Ryan Kai Sum Wong

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Skills

- **Design & Simulation:** SolidWorks, Fusion360, AutoCAD, Engineering Drawings, GD&T, ANSYS, XFLR5, KICAD.
- **Technologies:** Python (NumPy, Pandas, SciPy, Matplotlib, Seaborn), C++, MATLAB, Arduino, I2C, SPI, IMUs, PID.
- **Manufacturing & Machining:** Lathe, Mill, Waterjet, Laser Machining, CNC routing(Gcode), 3D Printing(FDM)

Experience

Mechanical Lead – UWaterloo BioMechatronics Design Team – Waterloo, Ontario. Sep 2025 – Present

- Led 20+ member team in SolidWorks to design and manufacture a soft exoskeleton, including a 2-DOF powered hip joint, enhancing assisted mobility by comfortably offsetting 20% of walking power
- Implemented anthropometric parametric modeling, leveraging human biomechanics and body measurement datasets to ensure ergonomic fit across 80% of standard human measurements..
- Led a 10-person subgroup conducting finite element analysis to optimize a 6061-aluminum dorsal chassis, given a 5 kg, 17 cm cantilevered load and additional 20kg compressional load with ~23% weight reduction.
- Designed manufacturing drawings using GD&T principles and executed multi-process fabrication (CNC, waterjet, lathe, 3D printing) to deliver functional exoskeleton components validated through testing and demonstrations.

Founder, Captain & Design Lead – VEX Robotics Team 3708E – Hong Kong. Feb 2023 – Aug 2025

- Founded and expanded the robotics program to 4 teams of 40 students, establishing team structure, budgets, and timelines, twice qualifying to represent Hong Kong at the VEX Worlds International Championship.
- Directed Mechanical and Hardware teams using CAD, FEA, and laser machining, reducing robot weight by 4 lb, coming 4th in qualifiers and winning the Excellence Award at the Hong Kong Tech Open.
- Managed a 300-page engineering notebook documenting mechanical design and build processes, directly supporting the team's Design Award recognition.

Research Assistant – MIT Jameel Clinic – Cambridge, Massachusetts. Jul 2024 – Aug 2024

- Developed Python program using Medicare APC/DRG/CPT codes to calculate SYBIL AI net cost savings (~$700 per patient) from 125k+ patient records, using Pandas, NumPy, and SciPy for data cleaning and analysis.
- Applied K-means clustering to identify distinct patient cost patterns across 4 treatment groups, enabling clearer assessment of AI deployment impact on healthcare cost efficiency.
- Documented and visualized findings in a comprehensive report using Matplotlib and Seaborn to communicate trends in patient treatment costs to the research teams.

Projects

FPV UAV Test Platform - Version 3 Dec 2025 – Present

- Performed aerodynamic stability and drag analysis using XFLR5 and ANSYS to design a high-speed airframe, achieving short-period and phugoid damping ratios of $\zeta = 0.37$ and $\zeta = 0.23$ respectively, and a static thrust-to-weight ratio of 1.2.
- Designed a lightweight structure using the anisotropic properties and density of LW-PLA to reduce overall mass by 48% while maintaining strength, and thermal properties of PETG to reduce ESC heat-sink enclosure warping by 78%.

Swerve Vacuum Robot Nov 2025– Present

- Designed and validated a high-speed custom swerve-drive module (5.07 m/s) using ANSYS static and transient structural simulations to guide mechanical design.
- Co-owned a ROS2-based holonomic control stack with LiDAR SLAM (Gazebo) and A* path planning, improving navigation via motion profiling and PID tuning.

Education

University of Waterloo – BASc, Mechanical Engineering Aug 2025 – May 2030

Portfolio

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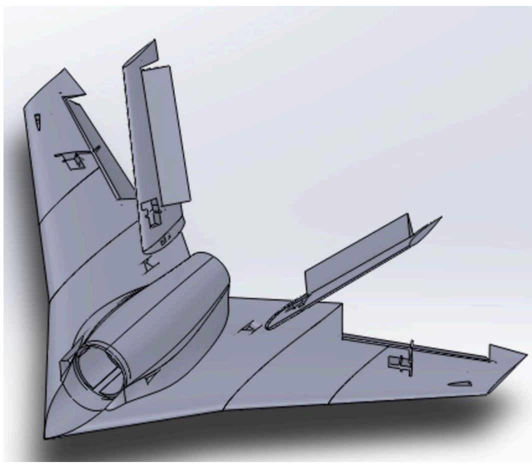
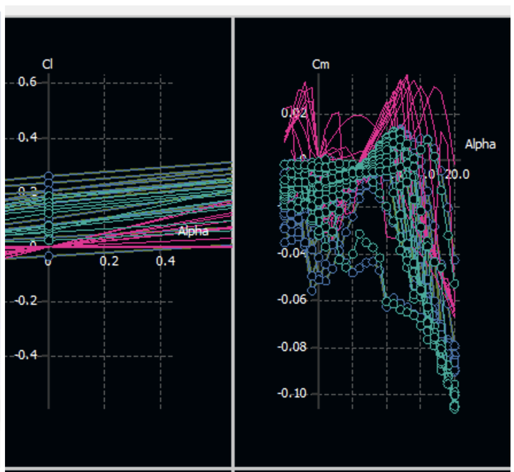
FPV UAV Test Platform - Version 3 (Dec 2025 - Present)

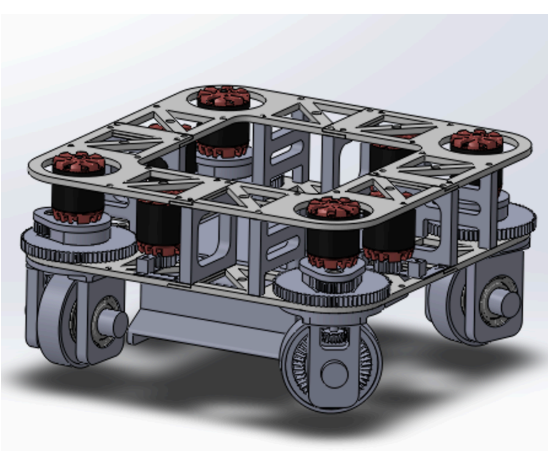
- Designed and fabricated a fully 3D-printed 1 kg flying-wing UAV optimized for efficient cruise flight above 30 km/h.
- Conducted batch airfoil analysis and stability analysis in XFLR5 across Reynolds numbers from 5,000 to 3,000,000 to properly inform airfoil, planform and geometry selection as to fit all regimes of flight comfortably.
- Used the Spalart-Allmaras model on ANSYS Fluent to simulate aerodynamic drag to validate design choices while minimizing computational cost in the transitional Reynolds flow regime of the drone(between Re = 10^5 to 10^6)
- Tuned sweep, dihedral, and V-tail geometry using modal stability analysis, achieving strong longitudinal damping coefficients (short = 0.372, phugoid = 0.231).

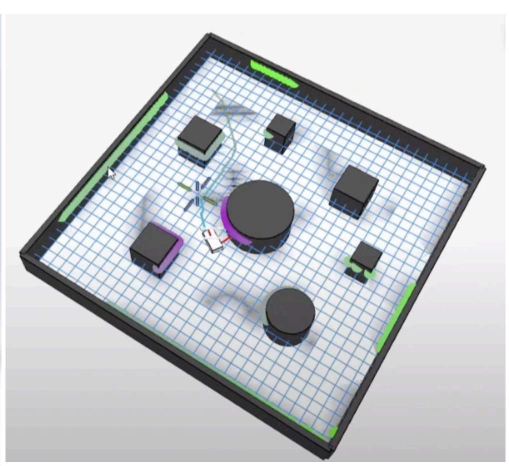


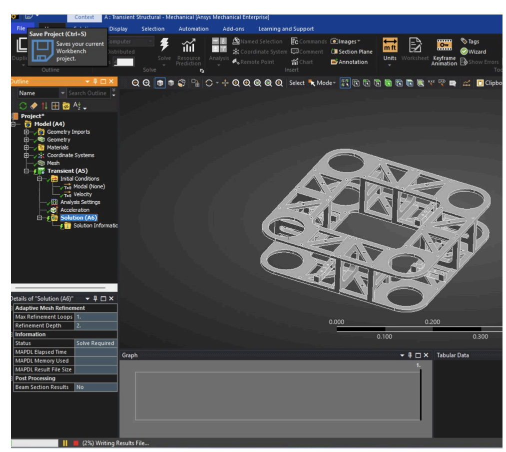


Swerve Vacuum Robot (Nov 2025 - Present)

- Designed a set of custom 3D-printable swerve-drive gearboxes utilizing bevel gears, spur gears and belt drives, and a chassis capable of stable omnidirectional motion with 5.07 m/s no-load speed.
- Developed mechanical CAD, electronics architecture, and system-level integration with modular expandability in mind.
- Co-developed a distributed ROS2-based control architecture simulated on Gazebo, partitioning high-level computation for LiDAR SLAM and A* path planning on a Raspberry Pi and low-level drive and steering control on an ESP32.
- Performed steady-state structural simulations on Solidworks to identify any large CAD errors, then refined simulations on ANSYS to verify component strength under operational and static loads.
- Conducted additional ANSYS transient structural simulations to model crash scenarios with inertia and evaluate impact-induced stress absorption by the structure.

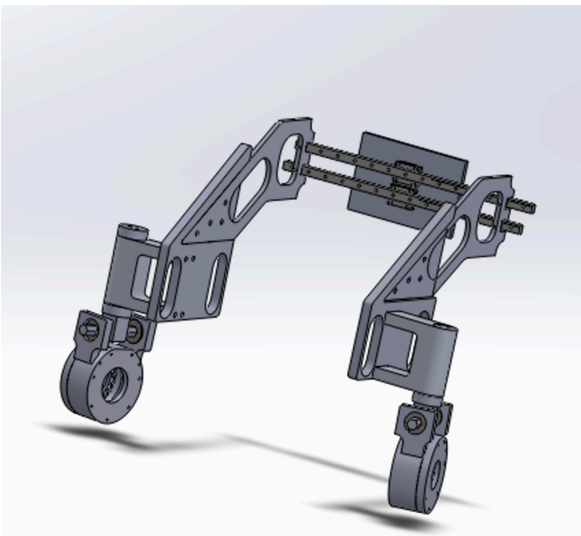


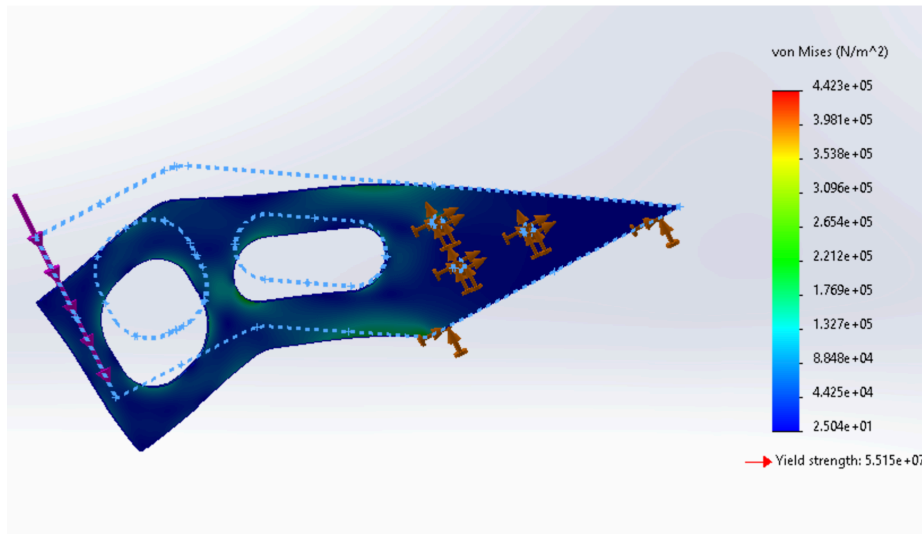




Soft Exoskeleton (Oct 2025 - Present)

- Designed a parametric lower-body soft exoskeleton using anthropometric data to ensure fit across different body sizes.
- Applied Design for Manufacturing (DFM) principles during concept development, prioritizing simple geometries and processes to meet design team constraints on cost and fabrication complexity.
- Implemented a passive self-adjusting mechanism using linear slides, allowing rigid components to automatically align to the wearer when straps are tightened.
- Modeled a 2-DOF hip joint system to support natural gait motion while maintaining comfort and mechanical simplicity.
- Designed a CNC-machinable cycloidal gearbox housing to reduce manufacturing cost by ~40% while preserving functional requirements.
- Applied GD&T principles to produce professional technical drawings, additionally developing reusable drawing templates and a set of drawing standards used for fabrication by the mechanical team.

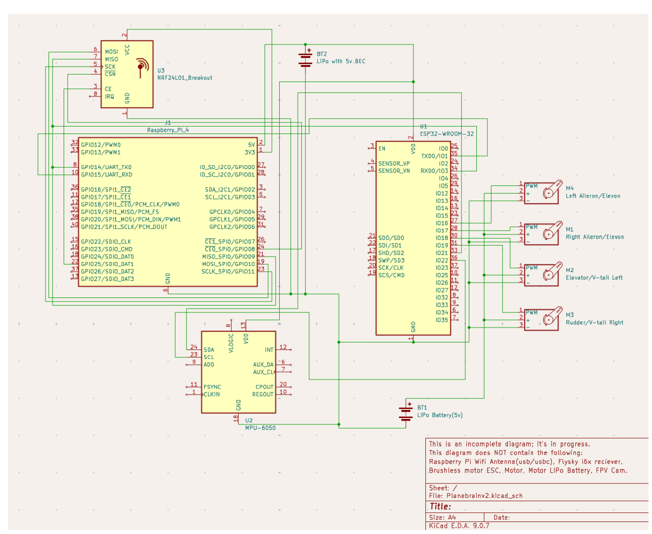




PlaneBrain (Oct 2024 - Present)

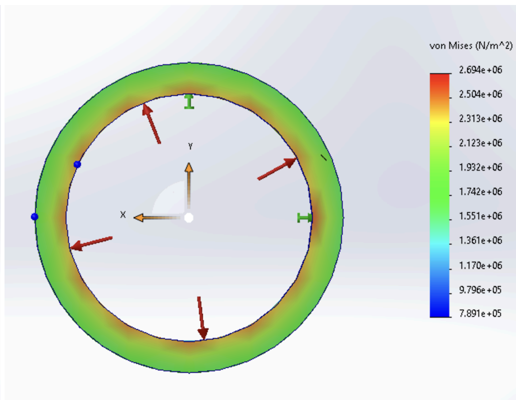
- Designed various flight control systems utilizing Mahony sensor fusion, originally arduino-based but now ESP-based for faster clock speeds and more responsive flight control.
- Implemented a modular embedded flight-control system using ESP32, MPU6050 IMU, and RC input (FlySky i6X), used onboard the FPV UAV test platform, mainly for yaw damping to counteract underdamped dutch roll.
- Wrote and tuned an ESP32-based program for a acro-style attitude rate controller utilizing PID control and exponential stick mapping to further improve precision and handling characteristics.
- Created block diagrams and PCB layouts in KiCad; currently in the process of designing a custom all-in-one flight controller PCB integrating ESP32-WROOM-32, IMU, and GNSS for direct companion computer and RC interfacing.
- Currently developing higher-level autonomy in MATLAB simulation, targeting a dual-processor architecture (Raspberry Pi for planning, ESP32 for real-time control).

```
  float rollcmd  = expo(ch_roll / 500.0, 0.3) * 180;
  float pitchcmd = expo(ch_pitch / 500.0, 0.3) * 180;
  float yawcmd   = expo(ch_yaw / 500.0, 0.3) * 120;

  //PID control
  float rolloutput  = pid(rollcmd, gyroXf, dt, kp_roll, ki_roll, kd_roll, prevrollerror, integralroll);
  float pitchoutput = pid(pitchcmd, gyroYf, dt, kp_pitch, ki_pitch, kd_pitch, prevpitcherror, integralpitch);
  float yawoutput   = pid(yawcmd, gyroZf, dt, kp_yaw, ki_yaw, kd_yaw, prevyawerror, integralyaw)
                      - kroll_damp * gyroXf; //roll damping via yaw

  //mixer for elevons
  int elevonleftsignal  = servomid + pitchoutput + rolloutput;
  int elevonrightsignal = servomid + pitchoutput - rolloutput;

  //mixer for vtail yaw only
  int rudderleftsignal  = servomid + yawoutput;
  int rudderrightsignal = servomid + yawoutput;

  //constrain signals
  elevonleftsignal  = constrain(elevonleftsignal, servomid - servorange, servomid + servorange);
  elevonrightsignal = constrain(elevonrightsignal, servomid - servorange, servomid + servorange);
  rudderleftsignal  = constrain(rudderleftsignal, servomid - servorange, servomid + servorange);
  rudderrightsignal = constrain(rudderrightsignal, servomid - servorange, servomid + servorange);

  //write servos
  elevonleft.writeMicroseconds(elevonleftsignal);
  elevonright.writeMicroseconds(elevonrightsignal);
  ruddermaster.writeMicroseconds(rudderleftsignal);
  rudderslave.writeMicroseconds(rudderrightsignal);
}

//read gyro with low pass filter
void readgyro(){
  imu.getRotation(&gyroX, &gyroY, &gyroZ);
  gyroX /= 131.0;
  gyroY /= 131.0;
  gyroZ /= 131.0;

  gyroXf = alpha * gyroXf + (1 - alpha) * gyroX;
  gyroYf = alpha * gyroYf + (1 - alpha) * gyroY;
  gyroZf = alpha * gyroZf + (1 - alpha) * gyroZ;
```



Pneumatic Launchers (Jul 2024 - Oct 2025)

- Designed a PVC boba launcher concept in CAD as a **theoretical engineering project (not physically built due to legal/safety constraints)**. Soft TPU/foam sabot rounds were designed to prevent boba disintegration during launch.
- Performed steady-state structural simulations to ensure safety of the theoretical PVC pressure vessel at a static maximum pressure of 70psi; hence the thin diameter of both barrel and reservoir to maximize relative wall thickness.
- Modeled time-dependent pressure behavior in complex flow geometry, notably around U-bends and through a bottleneck using transient CFD and Spalart-Allmaras on ANSYS Fluent. Discovered that Home Depot PVC could not form safe designs involving a U-bend due to pressure concentrations; only bottlenecks were somewhat acceptable.
- The launcher was based off of a previous experimental project investigating the relationship between chamber pressure and launch velocity, where I derived an adiabatic expansion model and compared predictions against measured data using a launcher testing rig. I then extended that theoretical framework to inform the launch behavior assumptions used for CAD and structural analyses in this concept study; see data below.



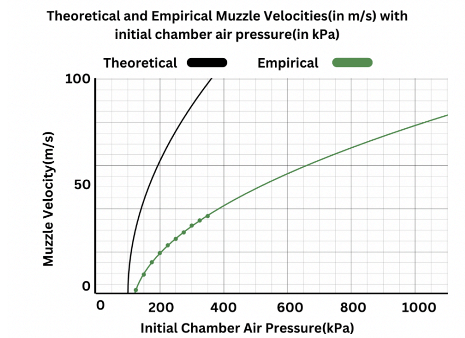


Figure 6 - Comparison between theoretical graph and empirical trend line.