

Harold Kikoyo – Warwick Submarine Report

Background

The International Submarine Races (ISR), sponsored by the Foundation for Underwater Research and Education (FURE), is a design competition that challenges university teams worldwide to design, build, and test human-powered submarines. It is held biannually at the David Taylor Model Basin, Naval Surface Warfare Centre, Carderock Division, West Bethesda, Maryland, USA. Held since 1989, it has been a successful event that has tested the engineering expertise of engineering students and independent teams. ISR 18, the 18th iteration of the event, was held in June 2025. The event fosters innovation in underwater vehicle design, encourages multidisciplinary collaboration, and provides a platform for students to apply engineering theory to a real-world application. Testing of the submarines is achieved via a time trial, where the submarines are required to travel 100m in a straight line as quickly as possible. The team to achieve the fastest top speed would win the overall event. However, there were additional awards, including the 'best technical report' and 'best use of technology'.

Technical Objectives

Warwick Submarine's participation in ISR 18 was to conduct water testing of the underwater craft (Godiva VI) with the FURE at the David Taylor Model Basin. The Warwick Submarine project is a final-year group project for students pursuing a master's in engineering (MEng) degree at the University of Warwick. The academic scope was extensive, including objectives such as the application of underwater telemetry, material research, modular hull design, and research on the effectiveness of propulsion methods, among other aims. The key innovations were the submarine's telemetry system and 2-degree-of-freedom (DOF) thrust-vectoring propeller.

Attendance at ISR 18 was important for Warwick Submarine, as the facilities provided by the US Navy allowed for extensive research into the performance characteristics of the submarine. Such research couldn't be done to the same quality using the university's resources, whilst facilities in the UK would be provided at the European ISR, held in 2026. The research conducted alongside lessons from other universities will be passed on to the incoming master's year students, assisting them with next year's MEng group project.

Logistics

The team members took flights from London Heathrow to Washington, DC. However, the freight of the submarine from the United Kingdom to the United States was also considered. We considered both sea and air freight for the submarine. Although air freight would be faster, we chose sea freight for its lower emissions and cost, making it a more sustainable option.

Participation at ISR 18

Initially, teams were required to pass dry and wet tests at ISR 18 before continuing with the project. Warwick Submarine was one of the first teams to complete both tests, which enabled us to quickly begin testing our submarine. The first half of ISR 18 proved difficult. The submarine's handling was difficult due to the sensitivity of our controls, which led to several crashes. Our telemetry worked successfully underwater, providing clear guidance to the pilots as to the orientation of the submarine. On the fourth day, a decision was made to attach larger dive planes to the submarine to enhance its stability. This worked wonderfully as we were able to complete our first clean run. We also surpassed our team's average speed record from ISR 17 at 1.77 knots.

The final competition race day was successful with a 100% completion of our runs, indicating that the greater stability provided by the dive planes could overcome the sensitivity of our thrust vectoring propeller.

Due to our telemetry system and thrust vectoring propeller, we were awarded 'Best Use of Technology' by the FURE at ISR 18. Our success at ISR 18 was acknowledged by the University of Warwick, and we received the 'Group Innovation Undergraduate Student Award' from the School of Engineering.

Presentation

On the second day of ISR 18, a presentation was made to the judges providing an overview of the project. This discussed all the aspects of the project, including the academic aims, project management and outreach conducted by the team. It was well appreciated for the insight it provided.

Networking

The visit allowed the group to exchange ideas with other universities from around the world and top engineers at NSW Caderock. Key ideas exchanged with the more experienced teams provided us with lessons to pass on to the incoming master's students. In addition, the British Embassy in Washington, DC reached out to us to discuss the project. They were also impressed by the interest from the IET.

The IET's contribution to the project

The travel bursary provided aid for the subsistence costs of the participating students. Such a trip to the US was expensive, and so the funding assisted in making it financially viable for the students to attend ISR 18.