Lachlan Whitehead

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Education:

University of Melbourne – BSc (Mechanical Engineering Systems) – March 2026

University of Melbourne – MEng (Specialisation in Aerospace) – Expected 2027

Graduate mechanical engineering student with a knack for learning new things fast. Holds a strong academic background and practical aerospace engineering experience.

Current Project: Harolld and Caroll

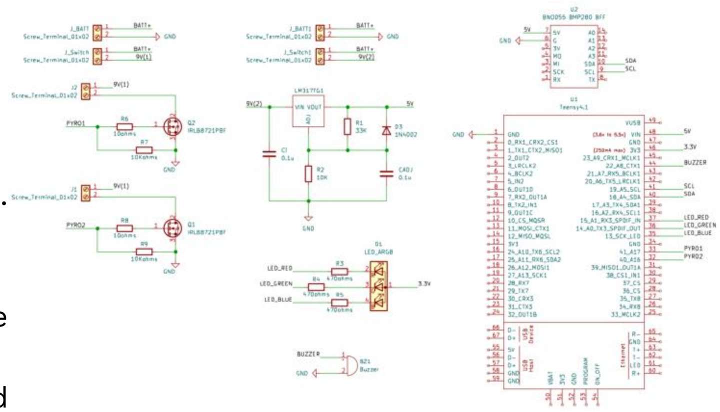
Overview

Harolld is an L1 rocket testbed for developing an aerodynamic roll control system, designed by myself and a peer. The purpose of the project is to encompass all the disciplines involved in mechatronics design, specifically tailored towards the skillset required for GNC. Caroll is the onboard flight computer also being developed by us, in charge of state detection for parachute deployment and implementation of the roll control system, using ailerons for aerodynamic control. Mechanical design of Harolld and schematic design of Caroll is effectively complete, and we are currently assembling the physical rocket and flight computer to begin ground testing, while still refining the control system in parallel in time for HITL and flight testing by the end of May.

Structural and Mechanical Design

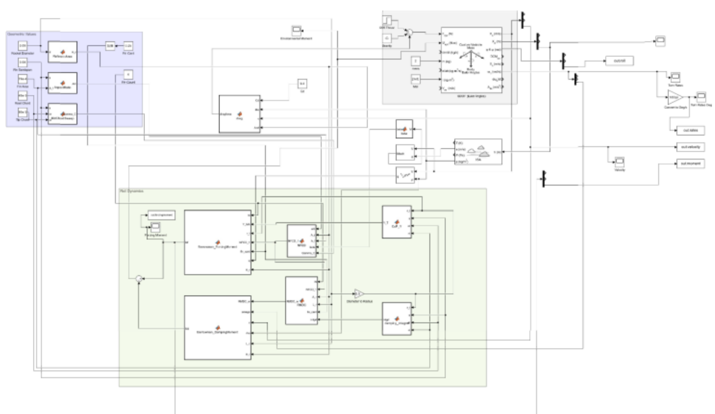
Harolld is made almost entirely from 3D-printed parts made from either ABS-CF or PETG. Its body tube is a cardboard mailing tube. Given the small thrust of an L1 rocket motor, there is little structural analysis beyond thermal considerations for 3D-printed parts near the motor exhaust. To guarantee the control surfaces can only induce roll and not pitch or yaw, the ailerons are mechanically linked and turned by a singular servo.

Flight Computer Design & Assembly



Caroll is a Teensy 4.1-based flight computer serving the primary purpose of hosting and actioning the control system. It uses a BNO055 and BMP280 for state detection and stores flight data to a µSD card to match the reader that comes with the Teensy 4.1. Caroll is intentionally designed to be simple as possible to allow for easy implementation of our control system without a steep learning curve, while also providing a suitable introduction to flight computer design (including eCAD, sensor fusion, and flight code).

Control System for Roll Control

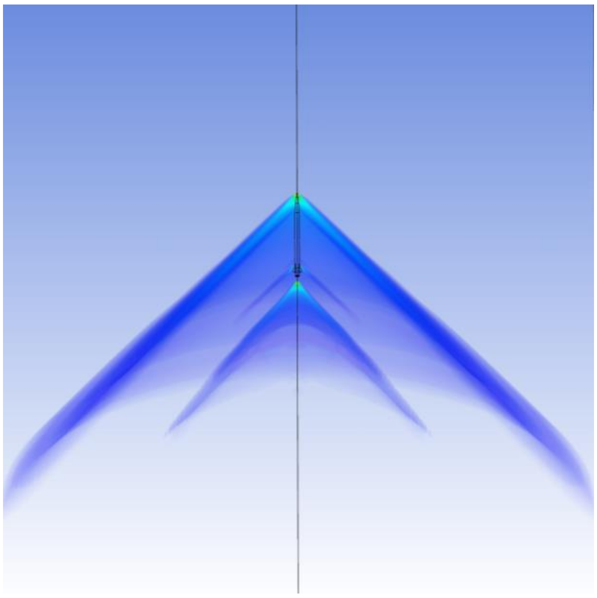


The roll control system is a PID-based system that is initially being tuned by a Simulink model and later will be tuned by flight testing. After working with PINN-based Model Predictive Control for the airbrakes on board competition rockets, we want to see how far a traditional PID approach could go for aerodynamic control.

Project Florence

Overview

Florence was the first successful 30,000 ft sounding rocket built by the University of Melbourne's ARES Rocketry Team, throughout 2023-24. During its development, I acted as the aerodynamics sub-team lead and principle CFD analyst.

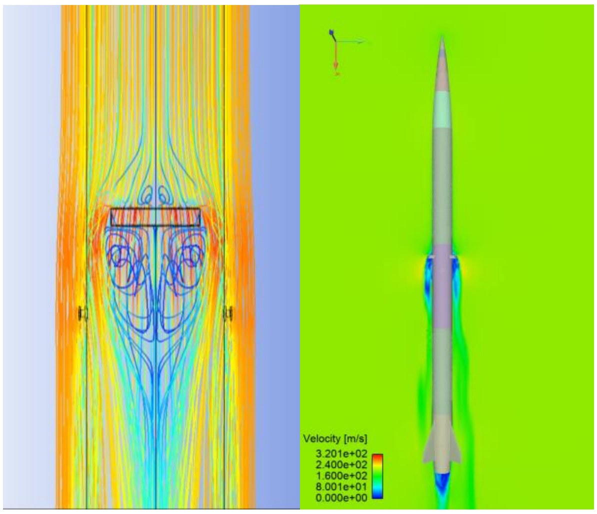


Drag analysis in Ansys Fluent

As a first-year undergraduate, I taught myself computational fluid dynamics in Ansys Fluent in incompressible and compressible flows up to Mach 2. I applied these skills in conjunction with scripting in Bash and Python on the University's HPC network to produce drag curves for Florence. From my work, Florence became ARES' first CFD-informed rocket design.

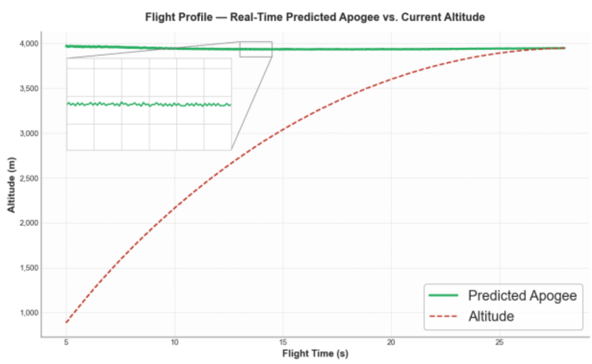
Flight Modelling

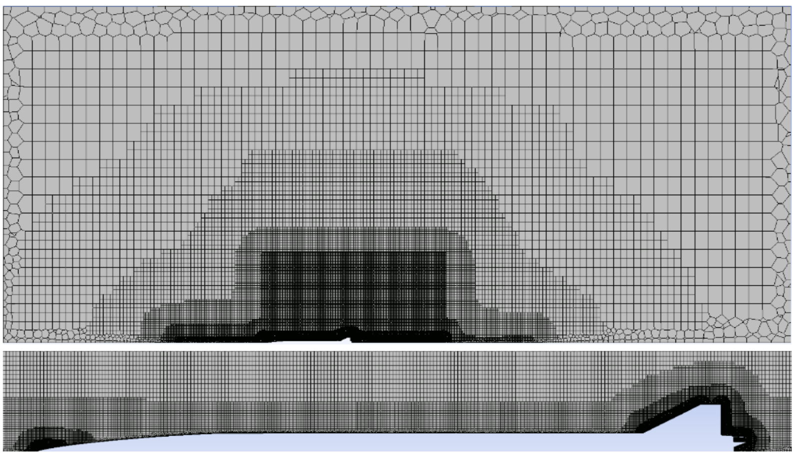
Data from these simulations were utilised in RocketPy - to predict the apogee of the developing rocket, later verified in multiple test flights to be accurate to within 1% - as well as in simpler 3DoF Python scripts to help inform design decisions about the air frame. CFD and RocketPy were also used to develop what would eventually become a PINN-based model predictive control system for active apogee control, utilising airbrakes.

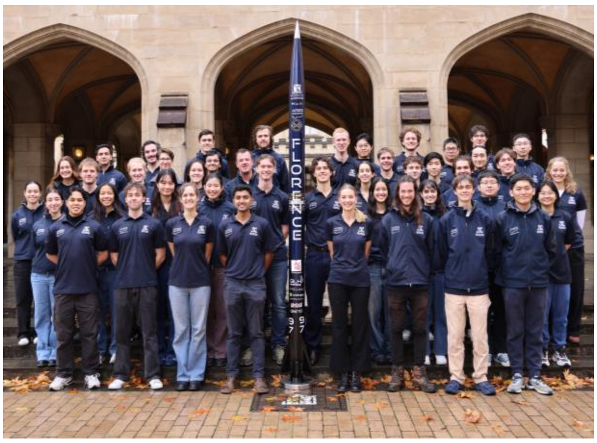


Post-processing for design & demo

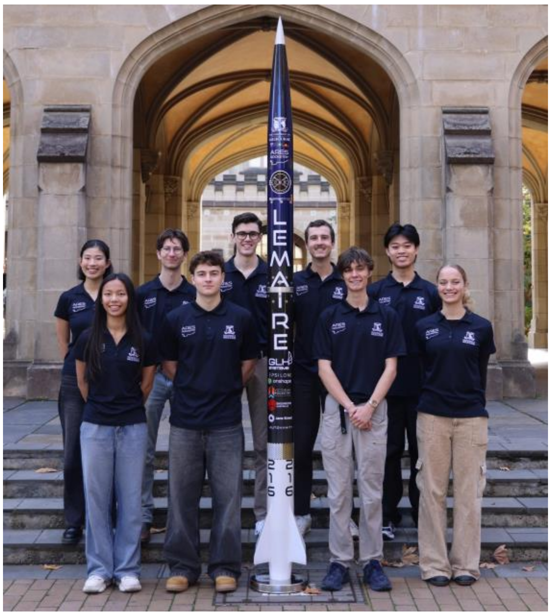
CFD-Post and Paraview were utilised for post-processing of CFD. Visual inspection of flow, shock and internal pressures helped identify inefficiencies and outright issues in aerodynamic design. Additionally, animations and other visualisations were utilised in team advertising and presentations to faculty and industry partners (and for the cover of this portfolio).







Project Lemaire



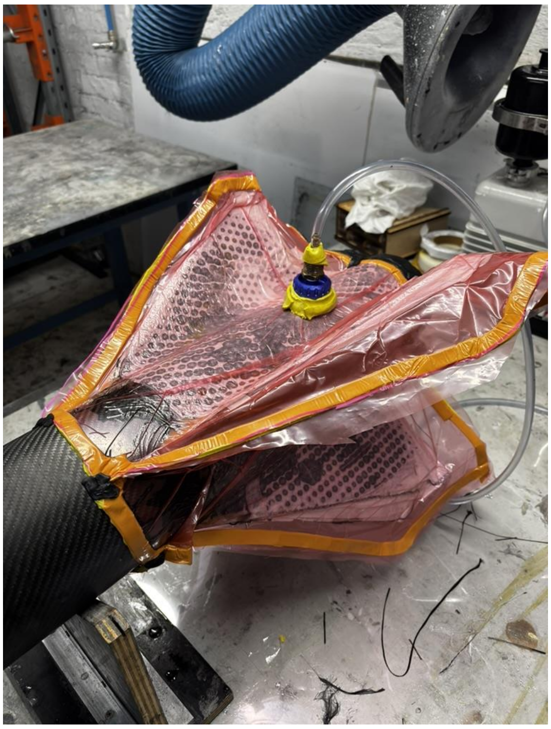
Overview

I served as Chief Engineer of ARES during the 2025 IREC cycle, leading development of ARES' second 30,000 ft, Mach 2 sounding rocket, launching successfully in Texas.

Aerospace design and manufacturing

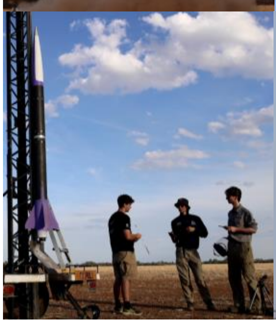
Lemaire's fibreglass nose cone and boat tail, and carbon fibre fin can are assembled in-house. Developments during this cycle included using vac-bagging around the tip-to-tip carbon layup over the fins, producing an invisible transition from body tube to boat tail. Supersonic drag was reduced by 23% by aerodynamic optimisation of airframe components using CFD in Fluent, and the design, testing and successful integration of retractable hardpoints.

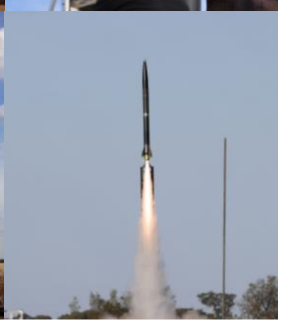
Lemaire also featured novel internal designs including topology-optimised CNC'd bulkheads and an internally connected avionics-recovery bay that eased vehicle integration.



Test Flight Campaign

As well as directing test programs for individual components, I helped lead the team through a rigorous flight-testing campaign vital for recovery system validation and airbrake control system development. This campaign saw four level 3 flights over four months, including two launches in one weekend, the highest launch frequency ever achieved by an Australian University. These included the design and implementation of integration and launch procedures using industry-wide platform Epsilon3.

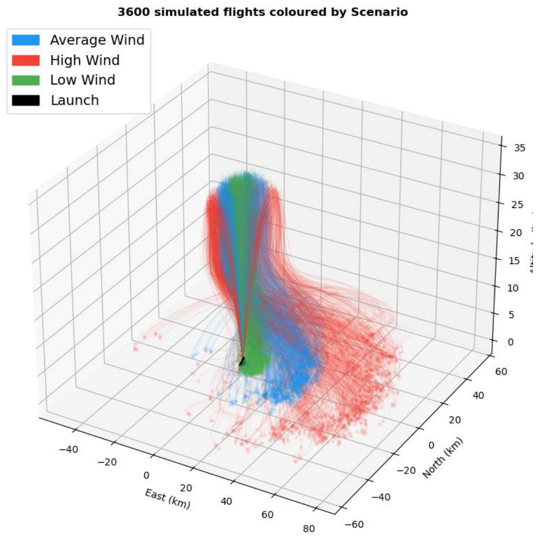


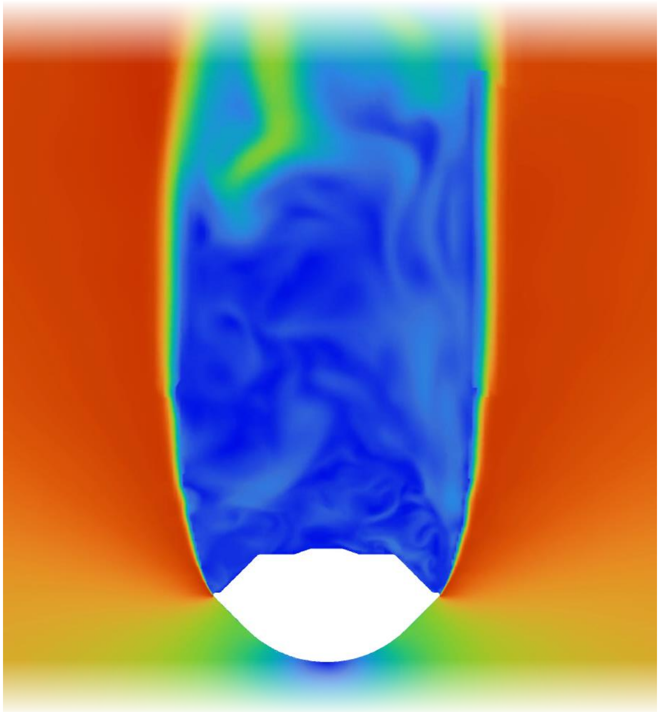


Miscellaneous Modelling

Launch Vehicle Trajectories

Throughout my degree, I have modelled flight trajectories of a variety of launch vehicles for a variety of purposes. This has included Monte Carlo simulations of competition rockets for apogee and landing distance analyses using RocketPy, SITL testing of control systems for airbrakes in both Python and Simulink, as well as miscellaneous flight models to help with drag optimisation of rocket airframes in MATLAB.



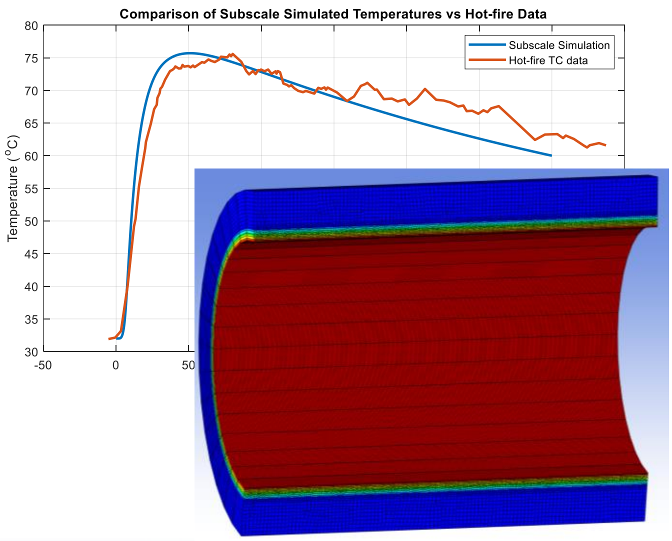


Transonic Re-entry Capsule

Over summer 2025-26, I worked with the University of Melbourne's Mechanical Engineering Faculty in collaboration with the Japan Aerospace Exploration Agency (JAXA) to help with initial analysis of oscillations of a JAXA sample-return mission re-entry capsule during transonic flight. I ran CFD simulations in Fluent and later OpenFOAM with cross verification, and used custom trajectory simulation software to compare results against a capsule drop test from 40 km AGL.

Hybrid Combustion Chamber

I assisted in the design of the phenolic-based TPS for a hybrid rocket engine combustion chamber by running pseudo-3D thermal simulations in Ansys Mechanical, using the Bartz correlation and published experimental data to form boundary conditions. I modelled a subscale engine to which hot-fire data was compared, validating results from the full-scale model. I also ran structural modal analysis and applied analytical acoustic methods to analyse the vibrational modes of the engine.



Test Lemaire launching to 4 km AGL on 04/05/2025