIO

Unmanned Aircraft Systems Student Design Team

- Automatic Antenna Tracking Station
- Drone Canopy
- Augmented Reality CAD Viewer
- Vortex Generators

Other Projects

Travel Planning Map

Induction Charging System

Virtual Reality Submarine Game

Remote Controlled Fireboat

Solid-fuel Hobby Rocket

CAD Helicopter Main Rotor System

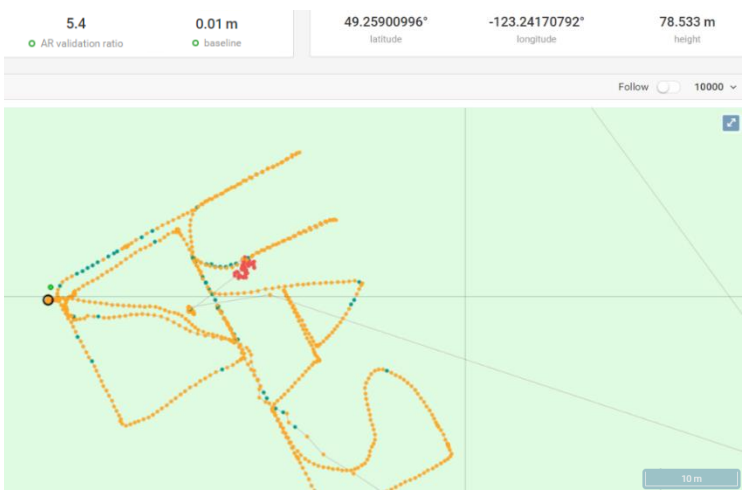
Future Projects

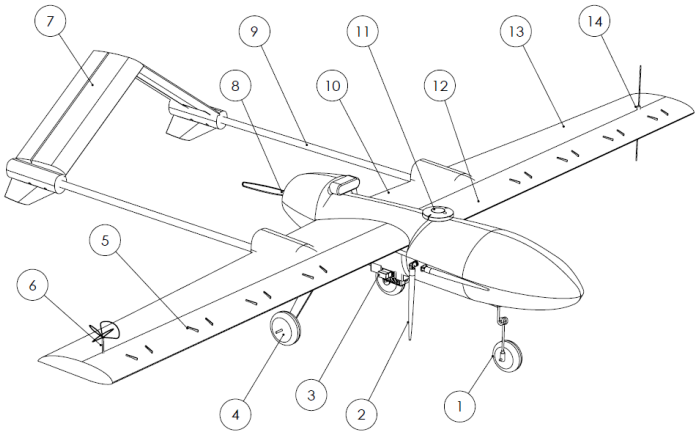
Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Unmanned Aircraft Systems Student Design Team





1 NOSE GEAR
2 TELEMETRY ANTENNA
3 GIMBAL AND CAMERA
4 MAIN LANDING GEAR
5 VORTEX GENERATOR
6 DATALINK ANTENNA
7 INVERTED V-TAIL
8 MOTOR AND PROPELLER
9 CARBON FIBER TAILBOOM
10 FLAPS
11 GPS UNIT
12 LEADING EDGE SLAT
13 AILERON
14 RADIO CONTROL ANTENNA

On UBC UAS, I developed unconventional unmanned aircraft and their support systems, such as 1.5m wide heavy-lift quadcopters and antenna tracking stations, while incorporating new technologies like centimeter-accurate RTK GNSS and augmented reality prototyping tools. My passion for aerospace led me to become a project manager and then the captain of the entire group of 34 students; I led the team to a podium finish at a national competition for the first time in the team's history.

I also spearheaded development efforts of a multi-mission UAV technology demonstrator to explore VTOL technologies, by modifying the airframe and performing aerodynamics and load analyses in wind tunnels and simulations. This aircraft created a foundation for future UAS projects, inspiring growth and innovation.

The team website can be viewed here.

Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

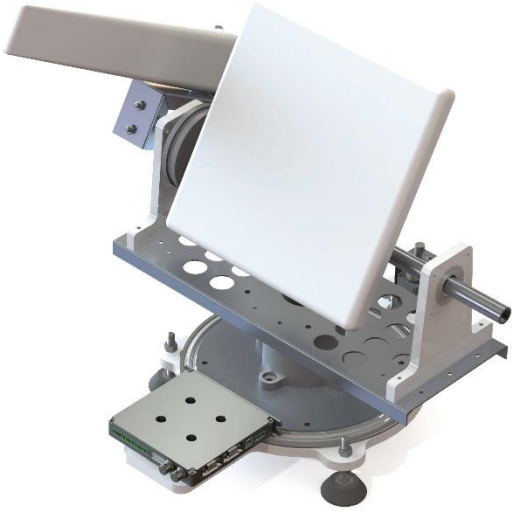
Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

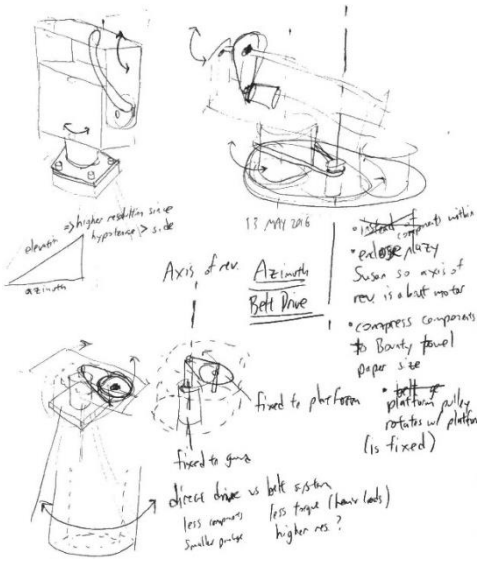
Automatic Antenna Tracking Station

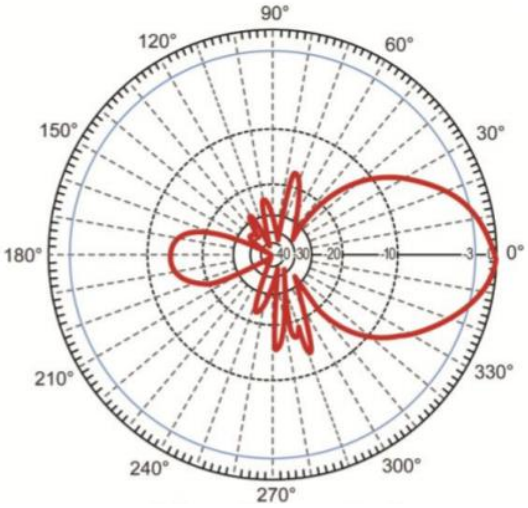
This unit can support a high-throughput datalink so images and videos can be processed live on the ground, instead of waiting for a drone to land and remove the camera SD card for post-processing. It was deployed at multiple UAV competitions, tracking drones and relaying mission data.

I designed, tested, and manufactured the tracking station, and calculated operating parameters dependent on drone and RF performance. High-resolution rotation in yaw and pitch achieved using stepper motors in belt-drive configurations.

Also developed feedback error-correction loop and formulated experiment procedures to test the motor torque, GPS and IMU accuracy, and signal attenuation.





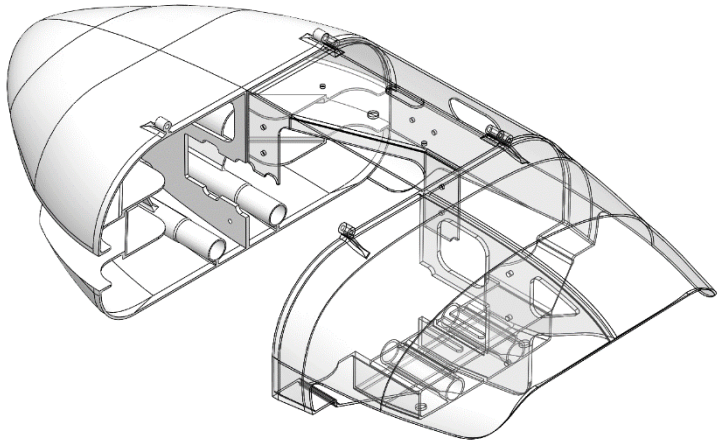


Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

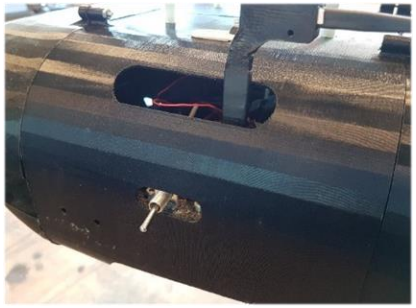
Drone Canopy

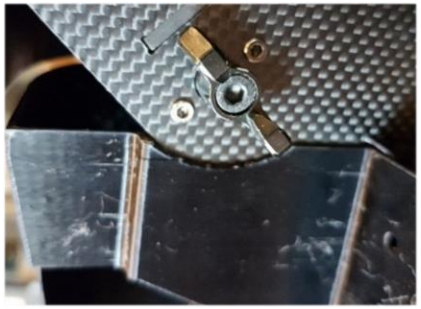


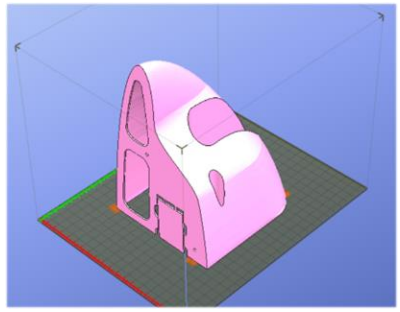
I designed a shell to be fitted over an existing drone frame to provide ingress protection in poor weather while maintaining aerodynamics and transportability.

Purposely designed to accommodate for tolerances and meet clearances, so it had zero interference problems with existing antennas, transmitters, switches, and flight controller. Retained ability to cool PDB with air intakes and collapse motor booms for transportation. Successfully 3D printed canopy and assembled on first attempt after a dozen digital mock-ups, including the use of the AR CAD Viewer.

Received an honourable mention at USC 2018 competition by organizers and law enforcement for aesthetics and ability to shield internals from the dusty environment.







Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Augmented Reality CAD Viewer

Often in the design process of new components, difficulties arise when trying to visualize the scale of designs or predicting problems without a high-fidelity prototype.

Recognizing this issue and the lack of accessible solutions, I developed an interactive AR program, reducing iterations while increasing workflow. Developed with Unity game engine and Vuforia SDK for target image or surface recognition, in addition to online documentation and YouTube tutorials.

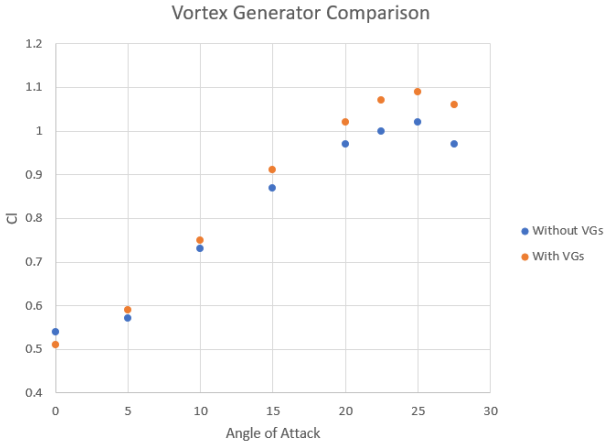
Coded algorithms for user to reposition the model, scale objects, and reset the program. Future project would be to update the app to use Google's ARCore SDK.

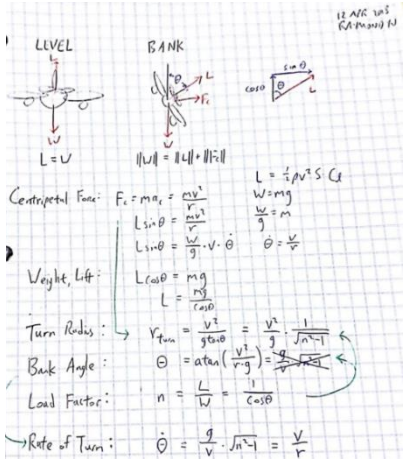
Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Vortex Generators

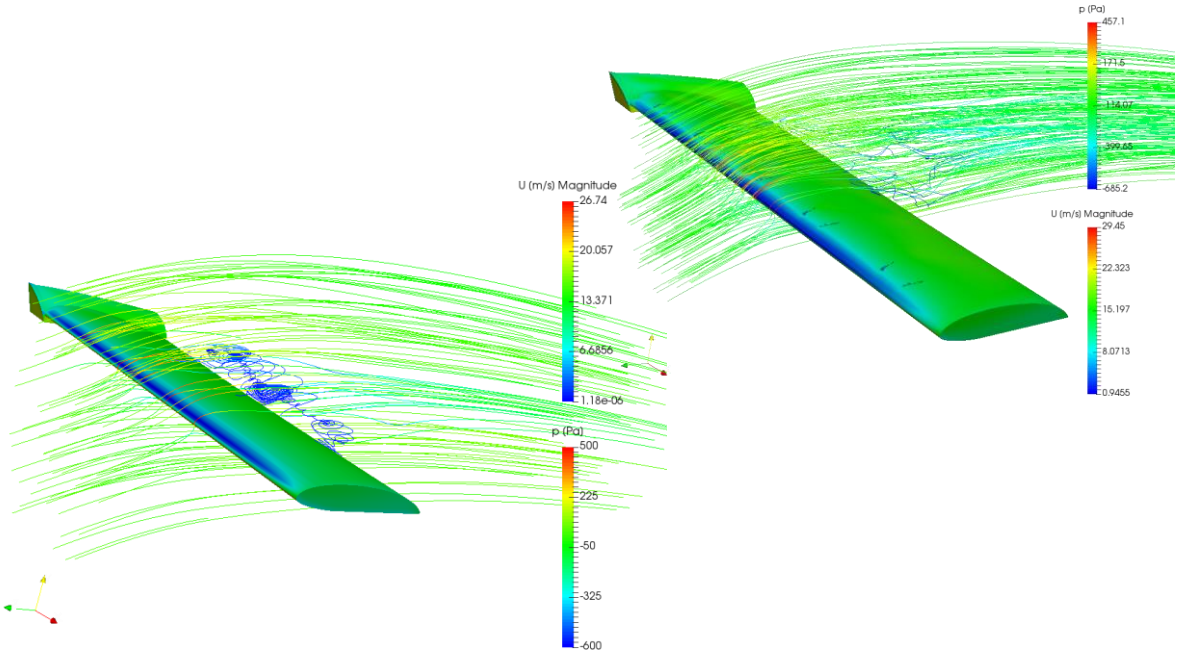




In order to overfly corner waypoints without breaching the geo-fence for the AUVSI 2018 competition, I designed vortex generators for the 2m wingspan drone.

Calculated dimensions as proportions of chord length, vortex radius, and boundary layer height, while CFD simulations were performed using cloud-based FEA software, allowing for dozens of simulations to be performed in parallel, drastically expediting the analysis.

Stall speed and turn radius were theoretically reduced by 5% and 8% respectively by comparing Cl vs AoA plots with and without VGs. Pilot-in-command praised the better stall recovery and increased maneuverability.



Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

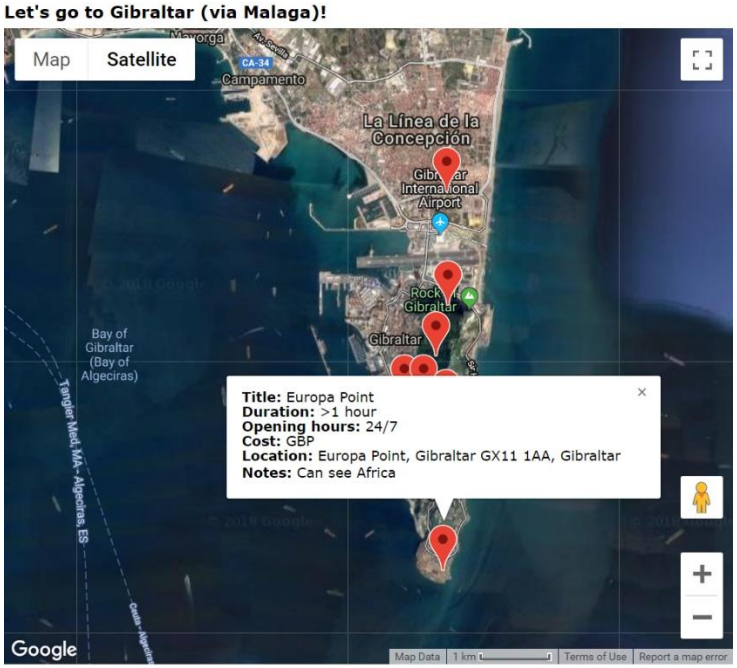
Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

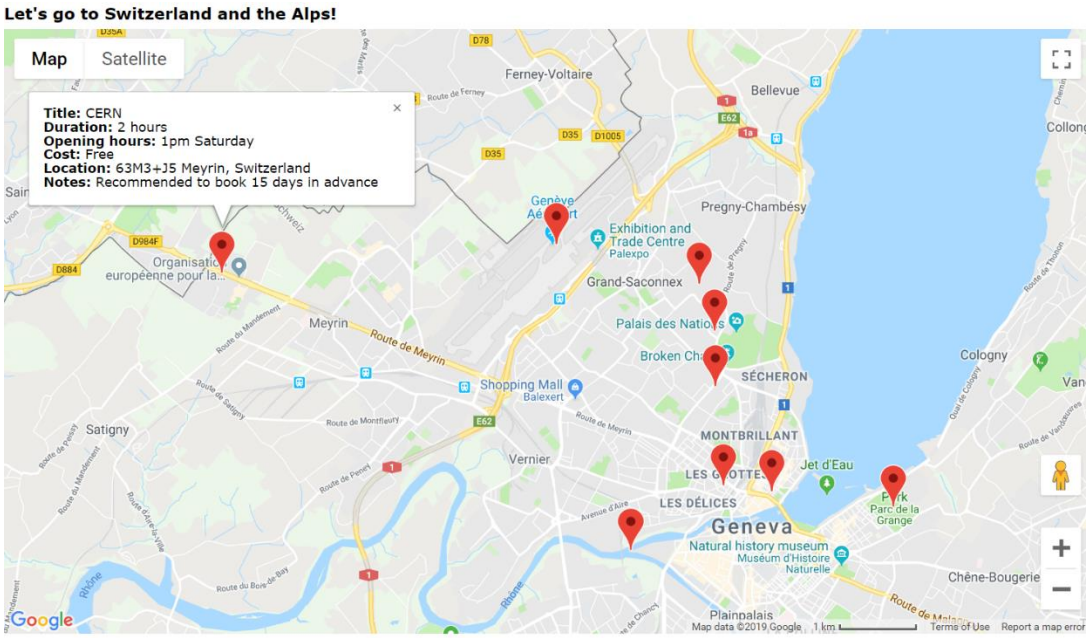
Travel Planning Map

To help plan and coordinate my travels in Europe with friends, I developed an interactive web-based map utility with Google Maps API, Google Scripts, JavaScript, and HTML. Travel information like opening hours, cost, and facts all updated live from Sheets. Additional scripts automatically searched for the street address and longitude/latitude coordinates to reduce manual input.

While I only realized that a customizable map was already released by Google, this project was nonetheless an engaging experience. Currently focused on expanding features to increase practicality, such as showing live user position and adding navigation directions with Directions API.

Sample code can be viewed at: github.com/raymondhcyu



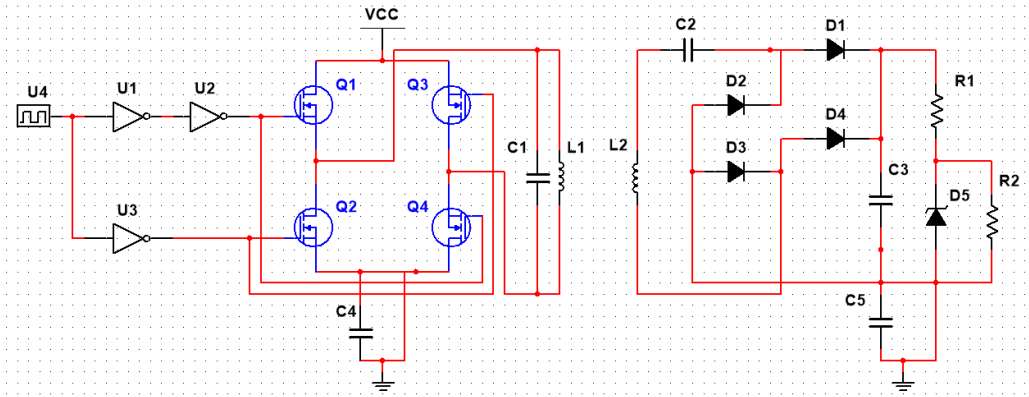


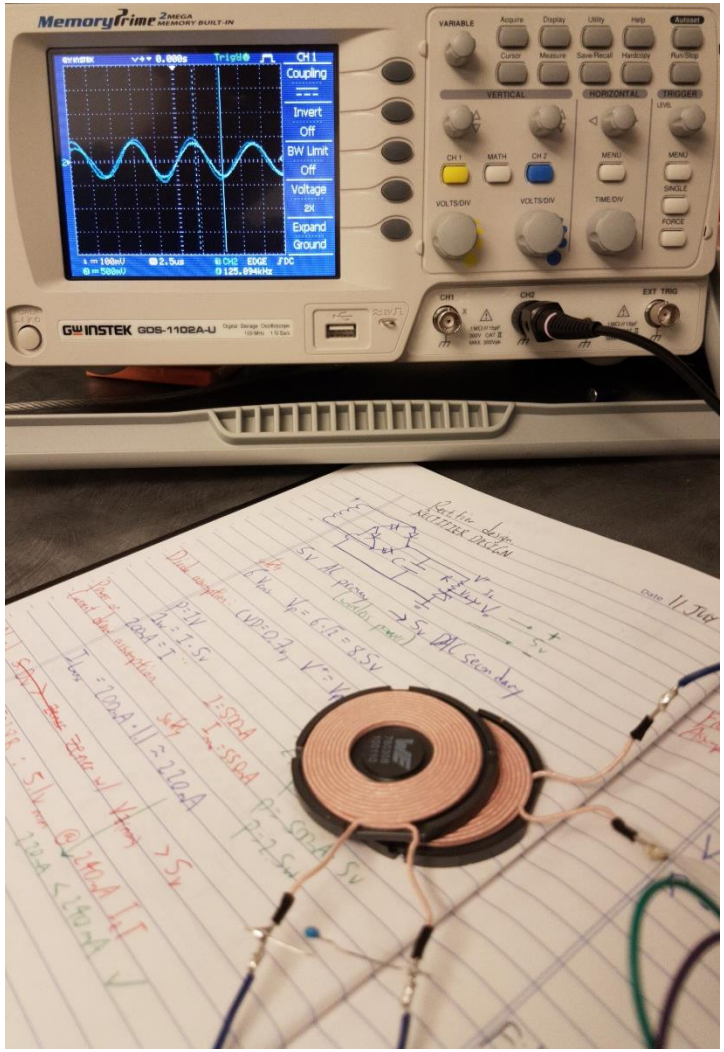
Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Induction Charging System





Wanting to avoid the nuisance of tangled wires during phone charging and to apply conceptual knowledge, I created a wireless charging station.

Designed the circuit using online tutorials, forums, and class notes, with components sourced from DigiKey. Raspberry Pi and logic gates used to provide PWM to H-bridge and to regulate voltage. Improved induction by maximizing Q factor at ~150kHz from coil datasheet, and calculated capacitance required for magnetic resonance.

A future project would be to move the circuit onto PCB and design an ergonomic housing for the transmitter and receiver for practical implementation.

Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

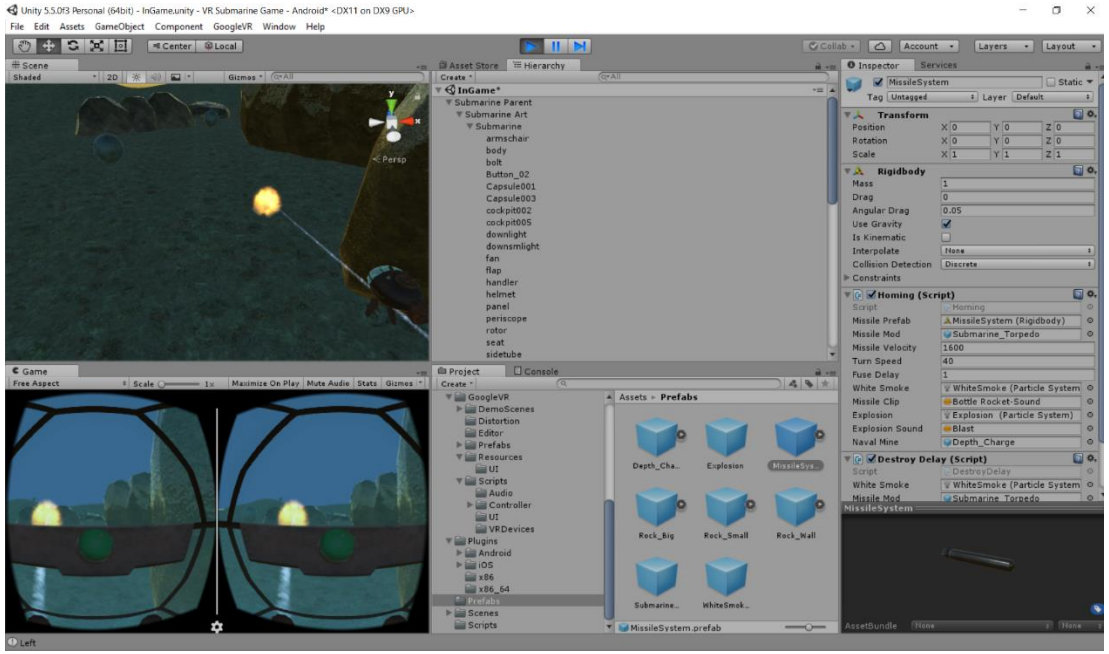
Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Virtual Reality Submarine Game

An interest for new technologies led to attending a workshop on virtual reality applications, which brought experience using the Unity game engine and VR development. Optimized for Google Cardboard with Android Studio.

Applied mathematical concepts like vectors and quaternions, and modified gameplay by scripting in C# and JS, following tutorials and documentation. Gameplay includes variable user-following movement, guided torpedoes, and explosion effects.

Sample code can be viewed at: github.com/raymondhcyu



```
void FixedUpdate () {

    float step = turnSpeed * Time.deltaTime; // time.deltatime makes speed indepednent of f

    if (missilePrefab == null || target == null) { // check to see if missile system or tar
        Debug.Log("Error: Cannot find missile prefab.");
        return;
    }

    missilePrefab.velocity = transform.forward * missileVelocity * Time.deltaTime; // prope
    aimDirection = Quaternion.LookRotation(target.position - transform.position); // define
    missilePrefab.MoveRotation(Quaternion.RotateTowards(transform.rotation, aimDirection, s

    // missilePrefab.transform.forward = (target.position - transform.position).normalized;
    // missilePrefab.AddForce(missilePrefab.transform.forward * missileVelocity * Time.delt
}
```

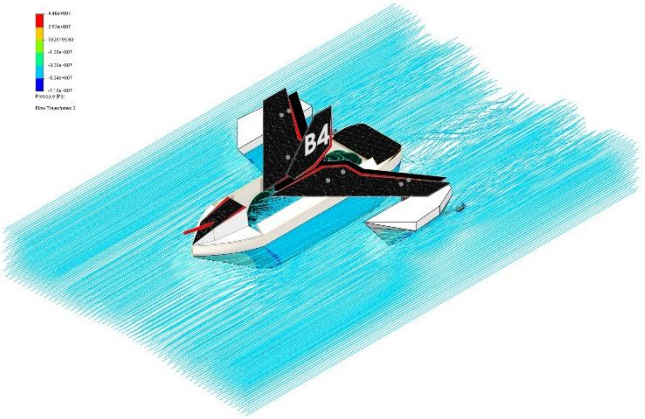
Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

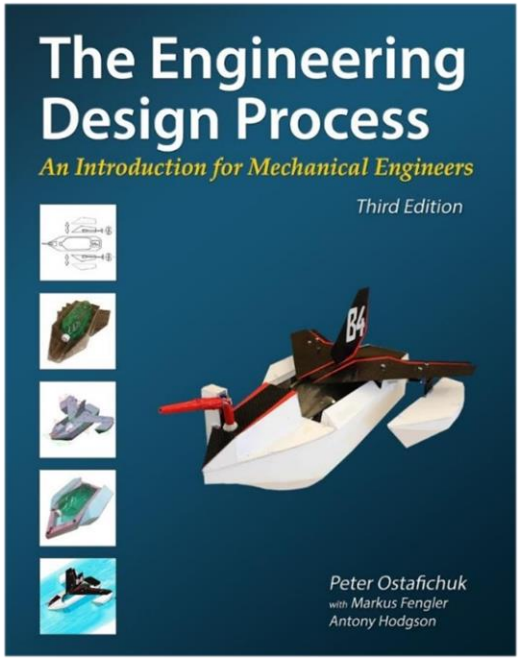
Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Remote Controlled Fireboat

Developed a scale model maritime response and rescue boat as part of a project design course. Proceeded with unconventional design after consultations with a renown naval engineering professor. Vessel design process featured in an engineering design textbook at the request of the UBC Mech2 Program Director.



Modelled and rendered vessel with SolidWorks and optimized ship design with SolidWorks CFD. Designed water cannon cupola, inspired by stealth technologies. Servo motor system provided water cannon trajectory control through pressure and elevation changes. RF controller and receiver provided control of propulsion, steering, and water deployment. High maneuverability achieved through trimaran hull and dual BLDC motors using alternating thrust.

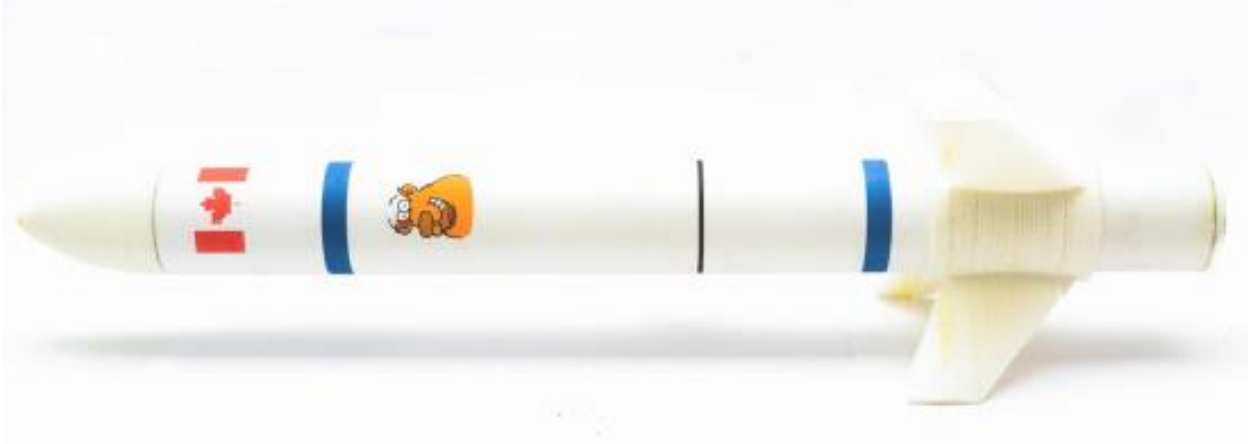


Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Solid-fuel Hobby Rocket



Designed, manufactured, and test-launched a rocket as part of a self-led high school chemistry project.

Fuel cell comprised of potassium nitrate, sugar, and sulphur, while aerodynamic surfaces were 3-D printed. Flame-retardant paper lined the interior to protect the fuselage against the delayed parachute charge. Tested individual subsystems like parachute and motor through simulated flight parameters.

See fuel cell/motor test here.

Raymond Yu

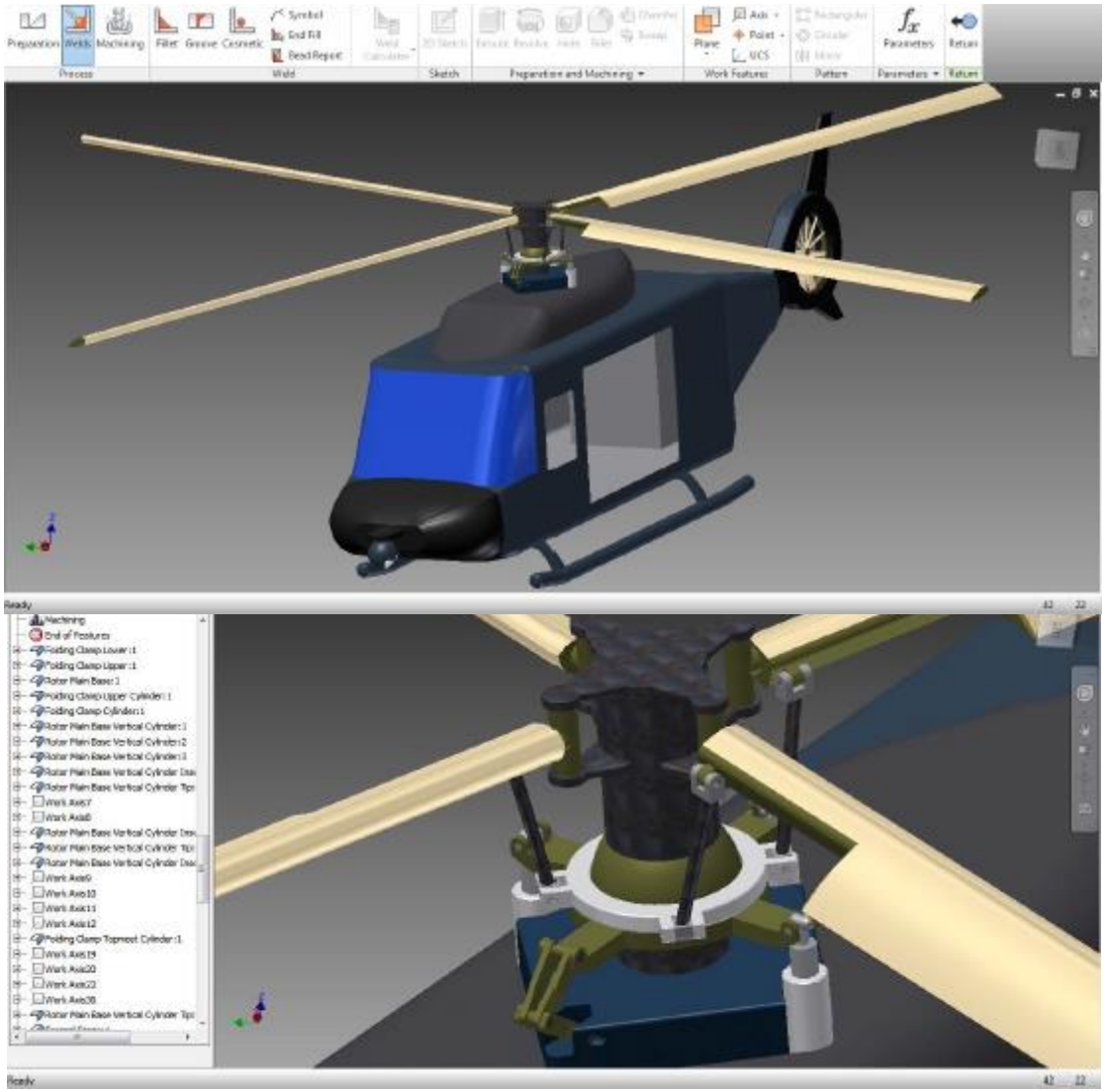
BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

CAD Helicopter Main Rotor System

A simplified and functioning main rotor system of a Sikorsky S92 helicopter on a modified Bell 412 airframe, designed with Inventor for a final high school drafting project.

Dozens of complex individual components, with each dependent on one another such that the final assembly is perfectly capable of coordinated movement. The angle of attack can be changed by the vertical translation of the swash plate.



Raymond Yu

BASc Mechanical Engineering Candidate, Mechatronics Option

Filton, Bristol, United Kingdom
raymond.yu@quaternion.me
quaternion.me/raymond

Future Projects

Currency Exchange Rate Scraper

Having unsuccessfully tried scraping online currency exchange rates with BeautifulSoup (received messages saying it was against their terms of use…), I will try again using Selenium. The intent is that whenever a preferable rate is found, a notification would be sent so I can order foreign currency at the best rate.

Cellular IoT or LPWAN implementation

With a fascination towards wireless communication and the importance that the technology has on our day-to-day lives, I want to learn more and implement cellular or long-range communications on a DIY project. Currently unsure what application to test it with, but inclined towards BVLOS drone operation (within regulations, of course).

Portfolio Pages on Website

At some point in the future I hope to transfer this PDF portfolio onto my website for better presentation, navigation, and description in a set of dedicated project pages.