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BIRD WATCH

The Monash Uncrewed Aerial Systems Newsletter



Issue No. 1



A Year of Firsts

A 2023 Retrospective

By Jordan Semjaniv, Team Lead

The team has made incredible progress over the last nine months, starting off the year with one clear goal in mind: flight. Having spent two years after 2020 in and out of lockdowns, off and on-campus, with competitions postponed and cancelled, the team struggled to gain a foothold. In 2022 this began to change, we returned to the workshop ready, eager, and full of ambition. The team had its sights set on the international stage, the New Flying Competition (NFC) in Hamburg, Germany, and to it we would bring our biggest, most advanced aircraft yet.

But with an average member shelf-life of 2-3 years, few if any on the team had competition experience. We were out of practice, and with the addition of component delays and cost inflation, our arrival at the NFC in September 2022 was sadly not in the cards. Nevertheless our progress during this time was outstanding. We had designed for the first time an entirely composite aircraft, developed new skills in neural networks, revolutionised our manufacturing techniques, and had risen to the challenge of competing with world class teams overseas. We had, in this process, designed and manufactured everything we needed to build our aircraft. All that was left was to put it together and fly.



The Albatross V2 'Phoenix' taking shape

And fly we did. Immediately into the ground. It was another sharp reminder of our inexperience, but one we quickly learnt from. This was the first aircraft we had designed and flown since the pandemic, the first we'd ever flown of this scale and it was naive for us to expect to get it right the first time. Nevertheless this was a huge milestone in getting us back on our feet, and this aircraft (later nicknamed 'Phoenix') would prove a valuable teaching tool for the semester to come. To finish off the summer we held our first in person showcase since 2019, unveiling not only The Albatross, but our plans for the year: a search and rescue demonstration that would highlight our aircraft's strengths whilst reminding us of our UAV Challenge roots.

Semester one had a heavy focus on growth, both in terms of members and our collective knowledge. With a significant portion of the team graduating in 2022, we held our largest recruitment to date at the beginning of March. The MUAS management team then set out to rebuild our skill bases as well as grow new ones. The most important of which was flight analysis and control. A huge theme of our first semester was frequent flight testing, this gave us an excellent opportunity to hone these skills and learn an incredible amount in our quest to achieve stability and improve our VTOL performance. None of this would have been possible without the help of Ardupilot expert and control guru Paul Riseborough, without whom we may never have left the ground.



The team after a successful day of testing with the help of Paul Riseborough

In the gaps of our busy flight test schedule, the team began work on the next iteration of Albatross. Our trusty prototype had taught us many valuable lessons and it was time to put those into practice and develop an aircraft capable of delivering our mission. With improved accessibility, volumetric efficiency, cable management, structural performance and a brand new propulsion system, this aircraft was a mature refinement of our previous version.

On the 28th of August, 2023, Albatross V3, 'Horizon', took to the skies for the first time. Utilising the data we gained from the testing of Phoenix and some well calculated parameters by our new Flight Analysis Lead Ronan Glover, Horizon returned to the workshop after its first flight without a scratch. Since then the aircraft has completed over 30 VTOL flights!

Whilst Horizon has been enjoying success in the field, we have also seen incredible progress in the workshop as our mission critical projects begin to come to life. Over the coming weeks, the aircraft will start to be integrated with a LiDAR, camera, and gimbal in order to make it search-ready, and our Lifeline (payload) team will be validating the safety and reliability of their aid delivery system.



Horizon being prepared for flight

We will also be completing autonomous testing through our purpose designed ground station interface and validating our complete patient identification and location pipeline. Finishing the semester on a high, we plan to celebrate week 12 with a trip to the country where we will transition Horizon into continuous flight for the first time.



The Albatross V3 'Horizon'

Despite the academic pressures building with the culmination of the university year, the team is truly abuzz as we witness over two years of passionate development begin to realise itself in the form of an aircraft that we are truly proud of.

I am incredibly proud of how far the team has come this year, and I cannot wait to see it continue to flourish in the years to come.



Jordan Semjaniv

Team Lead

AEROSTRUCTURES



by Rohan Amarasinghe

Aerostructures Lead

The past six months have been very productive for the Aerostructures section, in which we had to focus on the major structural repairs of our flying aircraft, Albatross V2, during its run of PID tuning earlier this year. Concurrently to those repairs, we have also worked to design and manufacture the next generation Albatross, Version 3.

V3 of The Albatross represents a major step forward in our manufacturing and design methods. In the design process, we utilised programs such as ANSYS and MATLAB to ensure that our designs could withstand the loads of flight, as well as programs such as XFLR5 to ensure that our designs were as aerodynamic as possible. To cut our weight down compared to V2, we replaced our aluminium wing connectors with a design that utilises carbon plate and reduces the weight of the assembly by 50%.



Aerostructures working on the V2 wing

The fuselage internals also underwent a massive redesign, which saw a new composite rail mounting system be implemented, replacing the aluminium brackets that originally held on components such as the avionics stack. A whole new system for mounting our batteries was also designed, allowing us to quickly swap out propulsion batteries when required, while also supporting the heavy batteries when the aircraft is taking sharp turns. Lastly, we achieved virtually 100% utilisation of our fuselage space when we moved the ESCs into the rear of the fuselage. This allows them to operate more efficiently, and finally allows us to have bare wing boom exteriors, providing us with greatly improved aerodynamics.



Cutting the wing slots on V2 (Phoenix)

These improvements allow V3 to carry extra items that V2 could not, such as a gimbal and eventually, a payload, on which we have been working hard to design and build over the past couple of months. By utilising lightweight materials such as carbon fibre and kevlar, our payload system will maximise the amount of weight that Albatross V3 can carry and deliver.

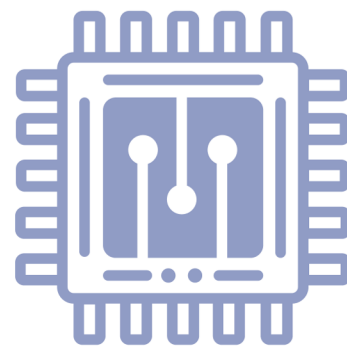
Alongside The Albatross, we have also been working on projects that help to elevate the experience of working on the aircraft, such as the Rookery, which has transformed our workflows both in our workshop, and in the field. With the ability to hold the aircraft in almost any desired orientation, as well as hold a second Albatross on its other side, the Rookery has quickly become indispensable to the team. It also allows for easier transport of our aircraft to their flight days, allowing us to maximise available daylight for flight testing.



The Avionics stack team working on Horizon mounted to the Rookery

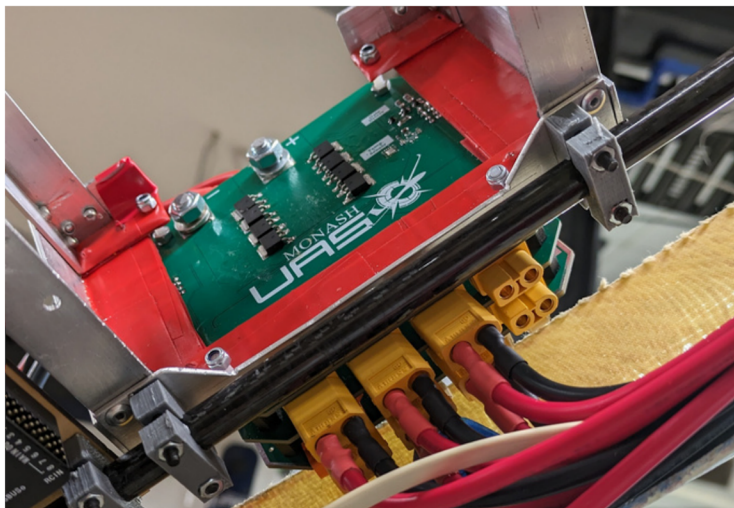
Section Updates

AVIONICS



by Dilshan Fernando

Avionics Lead



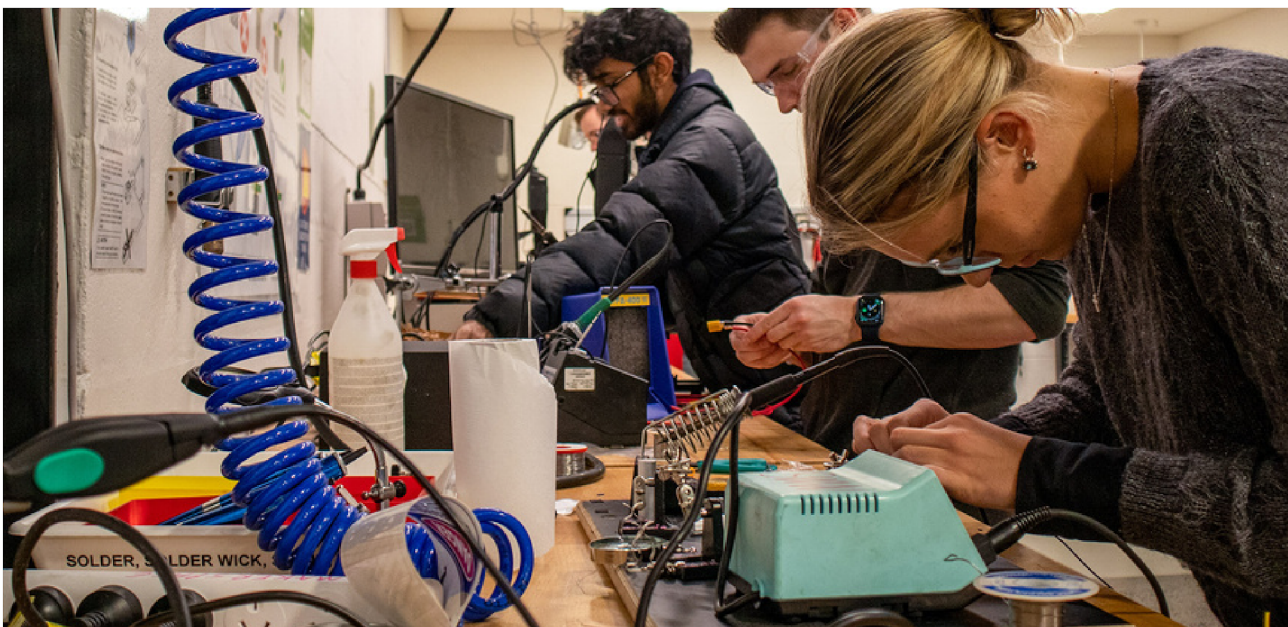
Horizon's Power Distribution Board

Avionics has worked on a myriad of projects over the past 9 months. The Avionics Stack is the brain of the drone. It houses the main power and communications harnesses to ensure mechanical functionality of the drone. Utilising a CAN orientated bus to handle communications, and converting that signal as needed, we are able to reduce noise otherwise introduced by cables.

We also worked on the Power Distribution Board (PDB). The PDB is a stack of PCB's which safely distribute power to our flight controller, propulsion, control surfaces and telemetry devices and include voltage regulation, current sensing and short protection.

Mission management is a software solution which allows us to control and view The Albatross in a meaningful way. We implemented a custom splining algorithm which allows the pilot to designate an area to search. It will then draw a flight path that will safely cover the search area. Alongside being able to view the different camera feeds, trigger a payload deployment and various other telemetry monitoring instruments, mission management is paving the way for us in terms of user friendliness and functionality.

The Vision system acts as the "eyes" of The Albatross and is part of the intelligence system which locates patients as we fly above them. We use a Jetson Xavier to run an object detection algorithm finding patients mid-flight. Using YoloV5, Vision is trained to detect human patients.



Avionics stack members preparing the wiring harness for The Albatross

Our gimbal is designed fully in house allowing for our search camera to point in a particular direction during flight. The Gimbal then locks to these detected patients allowing assessment of the situation by the ground team.

Lifeline is a custom payload winch system to enable us to deliver an item to a patient safely. Using systems such as a custom spool encoder and linear actuators, the team has been able to implement emergency systems that allow for the wire to be cut via electricity (using a nichrome wire) allowing the delivery to be aborted mid-way should a complication arise.

Our 4G system allows our various software to communicate and is one of the biggest helpers in the final integration and is vital to the success of the mission. Using our Real Time Kinematics GPS system, we have centimetre level accuracy of our drone's position, which allows for pinpointing of the patients' location ensuring the payload is delivered to the correct area or individual.

Overall, Avionics has had a year full of progress. By having the chance to learn completely new skills and become experts in some of the older knowledge, the section is once again coming into full bloom and we're keen to show off just how beautiful our work can be.



Avionics Lead William Li - working on Project Wedjat (Gimbal)

FLIGHT OPERATIONS



by Thomas Avent

Flight Operations Lead

Over the last year, flight operations has worked on a number of projects to aid the successful flight of The Albatross. A key project has been the FyreFly, a separate aircraft which allows us to test experimental propulsion configurations for The Albatross. This is what led to the choice of our iconic Y6 frame for The Albatross. Other key aircraft and equipment we worked on includes the Hexcopter, X8 and the X8 bungee launcher. All these were either restored or rebuilt from scratch and now currently play a crucial role in our testing and tuning suite.

Testing on The Albatross has been our biggest task this year. We've gone through an extensive battery of tests to ensure that the aircraft has been ready to progress to new degrees of functionality. We started the year with constrained flight testing by securing the aircraft to a stand called the E.M.U (escape management unit) allowing the aircraft to pitch, roll and yaw without taking off. These tests allowed us to verify our thrust output and attitude control.



V2 'Phoenix' on the E.M.U

After this came the tuning of the aircraft for flight. Over COVID, the team lost a lot of knowledge relating to PID tuning, making it all the more incredible how far we've come this year. With the help of Paul Riseborough the team has developed a whole new area of expertise dedicated to flight analysis. This is where the FyreFly really paid off. Having a much smaller and more robust aircraft allowed us to practise tuning without putting The Albatross at risk. We've now reached a point that we can confidently say this knowledge is back in the team. Where it took nearly 4 months to tune Phoenix, it only took 3 weeks to tune Horizon.



The FyreFly

Our flight days are among the most crucial days for the team. We take the aircraft to perform various flight tests and ensure the work we do in the workshop is translating to the aircraft's performance. At the beginning, the testing we did was heavily limited, but as we got more experienced and The Albatross became more refined we have been able to do thorough non-restricted flight testing. The culmination of all of flight operations' efforts with tuning and testing came at the most recent flight day where we climbed to a height of 50 metres and had the aircraft use its onboard systems to autonomously land itself for the first time.



OPERATIONS



by Elita Wu
Operations Lead

Our Operations team has undergone a large expansion over the past few months, providing us with the resources to expand our scope. However, regardless of size, our Operations team has achieved amazing things over the past year.

Our key achievement prior to expansion was the 2023 MUAS Showcase. With a main team of five, helped by members across the team, we were able to deliver an amazing night. We hosted over 100 people, ranging from sponsors and industry stakeholders to family and friends. The Showcase gave us a platform to acknowledge the hard work of all our team members and celebrate the whole team's progress. Our team greatly enjoyed the opportunity to show off their efforts of the past two years.

Throughout the past year, our Operations team has worked tirelessly in the background to ensure the long-term function and success of the team. With increased manpower, we have been able to fully spread our wings and start putting our plans into action. Specifically, we have been working to increase our focus on outreach, one of our key passions.

We are so grateful to have had the pleasure of visiting John Monash Science School, Melbourne Girls Grammar School and Melbourne Grammar School over the past year. We also teamed up with Monash Motorsport and Robogals to teach students about UAVs in fun, accessible and exciting ways. Working with students from Year 5 to 12, we have run a variety of activities to inspire students to pursue careers in STEM and teach them about MUAS' work.



2023 MUAS Showcase Night

Partnering up with our newly appointed People and Culture Manager Ethan Liberman, our Events team recently hosted our first Alumnight! The event brought MUAS members past and present together to compare stories from our times on the team, learn more about the exciting work our alumni are doing and play the hardest game of UAS trivia ever. They also hosted a Community Day to engage with students across all Monash faculties and share what makes our team so special.

As always, our marketing team have done a fantastic job of highlighting the work MUAS does with our sponsors and all the progress that we have made. Their work is essential in increasing engagement in MUAS' work and for bringing in new talent to the team.



MUAS Community Day



MUAS Drone Workshop

2024 Leaders

We are excited to announce our new Team Lead and Chief Engineer. They are both hugely talented individuals who have been part of UAS for a long period of time. We are excited to see the direction UAS goes in under their lead and believe in their vision for the team.



TEAM LEAD DILSHAN FERNANDO

Hey everyone, I'm Dilshan! I'm a current 4th year (going into my 5th year) Mechatronics student aligned with the AI stream of the degree and I've been with the team for the past two years. I'm super excited to be able to take up the mantle of team lead next year, excited to know everyone's names and aspirations and to help maintain the current awesome culture in the team. The more I learn about the role from Jordan, the more eager I am to dive in.

One of the main things I want to achieve or rather maintain next year is the incredible team culture that we have built up over the history of MUAS. I feel like what we have is so special amongst the teams and I want to ensure that we maintain and keep enhancing this culture as we move forward next year. I'm also excited to see how I can push the team and how they can push me to keep improving together.

Some things I like to do in my spare time is playing video games and reading books (and also working on the drone DUH!). Though as uni gets busier it is getting a bit rare that I have time to sit down, nevertheless I really love it when I have things to do so I'm not complaining one bit.



CHIEF ENGINEER WILLIAM LI

Hey! My name is William Li, and I will be MUAS' Chief Engineer going into 2024. I am an engineering student majoring in mechatronic automation and minoring in AI.

I joined the team in late 2021 and soon after joining the team I worked on the Vision project. I enjoyed working on this project thoroughly and soon after became its project lead. After working on Vision for a year, an opening for Avionics lead arose, and wanting to translate my passion for Vision to the section as a whole, I took the opportunity. I worked closely alongside Dilshan, who was the other Avionics lead, and we developed a close bond and are a strong team so it is the perfect opportunity for us to work together in the key leadership positions heading into 2024.

I want to use my role to act as a communication bridge between our sections and oversee the various key projects occurring across team. While I need to ensure that we reach our shared goal of seeing our aircraft take to the skies, I also hope to do this while fostering a good culture within the team, to ensure team-wide enjoyment as we together learn how to create a cutting-edge search and rescue UAV.

We will be announcing the rest of the 2024 leadership team in the next edition, so get excited to see the team who will take MUAS into the future.

Letter from the Editor

Hi All,

I'm Yasiru the editor of the MUAS newsletter. My vision for this newsletter is to give everyone a deeper insight into the team beyond that of what can be seen at our events such as Showcase or Demonstration. For context, I am currently studying commerce and law, so the question should be posed, why is a comm/law student in an engineering team? This is one of the areas I believe the team truly shines. Not only is MUAS a team of the brightest and most talented engineering students, it also has team members from many different degrees and backgrounds with a single united vision: we want to push the boundaries of UAV applications in humanitarian issues such as search and rescue, all the while advancing the next generation of thinkers. I hope that as we release more and more issues of the newsletter you can get a greater look into the team, our culture and come along with us on our journey.

This first issue is focused much more catching everyone up with all the progress we have made over the past nine months. I hope you found it interesting to see all the progress we have made, but for those wanting a closer look at the team and our members I have plenty of content planned for future issues.

I hope you enjoyed our newsletter and are keen for our future releases. They will be released quarterly so I will talk to you all again in February.

Until our drones cross paths again,



Yasiru Peiris
Chief Editor

SPECIAL THANKS TO OUR SPONSORS!

