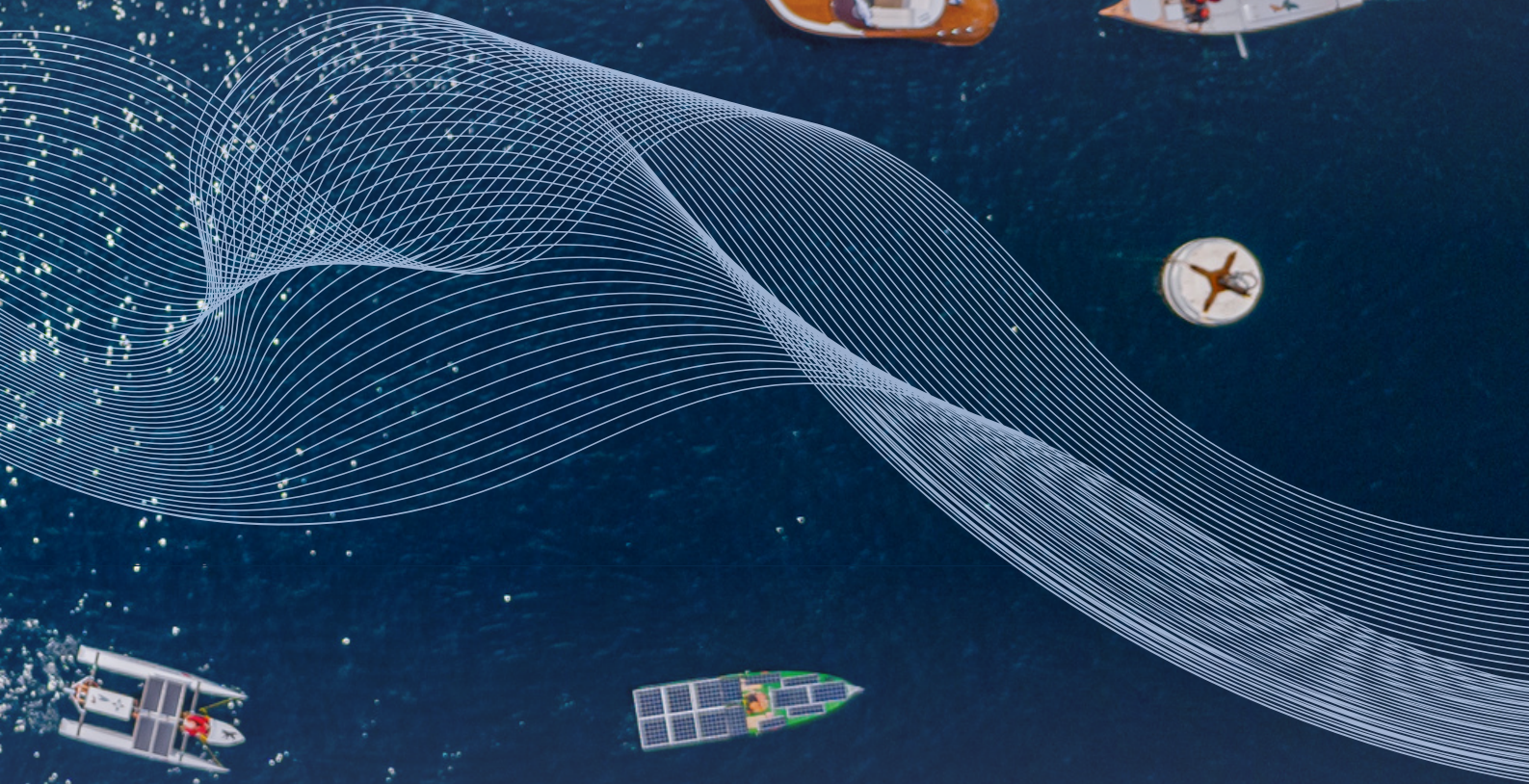


# RIVIERA

1<sup>st</sup> Edition  
December 2023



UNIVERSITY OF  
CAMBRIDGE



CAMBRIDGE UNIVERSITY  
RIVIERA RACING

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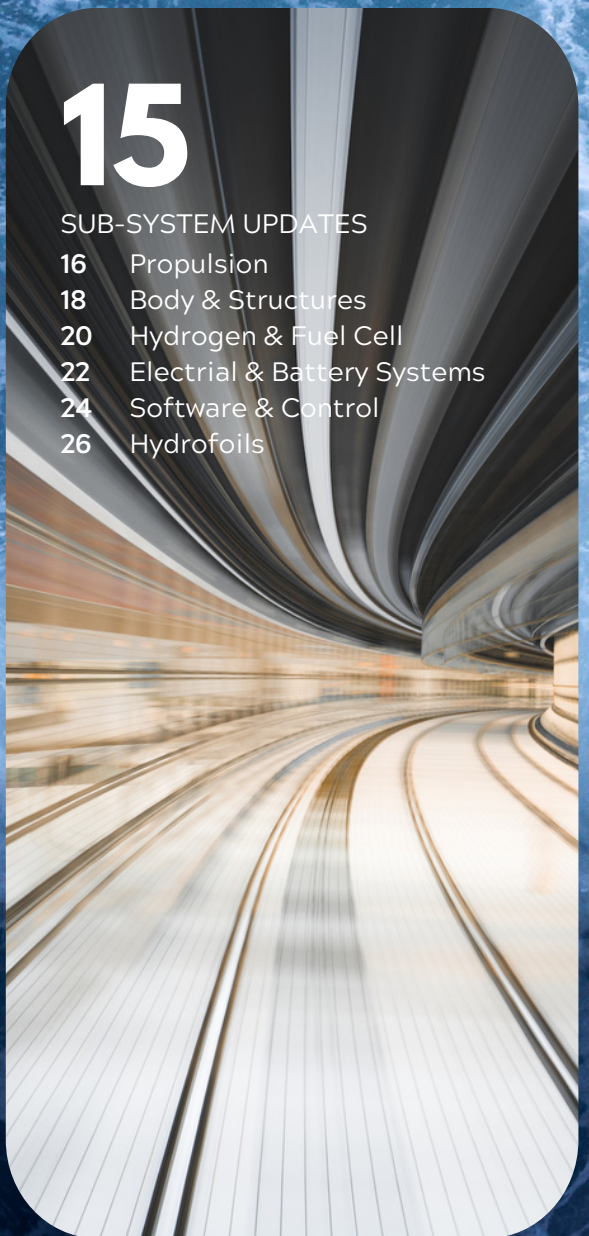


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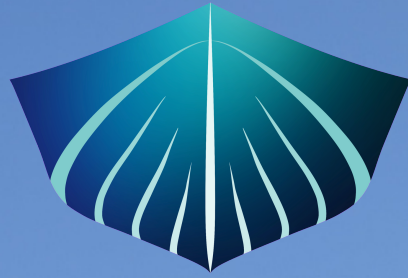
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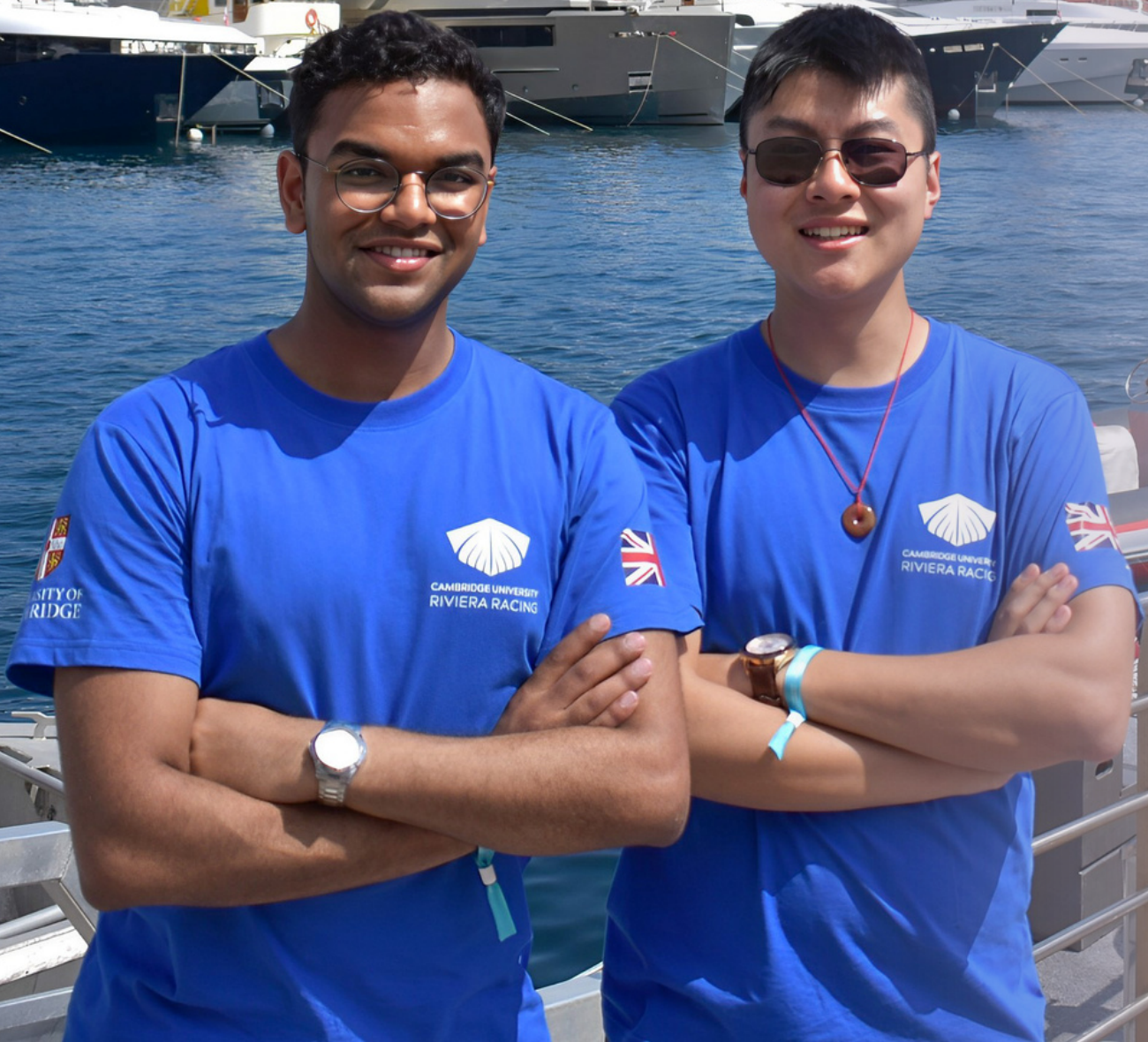
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SPONSORS  
Introducing the inspirational partners who  
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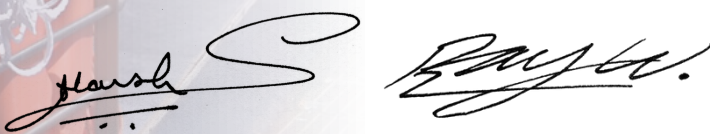
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What started as a concept discussed between two students in search of a practical outlet quickly developed into a skeleton of a society, consisting of a group of ambitious friends hoping to start something bigger than themselves. Today, it stands as a well-oiled machine, serving as a meeting point for the brightest students in Cambridge and a team of the most exciting innovators from industry and academia.

Anyone who has worked closely with the team, whether it be members of staff, industry titans or new recruits, has quickly realised the intensity with which we pursue progress. We have been astonished by the lengths to which people are willing to go to support the project, with members working through the night on short notice and travelling across the country to attend conferences with the sole aim of benefiting this motley collective of dreamers and thinkers they have joined. Perhaps the most unexpected part of this project has been the level of support and encouragement we have received from industry, whether it is from our mentors across the world who have spent hours of their own time crunching through calculations and providing invaluable advice or the multitudes of people who we have met at events who are excited to see where this project goes. It is clear that there is an appetite for our vision of a maritime future powered by hydrogen and we are incredibly grateful for the reception we have received.

Ultimately, the story of the team so far is of remarkable individual efforts combining to create something truly special. Although we still have a long way ahead of us, we are confident that we have chosen the right people to make it happen! The end of the year gives us a chance to slow down and celebrate the work done this year by the wonderful array of people involved in the project and appreciate the progress we have made so far. We hope you enjoy reading about our adventures this year in the rest of this newsletter and look forward to meeting again in the new year to complete our journey towards victory at the 2024 Monaco Energy Boat Challenge!



**Harsh Sinha & Ray Wang**  
Director of Operations & Chief Engineer

# FORWARD

# OPERATIONS

**Xiaoli  
Biggs**  
Team Secretary



In a project so focused on technological innovation, it is sometimes easy to forget those who are constantly working behind the scenes to keep everything running. With approximately 70 students involved in the project, the scale of the team and our ambitions have led to some interesting logistical challenges, but we work hard to keep the project on schedule.

A big part of our work stems from the help we receive within the university as well as from our partners in industry. We have been careful to forge partnerships with companies who share our vision for a hydrogen-powered maritime future and have been fortunate to have a talented team of mentors on board!

We have been able to attend several industry events, including the opportunity to exhibit at Southampton

International Boat Show. We are proud of the efforts made by our team to showcase our work, both at events and with our recent press releases crafted with the team at Yachting Ventures.

The term ahead promises to be packed with exciting challenges. We aim to extend our outreach efforts, encouraging younger children to consider a future in engineering. We seek to address the technical needs for our team, including securing a testing venue and procuring the materials needed to make the boat a reality. We are also looking forward to host our first ever boat launch, which celebrates both the boat but also the people who have made it possible - we look forward to inviting our partners to meet the team!

*Xiaoli B*

# ENGINEERING

**Heramb  
Modugula**  
Deputy Chief Engineer



The technical team is at the core of our operation and is diligently working on the boat in specialised sub-systems to maximise the efficiency of each component. Through dedicated weekend build days and regular meetings with the sub-system leads, we maintain continuous communication as a part of our approach.

The technical rule changes for next year's competition have resulted in significant last-minute design changes and have pushed back manufacturing. To comply with the significant reduction of the weight limit, we are meticulously tracking the boat's weight to maintain our desired centre of gravity. This has led to tight margins for the sub-systems and a complete overhaul of the components. The electrical and battery team has switched to a completely in-house solution, trading weight savings for increased volume.

On a positive note, the new rules open up the possibility of hydrofoiling surfaces. Given that the implementation of foils is a large technical undertaking, members of various sub-systems have branched out to form our newest hydrofoils sub-system.

As we near the end of the design phase, we extend our deepest gratitude to our technical industry partners. Their invaluable support, expertise, and commitment have propelled our project in the right direction. Together, we are not merely building a boat; we are charting a course toward a more sustainable and technologically advanced maritime future.

*Heramb M.*



L A T E R A L

NAVAL ARCHITECTS

ASK **NEW QUESTIONS**





# EVENTS OF THE TERM

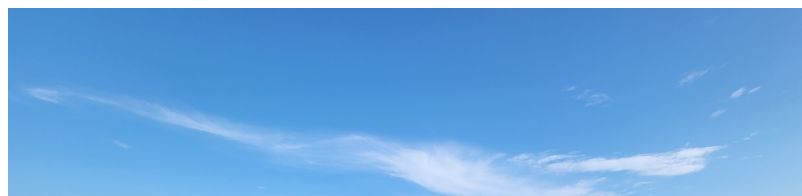


# MONACO ENERGY BOAT CHALLENGE

3<sup>rd</sup> - 8<sup>th</sup> July 2023



The Yacht Club de Monaco graciously invited us to attend the 2023 edition of the Monaco Energy Boat Challenge as an opportunity to get a taste of the competition in person. What followed was one of the most exciting weeks in Riviera Racing history thus far, with four members of our team making the journey to Monaco in early July, prepared to take in as much information as possible. We weren't surprised by the scale of the event nor the quality of the competition. What did come as a surprise, however, was the friends we made and the deeply-embedded culture for collaboration and camaraderie between the teams. This is a place which truly does bring out the best from some of the most ambitious and talented people we have ever met and we cannot wait to go back to challenge our friends with our own boat!

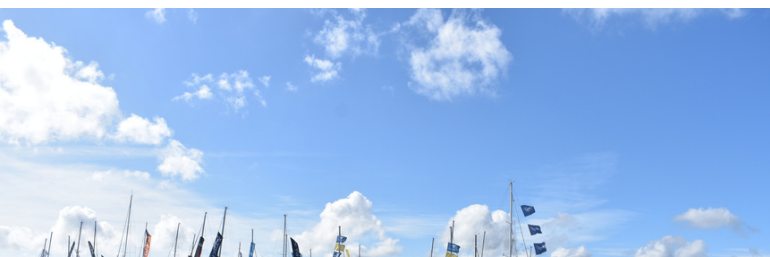


# SOUTHAMPTON INTERNATIONAL BOAT SHOW

15<sup>th</sup> - 24<sup>th</sup> September 2023



Being invited to exhibit at Southampton International Boat Show marked a turning point for the team where it became clear that the industry takes our project seriously and wants to hear more about the work we are doing. Weeks of preparation, including 3D printing a model of our boat, creating banners for the stall and adapting the MEBC simulator to work with controllers so we could encourage younger engineers to interact with the project. As the largest event of the year in the UK for the maritime industry, this also served as an important outlet for us to spread the word about the project and meet the key players in the British industry. We were honoured to have been able to attend and look forward to exhibiting at SIBS and other conferences in the future!



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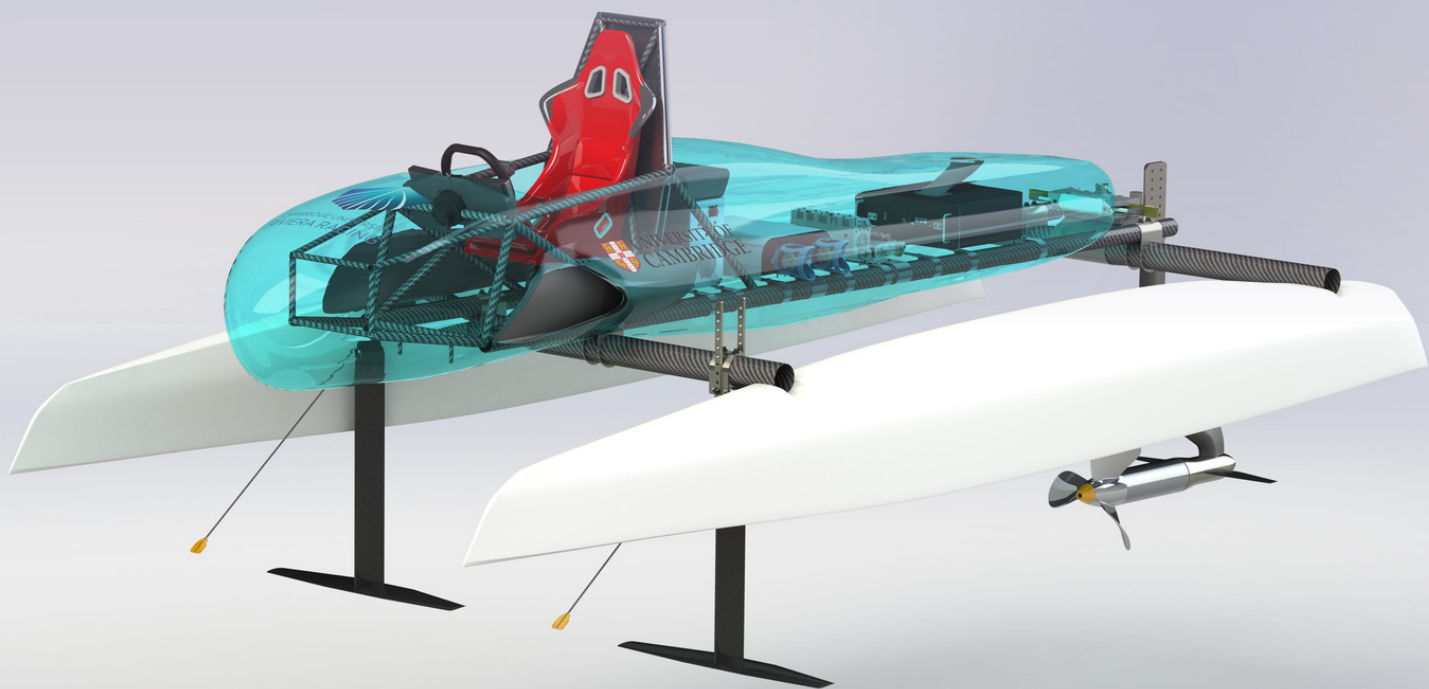
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# SUB- SYSTEM UPDATES



# PROPULSION

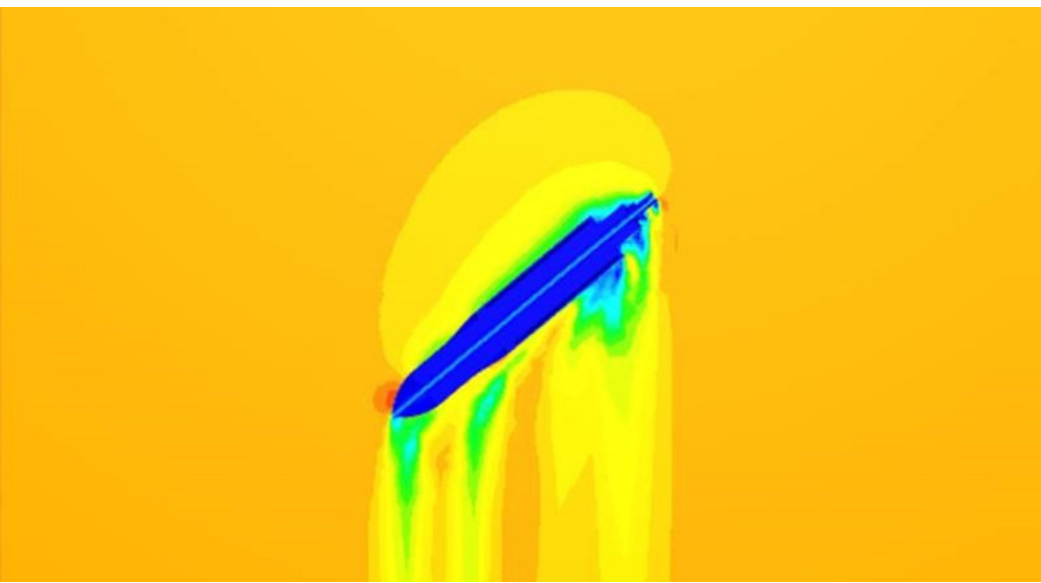


Over the last 8 weeks, the propulsion team have been working on creating a custom propulsion unit in close collaboration with industry experts ranging from propulsion companies to naval architects. After a number of iterations, we have designed a streamlined pod while incorporating active water cooling and multi stage motor arrays to boost the efficiency of our propulsion unit. The pod shape is designed to be as lightweight and hydrodynamic as possible through the use of CFD and adapting standard aerofoil profile.

We have also aimed to optimise strength while minimising weight through extensive structural calculations. With two candidate propeller designs already developed and the internal electronics finalised, we look forward to working on making our concept a reality in the New Year!

**Max Weston,**  
**Mridhula Sridevi Prabhakar**  
Propulsion Sub-System Leads







# BODY & STRUCTURES

Regarding the cockpit design, we have employed SolidWorks to craft a frame, serving as the primary structure for the front of the build. This frame supports the pilot and control systems, while integrating with the main chassis and carbon-fibre nosecone. Carbon-fibre beams with a circular cross-section have been selected for weight reduction while ensuring that the structure is appropriately rigid. Our priorities for the coming months, as with the chassis side, are to procure the materials necessary and to move ahead with building the cockpit. This will continue to require extensive collaboration with other sub-systems and is a challenge we look forward to tackling!

## Annabel Gray

Body & Structures (Cockpit) Sub-System Lead

The body and structures team has a simple overarching brief - to design and build the cockpit and chassis of the boat, with the sub-system split accordingly. On the chassis side, we have created a concept design and are currently in the process of procuring materials to commence our build. We have opted for a carbon-fibre structural member running along the spine of the chassis with aluminium plates mounted on it, allowing for a modular and versatile layout. During the design of the chassis, we have been particularly focused on managing overall weight and distribution, with our members overseeing the allocation of weight allowances for each component across the project. At the start of 2024 we are expecting to be able to move ahead quickly with the manufacture of the chassis while managing weights across the build.

## Terrence Ng

Body & Structures (Chassis) Sub-System Lead



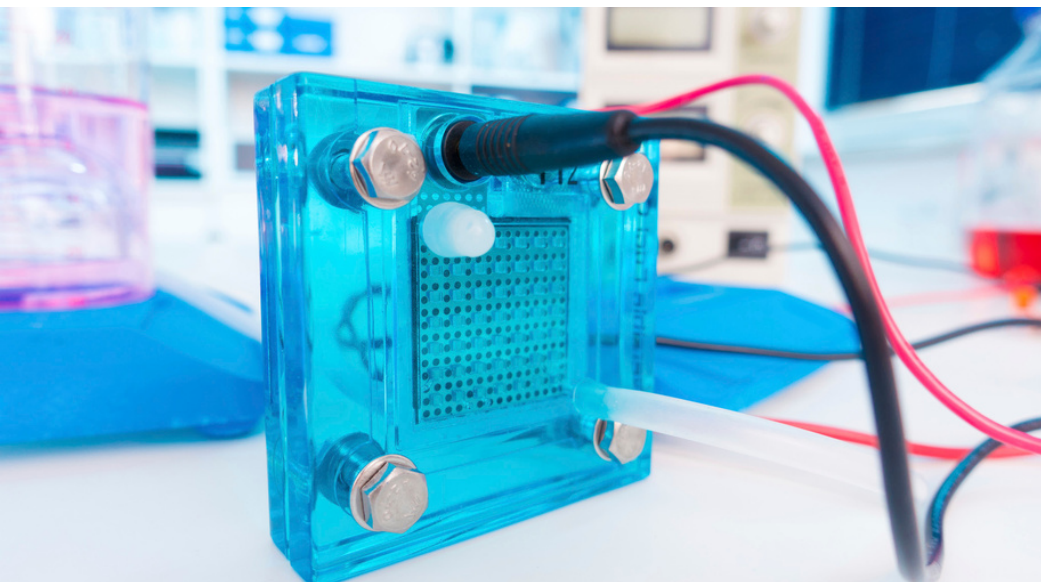
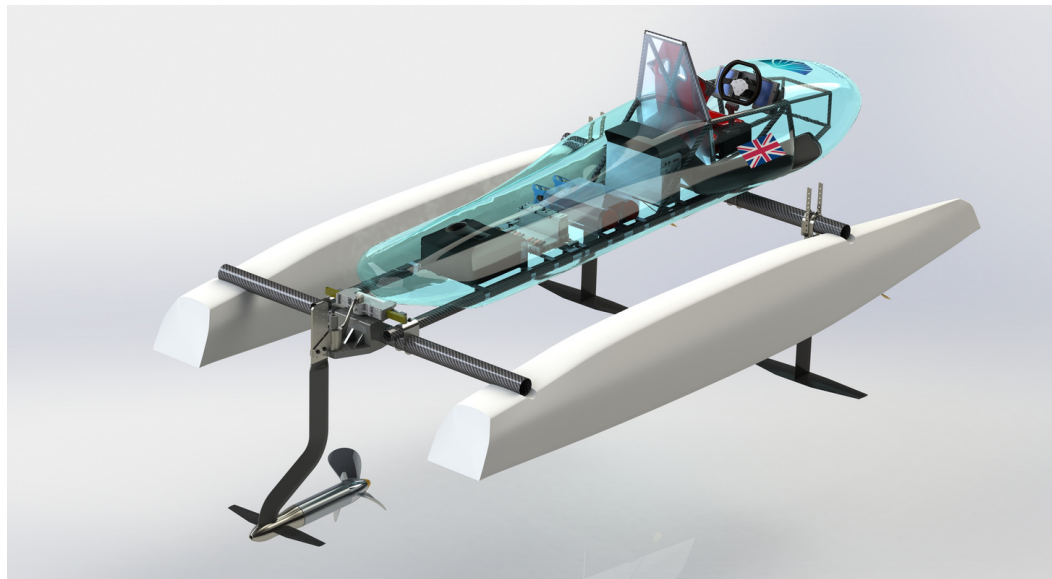
# HYDROGEN & FUEL CELL

The hydrogen fuel cell is at the heart of the boat and the vision this project aims to embody. This term, the hydrogen team has made great progress with designing and building a safe and efficient system that delivers power using hydrogen as a fuel. We have been working with industry partners and faculties within the department to create and integrate a hydrogen fuel cell. Creating the appropriate fuel cell has been a challenge as hydrogen, though a promising future for the maritime industry, is still fairly new for maritime applications.

It is therefore incredibly rare to find a solution which meets our very specific specifications. The challenge also involves integrating the hydrogen fuel cell with the battery and electrical systems to create an efficient hybrid powertrain. Managing all of these aspects while continuing to prioritise safety will continue to be our priority over the next term and beyond as we work on a pressurised hydrogen network with safe delivery and sufficient cooling and ventilation for our fuel cell system.

**Sanadi Ilandaridewa**

Hydrogen & Fuel Cell Sub-System Lead



# ELECTRICAL & BATTERY SYSTEMS



It has been an exciting term for the electrical and battery systems sub-system, with a number of decisions made and a greater number of tasks generated. The foundation for our approach has been to consider the rules of the Monaco Energy Boat Challenge as our baseline requirements and then to see how we can push performance as far as possible. We have been focusing on designing our overall electrical system and power flow to see where we can find the maximum potential for innovation and improvement.

One incredibly exciting decision made this term has been to make our own batteries using cells! Our power requirements require very low energy storage while providing a very high power and discharge rate. Having found no feasible commercial solutions without significant compromises either in weight, price or performance, we investigated the possibility of making our own solution.

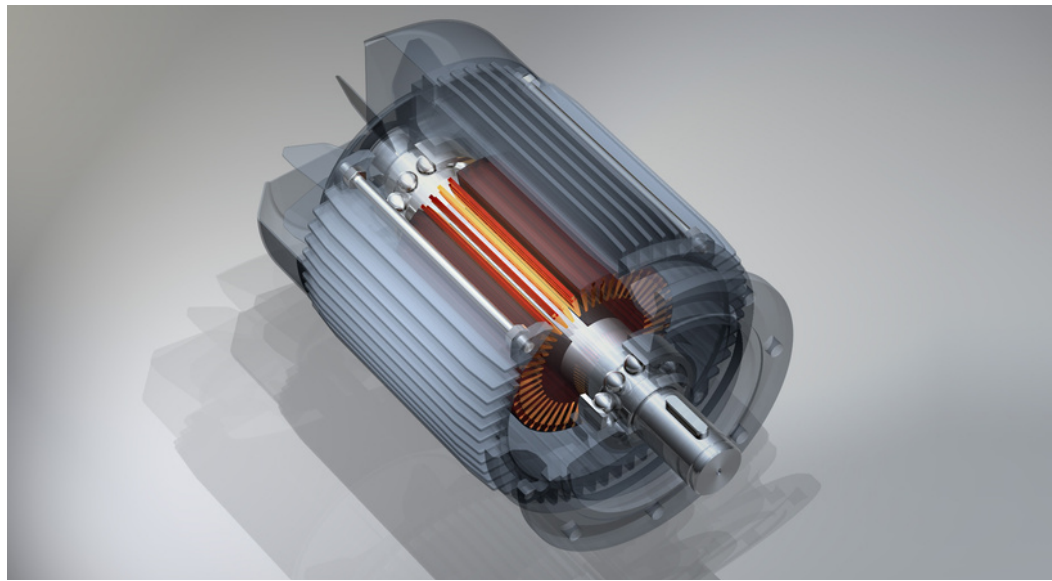
We soon discovered that it is possible for us to make a battery which is much lighter and cheaper than off-the-shelf alternatives, even allowing us to include a mode switching configuration to adjust for the vastly different requirements for each race. Additionally, we explored the feasibility of solar energy as our secondary power source (energy we generate while running the boat during the race).

We have started designing our own boost circuits to ensure voltages of the battery, fuel cell and solar panels stay the same during the longer races to allow the hybrid system to function properly.

A significant portion of our time and energy continues to be devoted to sourcing the right parts to make the system work well as a cohesive whole - we aim to get the electrical systems created early next year.

**David Forcada,**  
**Misha Koshutsky**

Electrical & Battery Sub-System Leads



# SOFTWARE & CONTROL

The software sub-system, although focused on our internal projects, is uniquely spread in our interaction across the team to fulfil the software requirements across the boat. The team is split into two crucial categories: telemetry and control.

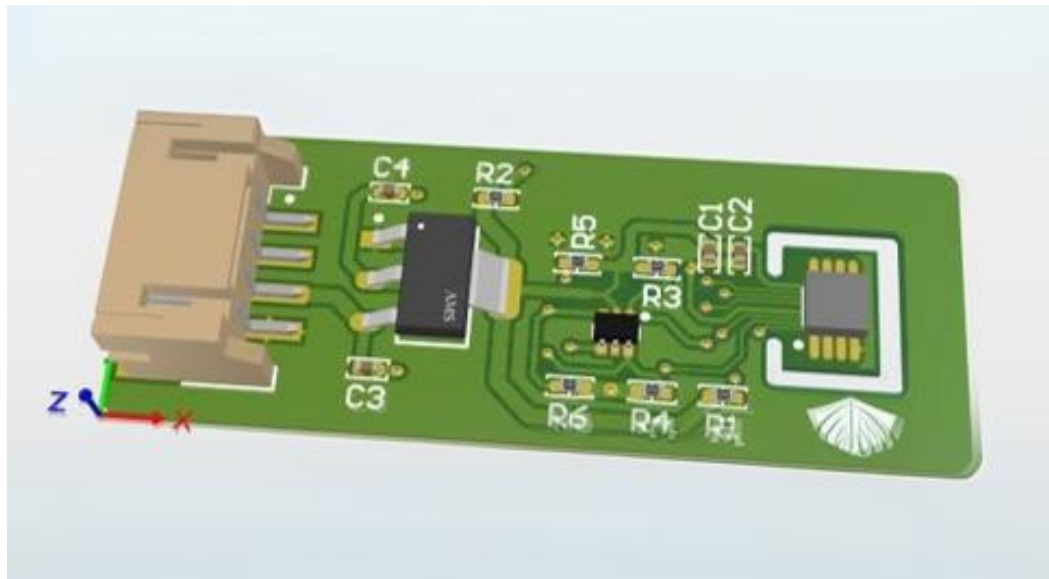
The telemetry sub-system plays a pivotal role in delivering real-time sensor data, like temperature, pressure, and speed, from the boat to our onshore team. This is made possible through the use of 3 ESP32 microcontrollers, each responsible for a key sub-system: propulsion, fuel cell, and batteries. The microcontrollers, running custom software, gather, process, and relay data to a central Raspberry Pi.

This Raspberry Pi not only drives the pilot display screen but also transmits vital data to the team onshore via radio. Our achievements this term include the design of a custom build system, the development of configuration and sensor data collection code, and the creation of a prototype GUI for the pilot display. Over the break, we plan to explore new protocols for interfacing with the motor drive unit, refine the pilot display GUI, and pave the way for system integration when we return. We will also focus more on the control side of the project as the hardware for the boat is confirmed.

**Sunaabh Trivedi,**  
**Thomas Yam**

Software & Control Sub-System Leads







# HYDROFOILS

Although we are the newest sub-system formed after a change in design direction following the recent rule changes allowing us to foil, the work done in the Hydrofoils sub-system is done with the knowledge that it is crucial to our aspirations for a podium position. The hydrofoil will provide lift to the boat, allowing us to reach faster speeds quicker, and maintain it. This term, we've explored a plethora of options regarding placement, profiles, foiling strategy and beyond.

We have also looked into materials and how we can make use of the expertise available within the department, both in the workshops and in research. In the build-up to next term, we are continuing to liaise with industry partners to confirm our layout for the hydrofoils. This will allow us to continue on our journey to make our boat fly!

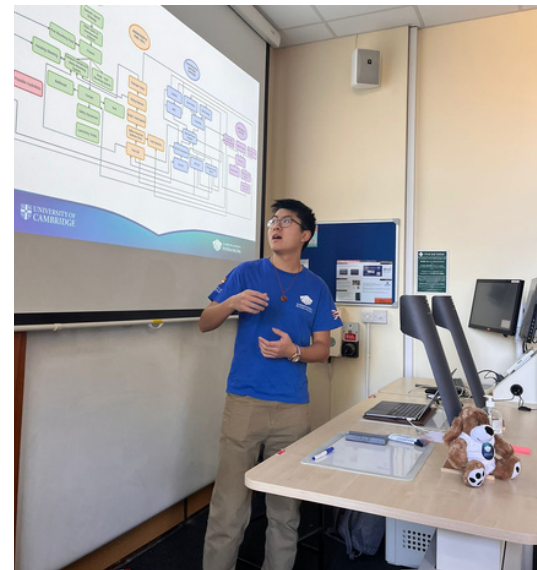
**Amanda Kangai**

Hydrofoil Sub-System Lead



# BUILD DAYS

Although work is done throughout the week, the build days are a valuable opportunity for the whole team to meet together in one place at the end of every week. Fuelled by an assortment of sweet treats courtesy of the local Sainsbury's and the entirety of the Engineering department library invaded, with sub-systems setting up camp at separate tables, the Saturday build days have served as weekly catalysts for productivity and a chance to consolidate the work done throughout the week. They also serve as our introduction point to the society for the members who have been chosen to join us, giving them a taste of what the structure and working methods of the team are. Finally, our build days also line up with other engineering societies within the department, allowing us to foster links between societies to work together on our shared aim of providing an environment for students to develop their skills through real-world challenges.





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