Introduction to Undersea Technology Course Development

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- research & teaching interests in acoustical oceanography, sonar systems engineering, acoustic signal processing, underwater acoustics, marine bio-acoustics, ocean data analysis, modeling, and underwater vehicle design.

Rich Christenson, Professor, Univ. of Connecticut

Co-Director, National Institute for Undersea Vehicle Technology (NIUVT)

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- research & teaching interests in structural dynamics, methods to control and reduce vibrations, performance and resilience of various structures
- AUKUS Fulbright recipient: international collaboration across academia, industry & gov. to explore challenges, security measures, & opportunities

Shipbuilding Activities at UConn & URI

Applied Research – NIUVT

Navy STEM Coalition

Shipbuilding Supply Chain Initiative

International Opportunities: AUKUS

National Institute for Undersea Vehicle Technology

- 195 Applied Projects: 123 Active, 72 Completed
- 100% of NIUVT Research Involves Industry and/or Government
- Regular cycles to identify projects & conduct our 1, 2 & 3 year projects
- 90+ Faculty Conducting Research across both Colleges of Engineering
- 229 Active Grad & Undergrad Students; 200+ graduates: BS; MS; and PhD
- Broad: technologies (12 technical areas identified), disciplines (across both colleges of engineering), people (from undergraduates to engineers to sailors), and platform agnostic (Virginia–Columbia–UUVs–SSN(X)–AUKUS)

Fundamental Change in Academic-Industry-Government Partnerships: Provides for persistent collaboration, increased speed of innovation & constitutes fundamental change in Navy R&D/workforce development

NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

niuvt.us

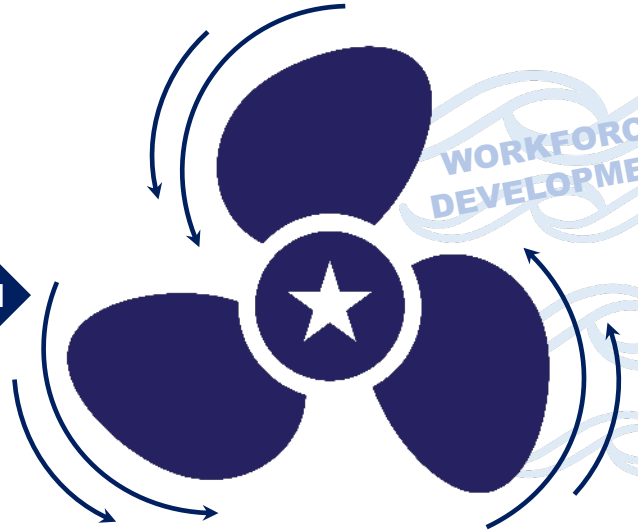
ECOSYSTEM

UCONN COLLEGE OF ENGINEERING

THE UNIVERSITY OF RHODE ISLAND COLLEGE OF ENGINEERING

NAVAL UNDERSEA WARFARE CENTER NUWC DIVISION NEWPORT, RI

BASIC RESEARCH — Office of Naval Research ONR Science & Technology — APPLIED RESEARCH



NEED & RELEVANCY, CONTEX & MISSION SCENARIOS: Warfighter, Navy Labs, Shipbuilder

UNCLASSIFIED RESEARCH: Universities

CLASSIFIED/SENSITIVE RESEARCH: Navy Lab, Shipbuilder

SKILLED WORKFORCE: K-12, UG/GRAD, Full Time Engineers

PERSISTENT COLLABORATION
FACULTY/STUDENT ENGAGEMENT W/ GOV./INDUSTRY
TECHNICAL MEETINGS & PROJECT REPORTS
PUBLICATION REVIEWS; INTERFACE W/ CONGRESS

2+1+1/3 + SUSTAINMENT

EXPERT WORKFORCE

MAINTAIN UNDERSEA SUPERIORITY

NIUVT MISSION

Conduct applied research, closely aligned with government and industry partners, to accelerate the development and transition of enabling technologies to advance and streamline the design and manufacturing of the next-generation U.S. undersea fleet

The Ecosystem is driving collaboration, engagement, applied and accelerated research, and workforce development that are critical to realizing the NIUVT mission and maintaining undersea superiority.

UConn – URI Navy STEM Coalition

The UConn–URI Navy STEM Coalition is a regional partnership between the University of Connecticut and the University of Rhode Island that advances STEM education and workforce development aligned with U.S. Navy science and technology priorities, particularly in the maritime and submarine sectors.

16,000+
students engaged across K–16 / year

65+
students employed / year in outreach and research positions

~30
Naval senior-design projects / year

9 years
sustained Navy, DoD & industry funding

Funding Evolution

ONR · 2017–2020
Coalition launched, $1M+

NDEP · DoD · 2021–2024
Programs scaled, $3M

ANCHOR · EB/SIB · 2024–Present
Current mechanism, $11M+

Defense & National Security Relevance

- Sustains the Submarine Industrial Base — southern New England's "Silicon Valley of undersea warfare."
- Demand rising with AUKUS and South Korea shipbuilding; the model is replicable across other defense sectors.

Research-Driven & Proven

- Built on IRB-approved educational research — rigorously studied and continuously improved, not just delivered.
- Produces evidence-based, replicable models with proven, measurable outcomes.

ANCHOR IN ACTION

AUKUS & Academia

- UConn & URI see tremendous opportunity in engaging in AUKUS
- Research: faculty experts in similar and complimentary areas; unique facilities; broaden the student talent pool
- Workforce Development: attract more students to defense/defence and the undersea technology domain; provide exciting opportunities to engage the next generation of engineers

AUKUS

AUSTRALIA UK USA

AUKUS Partners in Australia

- Adelaide University
- Australian Maritime College (Tasmania)
- Flinders University
- University of Melbourne
- University of Sydney (and the United States Studies Centre)
- University of Westen Australia

Newer/Future Partners

- *Curtin University*
- *Deakin University*
- *Monash University*
- *RMIT*
- *Swinburne Univ. of Technology*
- *University of New South Wales*

AUKUS Integrated Research & Workforce Initiatives

Coordinated activities linking secure research collaboration, undergraduate pipeline development, and graduate research exchange

01 Secure Collaborative Acceleration

Research security + controlled collaboration

Addresses research security barriers to AUKUS University partnerships.

Defines Navy/industry-approved protocols that enable universities to conduct controlled academic research on sensitive AUKUS topics.

Security workshops • CUI/CTI standards • pilot technical workshop • Navy playbook inputs

Primary contribution

02 AUKUS Scholars: Launch

Undergraduate pipeline activation

A two-week immersive experience introducing students to undersea, maritime, and defense engineering through hands-on projects.

Experiential training • international labs • early talent pipeline • target May 2027

Primary contribution

03 AUKUS Scholars: RISE

Graduate research exchange

A two-month graduate exchange embedding students in partner laboratories to conduct industry-directed AUKUS research.

Research placements • faculty alignment • technical outputs • target May–Aug 2027

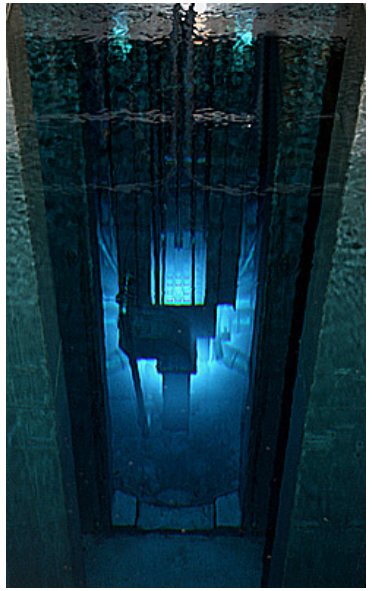
Primary contribution

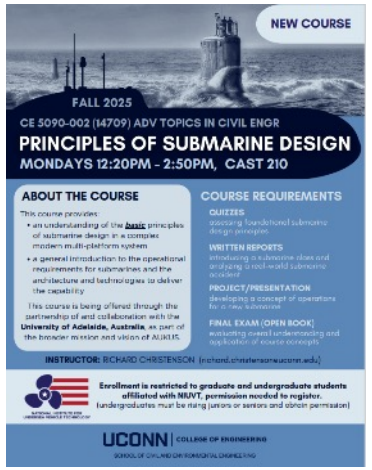
Secure Acceleration enables controlled collaboration; Launch grows the early workforce pipeline; RISE converts mobility into sustained AUKUS-aligned research outputs.

Outcome: a scalable pathway for AUKUS academic partnerships that strengthens workforce development, accelerates secure research, and supports Pillar 1 and Pillar 2 priorities.

AUKUS Curriculum Opportunities

- Developing curriculum and programs at UConn and URI building on the success of Adelaide University Maritime Engineering and Flinders University Robotics Engineering
- UConn offered Principles of Submarine Design Fall 2025 (developed by Adelaide University)
- URI offering Nuclear Engineering courses to Flinders University students
- Future AUKUS Curriculum/Programs (UTIC proposal)



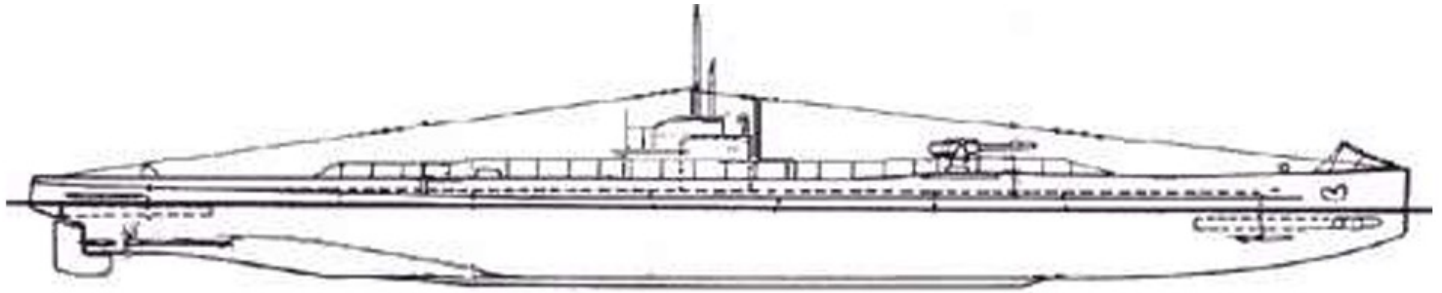


Introduction to Undersea Technology Course

- This UTIC 2025-2026 Workforce Development Challenge is developing a curriculum (based on lecture material by Dr. Eric Fusil, Adelaide University) to support the AUKUS Scholars Launch 2-week undergrad experience currently being developed
- To provide an understanding of the undersea environment, operational principles of submarine and undersea vehicles, and fundamental concepts of design and analysis of complex modern multi-platform systems
    1. Undersea Environment & Mission Context;
    2. Submarine Design Principles & Concept Development;
    3. Platform Architecture, Systems & Structural Integrity;
    4. Performance, Propulsion & Control; and
    5. Seaworthiness, Safety & Survivability

Undersea Environment & Mission Context

- The undersea domain is a foundational pillar of US national security, acting as a critical arena for both economic stability and strategic military deterrence. Submarines form the core of US capabilities in this arena.
- A historical perspective of submarines and what they have been used for within defense: 19th century; WW1; WW2; Cold War

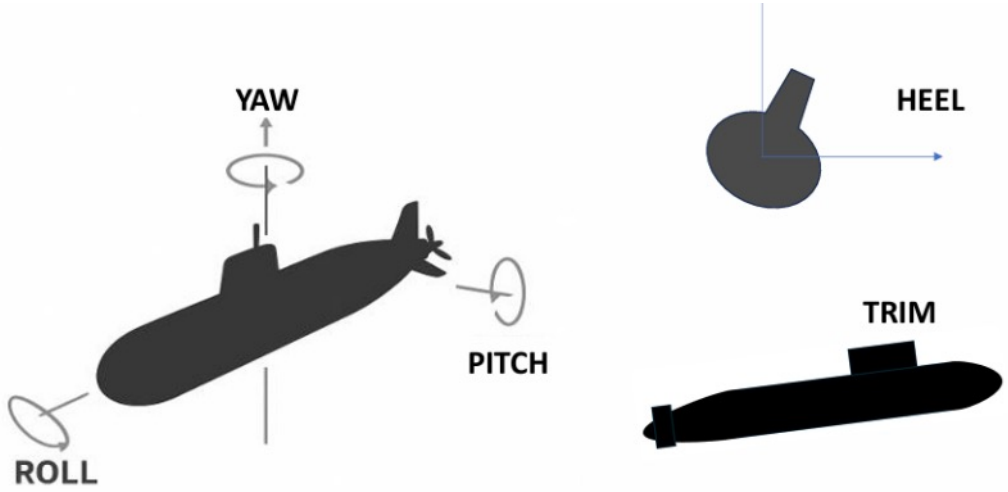


- Enabling technologies: propulsion (sails, compressed air, steam, electric, diesel, nuclear); surface/submersible to submerged performance; hydrodynamic shapes; air independent propulsion; nuclear power; batteries; steel/materials; welding; and sonar/sensors

Submarine Design Principles & Concept Development

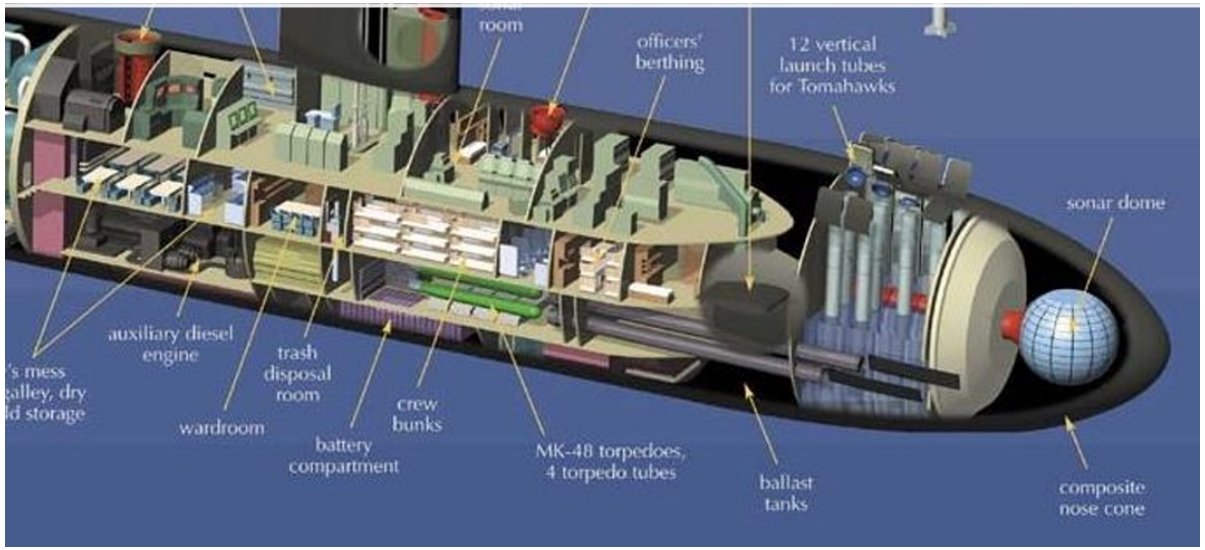
- Operational requirements that make the submarine solution different than surface ships: undetected/deterrence; versatile missions; covert (anywhere and with anyone)

- Key submarine characteristics and naval architectural choices: displacement; pressure hull profile; main tanks' location; decks (height & numbers); platforms; systems integration (internal vs. external)

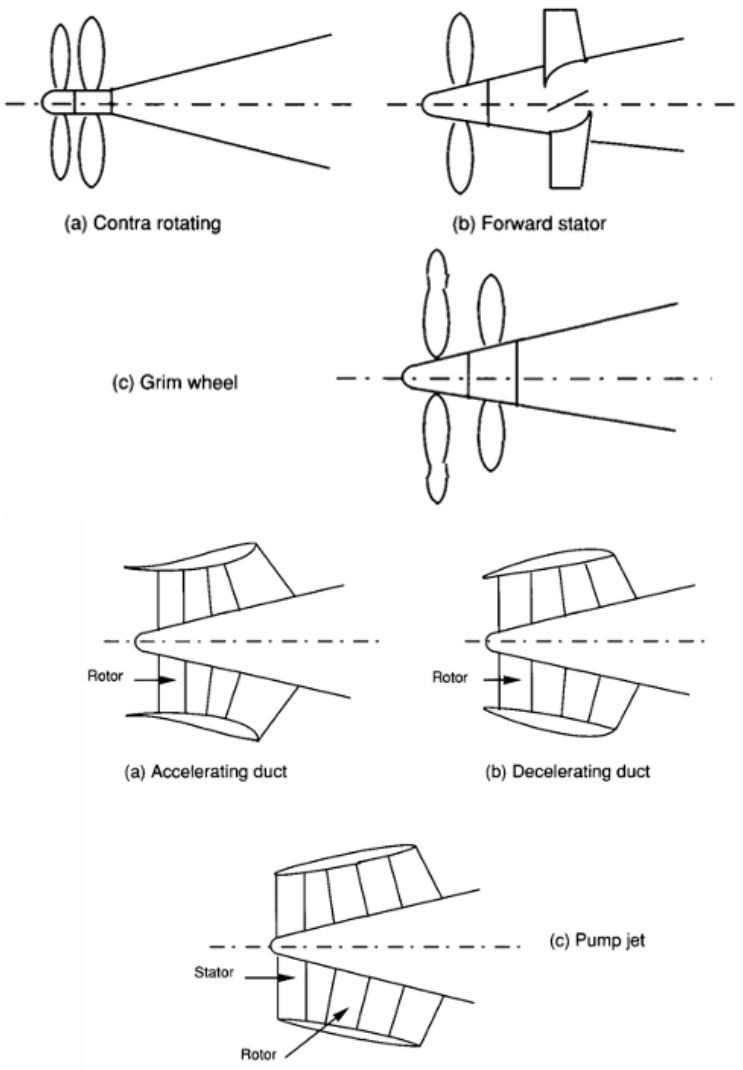


Platform Architecture, Systems & Structural Integrity

- Platforms: pre equipped modules & modular construction
- Submarine systems: hydraulics; high pressure air; water distribution systems; environmental control; electrical power – systems integration: internal vs. external
- Submarine structures: design of pressure hull; bulkheads, deep frames, stiffeners; manufacturing impacts (residual stresses, out of straightness/roundness); failure modes (buckling, fatigue & fracture)



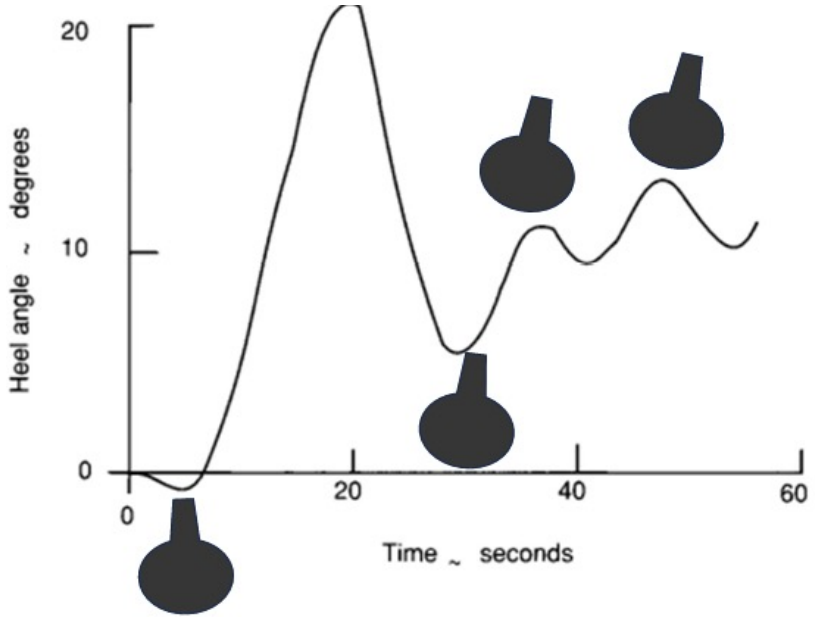
Performance, Propulsion & Control

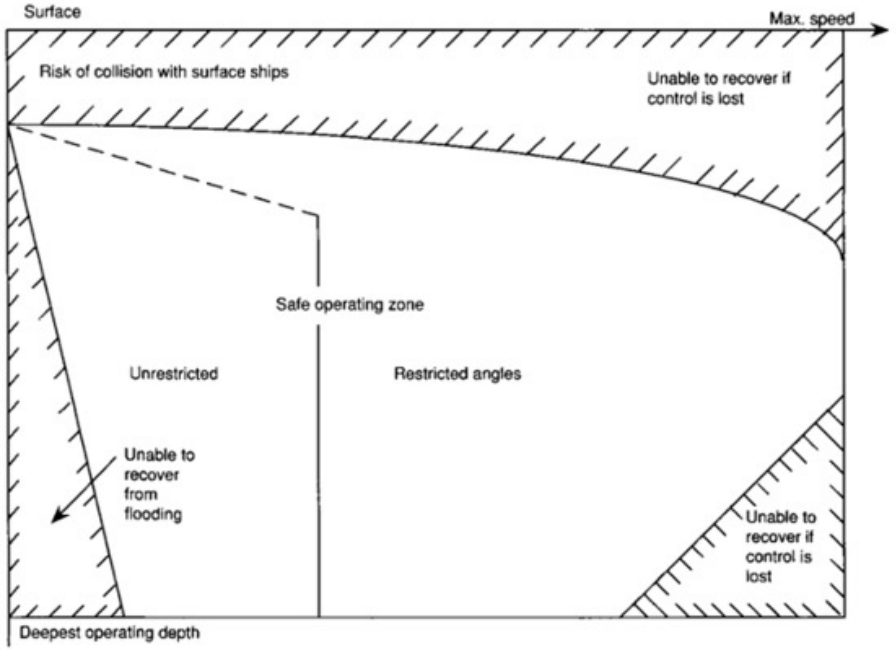


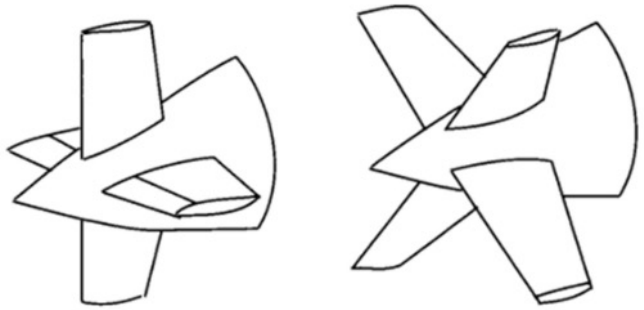
- Propulsive efficiency: low hydrodynamic drag; high efficiency of propulsive system; high energy conversion efficiency of power plant; high energy density storage system
- Sizing the propulsion system: motors; batteries; diesel generators; etc.
- Control and dynamics: equations of motion; determination of coefficients (tow tanks; simulation)
- Signatures control: acoustic; magnetic; electrical; radar cross section; optical; infrared (IR)

Seaworthiness, Safety & Survivability

- Stability: control surfaces; maneuverability; snap roll
- Submarine escape & rescue

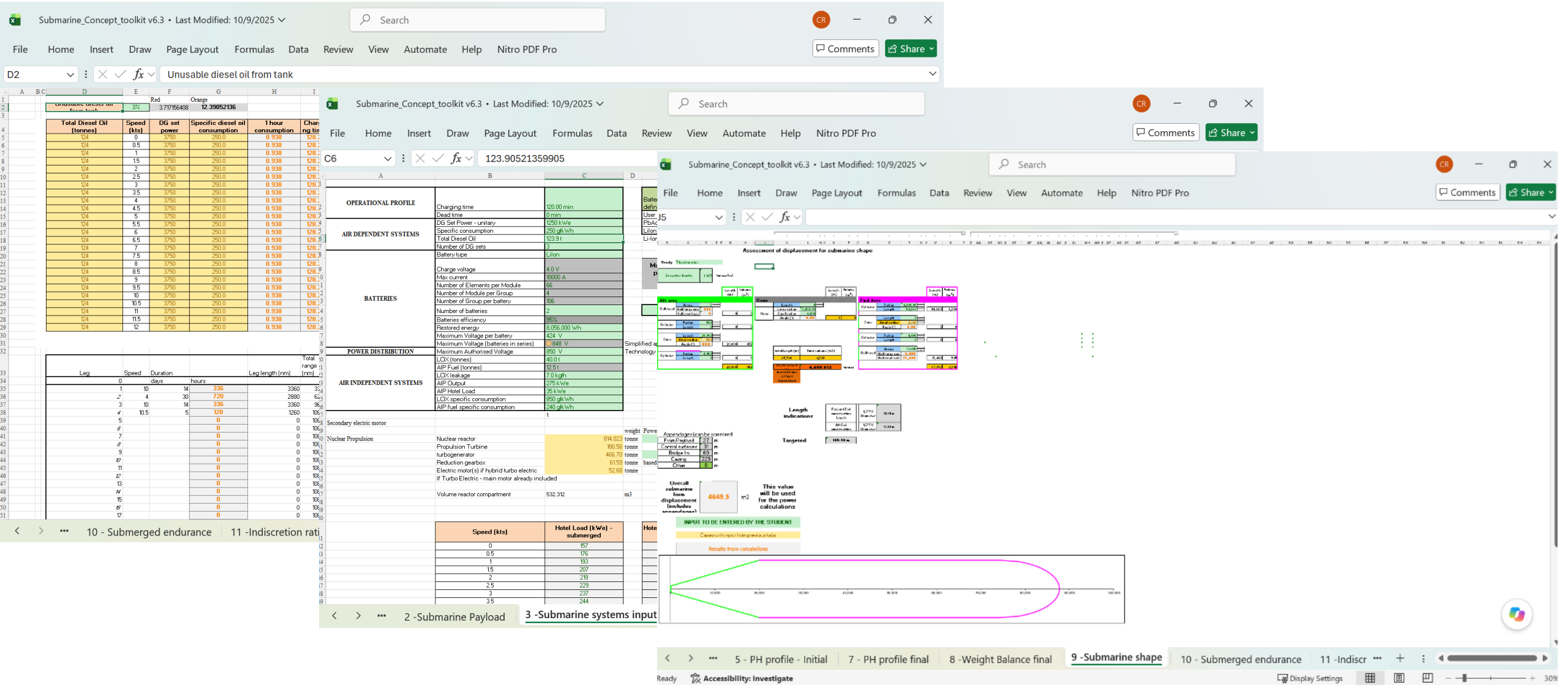






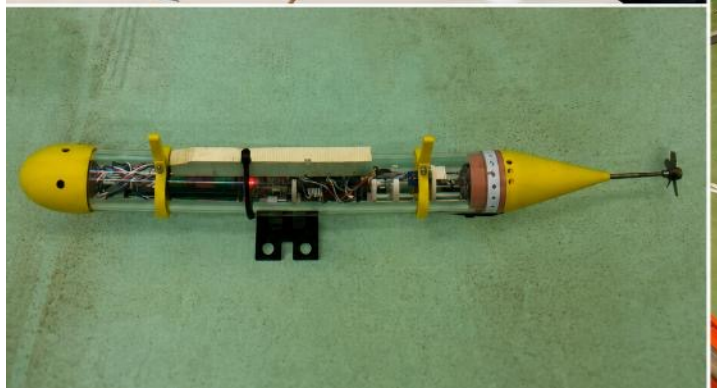
Submarine Design Tool

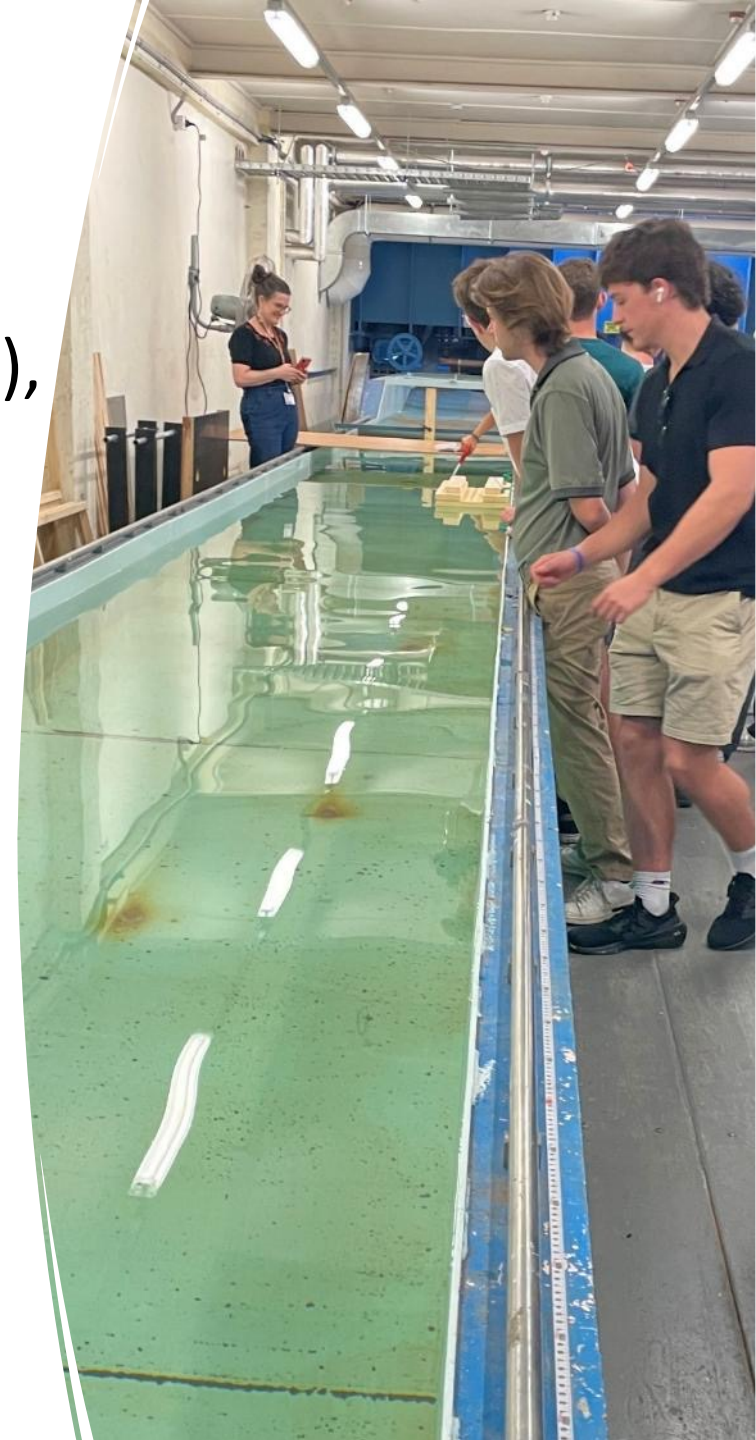
- Developed by Dr. Eric Fusil: Adelaide University



Propeller Design Competition

- Adelaide University flume
- Students participate in design, fabrication (3D printed), and flume testing of underwater vehicle propellers
- Combining engineering theory with experimental validation to address real-world maritime challenges

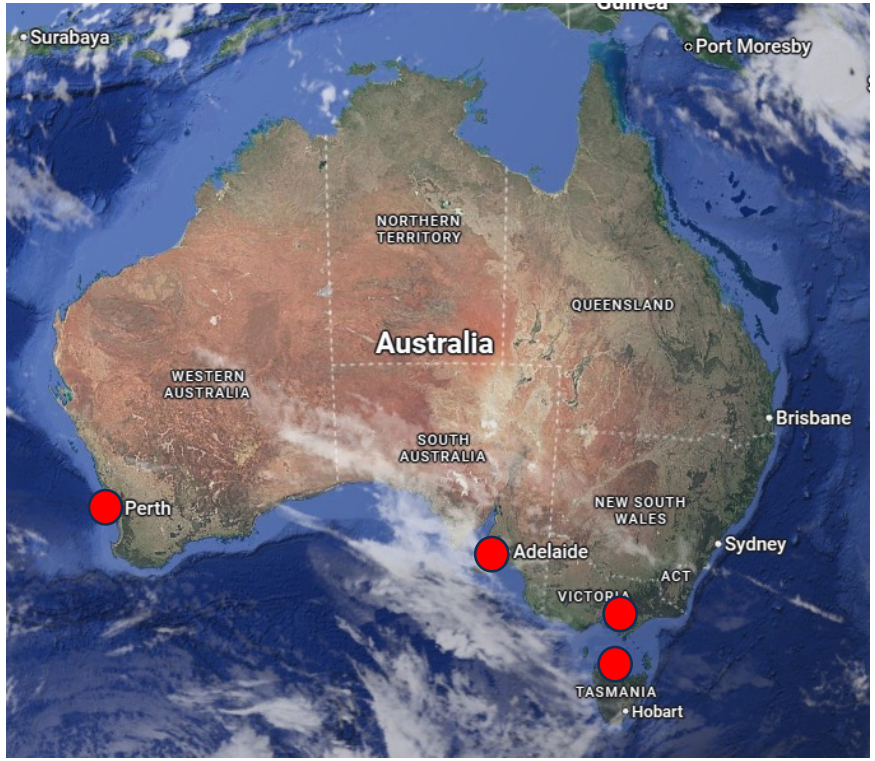




Proposed Itinerary: Target is Summer (May) 2027

- 2-week, 3-credit, undergraduate experience

Day	Lecture	Activity	Location
1	weekend	Arrive	Perth
2	1	Program Orientation/University Visit	Perth
3	2	University and Research Activities	Perth
4		Industry Visit & Travel to Melbourne	Perth/Melbourne
5	3	Program Orientation/University Visit	Melbourne
6	4	University and Research Activities	Melbourne
7	weekend	Cultural Activities	Melbourne
8	weekend	Travel to Tasmania - Program Welcome	Melbourne/Tasmania
9		AMC Facility Tours	Tasmania
10		Arrive & Flinders Welcome	Tasmania/Adelaide
11	5	Flinders University	Adelaide
12	prop. design	Adelaide University	Adelaide
13	design comp.	Adelaide University	Adelaide
14	weekend	Depart	Adelaide



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