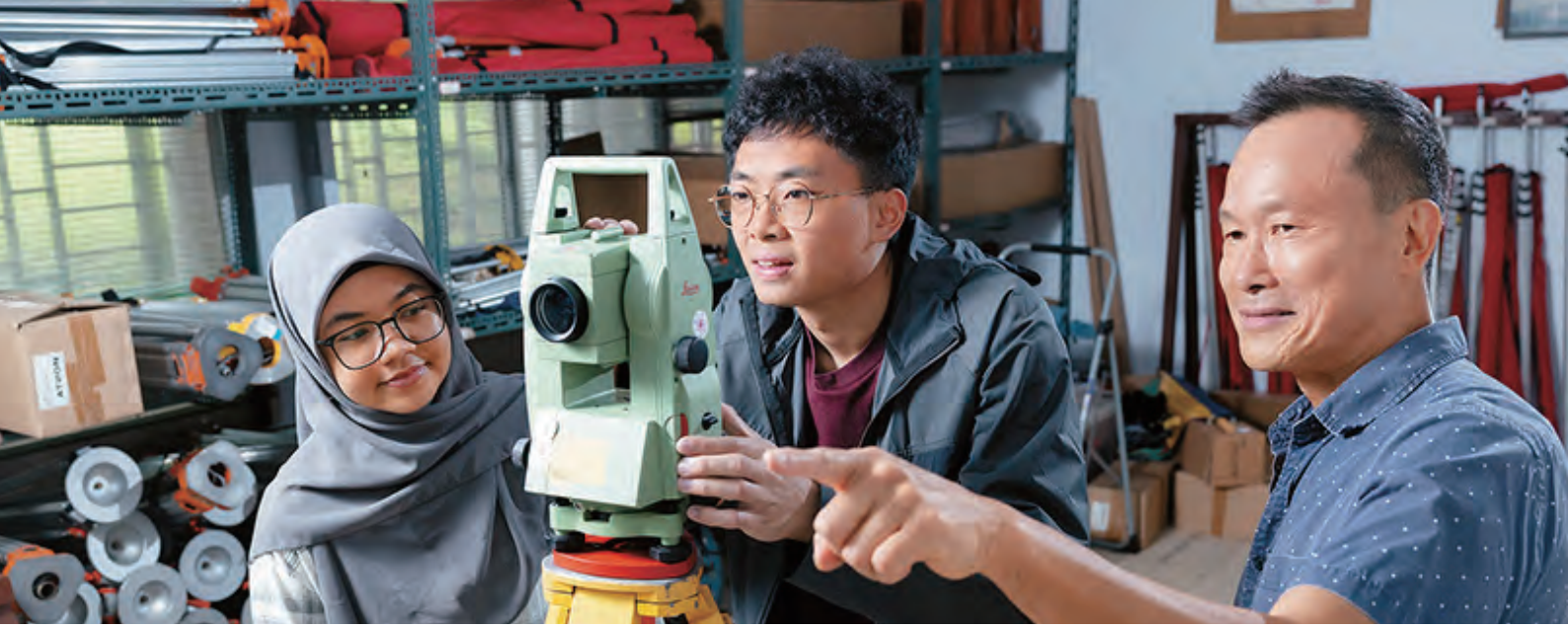
14

LIFE BELOW WATER

2020-2024 Publications	51
2020-2024 Percentage of all Taiwan Publications	2.3%
Course Units	47
Student Engagement with Units on SDG 14	970



Research

Reimagining the Seafloor with Satellite Observations

Professor Cheinway Huang from the Department of Civil Engineering and his team leveraged Surface Water and Ocean Topography (SWOT) satellite data, combining radar altimetry with marine gravity anomalies to develop a new inversion method for seafloor bathymetry. Published in Science and honored with a 2024 National Chair Professorship, this technique delivers wide-area, low-cost, and long-term continuous observations that markedly improve bathymetric reconstruction and ocean monitoring. The results support plate tectonic and trench system identification, nearshore hazard assessment, coastal flood modeling, and water resource planning. In terms of a sustainable ocean, this tool can also strengthen governance capabilities, such as marine ecological habitat inventory, fishery and protected area planning, navigation safety and maritime monitoring, and provide a key observation basis for the waters surrounding Taiwan and the global blue economy and climate resilience.

AI Tools for Underwater Acoustic Imaging

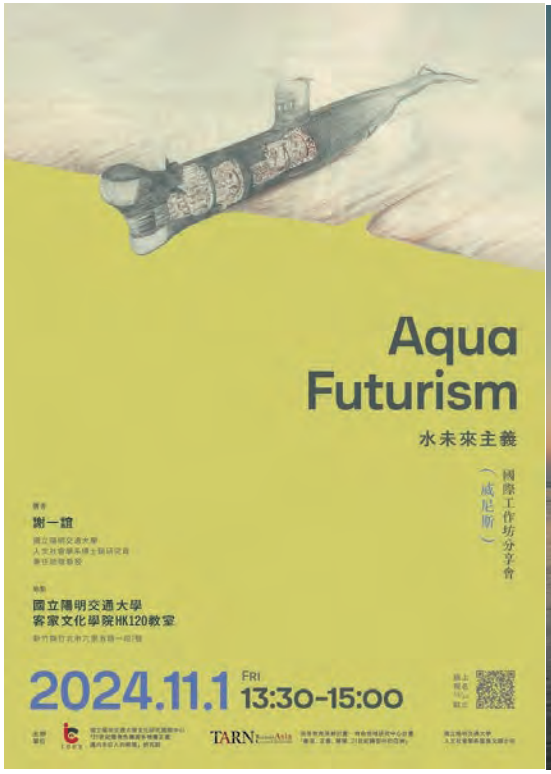
Professor Hong-Han Shuai from the Institute of Electrical and Computer Engineering and his group developed CMAF (Cross-Modal Augmentation via Fusion), an underwater acoustic-image recognition method reported in the ACM Transactions on Multimedia Computing, Communications and Applications. CMAF uses a dual-branch architecture that fuses visual imagery and sonar signals with attention-based integration, alongside masked training and focal loss, to significantly improve the accuracy and robustness in noisy, data-sparse underwater settings. The team has open-sourced the code to spur industry–academia collaboration and cross-domain applications. Use cases include long-term marine environmental monitoring, habitat and species identification, and systematic biodiversity data collection—delivering a key AI capability for marine governance and decision support.

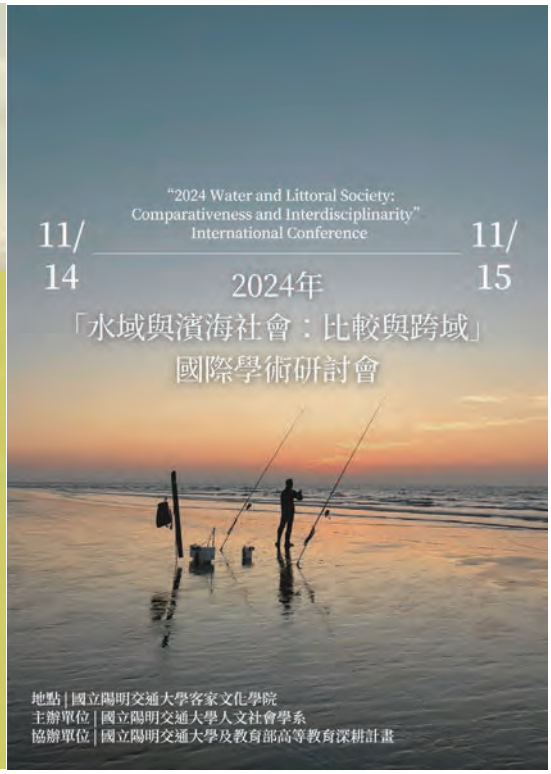
14 LIFE BELOW WATER

Social Impact

Cross-Disciplinary Dialogue for Ocean Sustainability

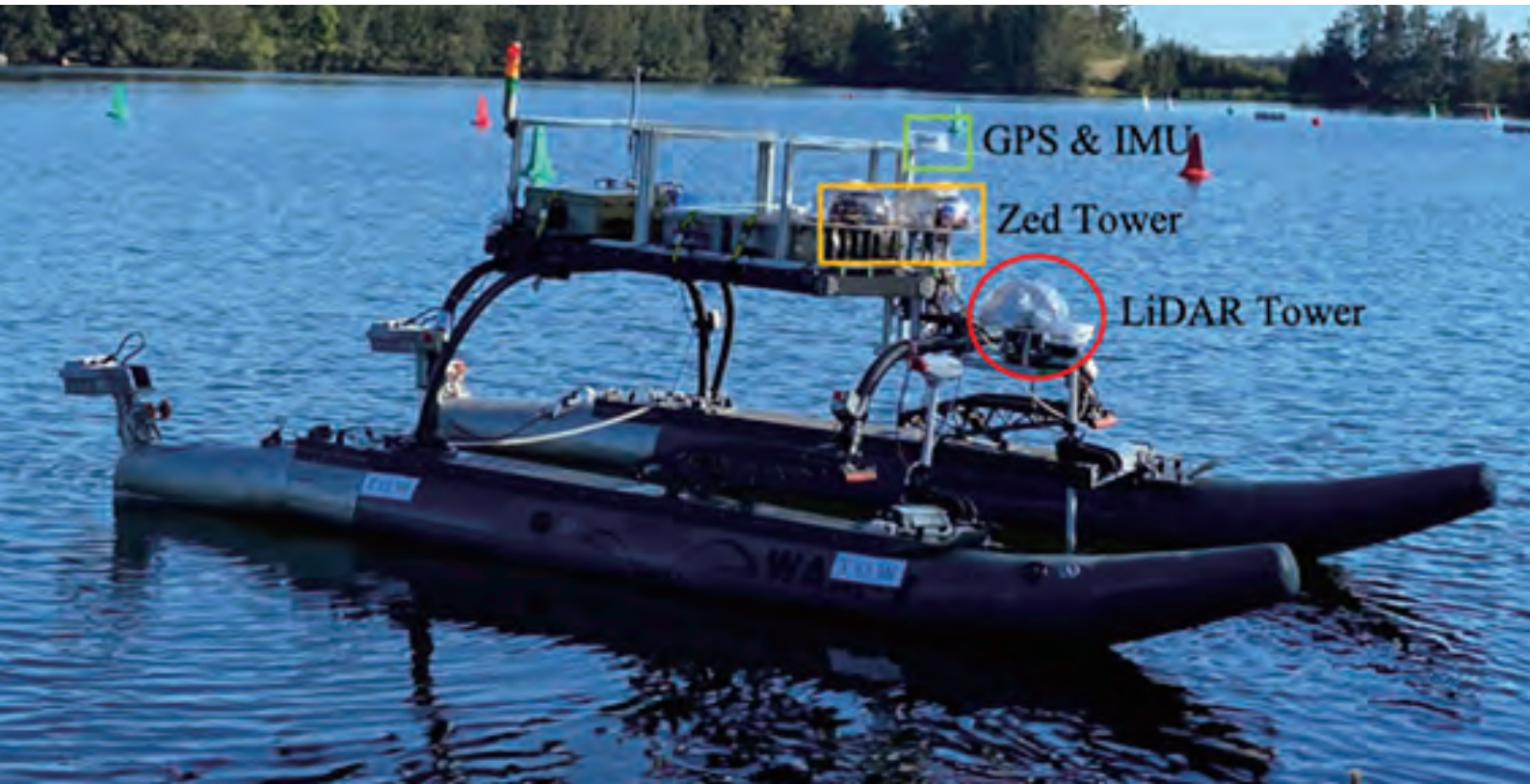
Hosted by the Department of Humanities and Social Sciences, the international symposium, “Waters and Coastal Societies: Comparative and Cross-Disciplinary Perspectives,” brought together more than 20 scholars from over 10 institutions. Through talks on the environment and local communities, coastal fisheries and livelihoods under Japanese rule and in the postwar era, distant-water fisheries and local societies, and religion and place, the meeting examined environmental change and social impacts in the seas around Taiwan from historical, cultural, industrial, and governance viewpoints. Discussions focused on fisheries transition, nearshore ecological impacts, community resilience, and resource co-management, proposing concrete pathways that weave local knowledge with scientific monitoring, promote sustainable fishing and cultural landscape conservation, and strengthen civic participation and cross-sector governance. The dialogue not only advanced ocean education and public awareness, but also offered evidence and recommendations for coastal governance and policymaking.





Strengthening Ocean Monitoring and Rescue

JetSea AI, a spinout from NYCU, specializes in creating autonomous surface vehicles (USVs) and smart vessel control systems. These systems integrate panoramic vision, radar/LiDAR, AIS tracks, and sonar with AI-driven obstacle avoidance, deep reinforcement learning, and frequency-hopping communication. This combination allows for dependable data gathering and mission performance over extended distances and under challenging sea conditions. The platform accepts modular payloads, such as hydrophones, multibeam, and side-scan sonar, supporting marine environmental monitoring, maritime patrol, and emergency response, while improving pollution detection, habitat mapping, and navigational safety management. With a core team from NYCU and MIT, JetSea AI placed 3rd worldwide at RobotX 2022 and 7th in DARPA SubT, demonstrating world-class autonomy. This capability strengthens science-based decision-making and governance, advancing the conservation and sustainable use of ocean resources.

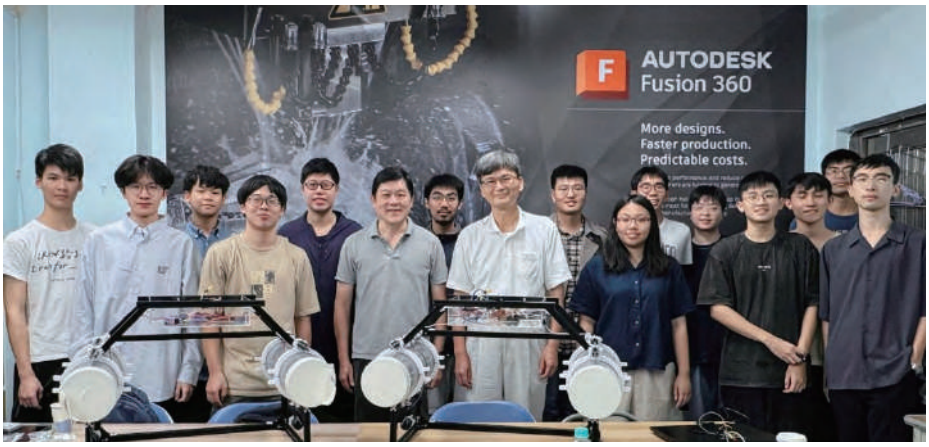


14 LIFE BELOW WATER

Social Impact

Engineering Practice for Marine Debris Governance

NYCU's ICT Co-Working Space offers a hands-on course on "Intelligent Waterborne Garbage Collection Vessel," integrating marine environmental concerns with engineering. Using problem-based learning, students start from real-world ocean-pollution scenarios and apply fluid mechanics, mechanism design, control programming, and mechatronics to build working prototype boats. The performance is validated through a "trash collection challenge" that evaluates the capture volume, handling stability, and energy use. The course deepens understanding of marine sustainability and social implementation while training students to turn ideas into verifiable engineering solutions and collaborative team practice—providing replicable designs and technical pathways for marine-debris mitigation.



Governing Multi-Species Fisheries Resources

NYCU's International Center for Cultural Studies (ICCS) invited Associate Professor Ting-Chun Kuo from National Taiwan Ocean University to speak on multi-species fisheries management. Challenging mainstream frameworks shaped by temperate ecologies and single high-value species, the talk proposed localized, context-aware governance for subtropical/tropical, high-diversity waters. The approach incorporates food-web interactions, gear differences, community livelihoods, and market structures to develop ecosystem-based management and community co-management. Echoing social-science perspectives on "decolonizing knowledge," the lecture advocated cross-disciplinary learning and policy collaboration to strengthen synergies among fisheries science, the humanities and social sciences, and on-the-ground governance.

Stewardship

Beach Cleanups to Safeguard the Ocean

NYCU's College of Management, together with student groups such as the Youth Volunteers Club, organized a series of beach cleanups spanning the Hsinchu coastline, Nanliao Fishing Harbor, and Taoyuan's Guanyin Algal Reef. These actions were paired with visits to environmental education centers and on-site briefings to deepen the understanding of marine-debris sources, habitat protection, and resource circularity. Participants removed plastics and other single-use waste to restore coastal environments and ecological functions, while plastic-reduction advocacy, sorting demonstrations, and behavior-change campaigns helped embed sustainability in daily habits. These efforts mobilized both campus and local communities, strengthened civic participation in marine environmental governance, and enhanced the resilience of nearshore ecosystems.

Co-Creating Ocean Narratives and Action Across Disciplines

NYCU's International Center for Cultural Studies (ICCS) hosted an online showcase for the "Aqua Futurism" International Workshop (Venice), reflecting on the outcomes of Contested Waters, a transnational collaboration carried out in Venice in October 2024. This project, supported by the ICCS Multispecies Justice research cluster and in collaboration with S.a.L.E. Docks and the Program in Environmental Humanities (NICHE) at the University of Venice, connects artists and scholars from Taiwan, Italy, and India. Through lagoon walks, boat trips, wetland ecological explorations, and sound-based practices, the project explores the geopolitical impacts of militarization and capitalization of water bodies, and conducts innovative research on the ocean. The project strengthens narratives about the marine environment, fosters social engagement, and promotes international, cross-sector collaboration.