OES BEACON

Newsletter of the Oceanic Engineering Society

DECEMBER 2024, Volume 13, Number 4 www.ieeeoes.org (USPS 025-095) ISSN 2164-8042

IEEE

IEEE Oceanic Engineering Society

The OES BEACON is published four times a year as a benefit to the membership of the IEEE Ocean Engineering Society. The OES Beacon is printed and distributed from IEEE headquarters in New York City, New York, USA.

Publication Copy-Due schedule:
1st Qtr: March 2025: February 14 2nd Qtr: June 2025: May 14

Members are encouraged to submit copy highlighting 1) Chapter Events, 2) People & Company News, 3) Student & Young Professional News, 4) Technology Updates, or 5) other material of broad interest to the OES. Please send to Beacon Editor-in-Chief, Harumi Sugimatsu <harumis@iis.u-tokyo.ac.jp>. Word format, 1-1/2 space; Photos (always encouraged): jpg, 300 dpi preferred. Material becomes property of IEEE-OES. Please send e-mail or physical address corrections or updates to the EIC.

IEEE OES Beacon Newsletter (ISSN 2164-8042) is published quarterly by the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. Headquarters: 3 Park Avenue, 17th Floor, NY 10017-2394. $1.00 per member per year (included in Society fee) for each member of the Oceanic Engineering Society. Printed in U.S.A. Periodicals postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to IEEE OES Beacon Newsletter, IEEE, 445 Hoes Lane, Piscataway, NJ 08854

Table of Contents

Member Benefits—Did you Know?

As an IEEE member, you have access to Specially negotiated and dependable life insurance coverage engineered for you. Whether you want to lessen the burden on your loved ones or leave a legacy, we have a custom solution for you. Search "**IEEE member insurance program**"

From the OES BEACON Editors

Harumi Sugimatsu and Robert Wernli

Welcome to the December issue of the Beacon. Following a summer where events and meetings worked around vacations, etc., this issue picks up with a lot more activity. This is highlighted by the OCEANS 2024 Halifax conference, along with side meetings and competitions, which are reported herein.

The reports from our Executive Committee highlight the activities of the society and what we can expect next year. The VP for Workshops and Symposia describes the many events held late this year that are keeping the society active around the world. There were so many workshops, symposia and other events held recently and documented in this issue that we refer you to the Table of Contents for the list.

Our primary events are the OCEANS conferences, which will be impacted in 2026 when the MTS is withdrawing as a conference sponsor. OCEANS conferences are scheduled for Brest and the Great Lakes next year. Bids are being accepted by OES for the 2027 OCEANS conferences and beyond.

The VP for Technical Activities reports on the status and future of the OES Technical Committees. The reorganized list of Technical Committees to go into effect next year is also provided. The article also includes the 4 new Distinguished Lecturers for the 2025-2027 term. We'll have the call for the next set of DLs in the March 2025 issue. And, our AdCom nominations are now open. Submit nominations by 1 March 2025.

Bob giving the Plenary address as Co-Chair of OCEANS 2021 San Diego. He was also Co-Chair of the 1995, 2003, and 2013 San Diego OCEANS conferences and is looking forward to Co-Chairing his 5th OCEANS conference in the near future.

Harumi at AUV2024, with OES friends, Marinna Martini and Hanumant Singh (L to R).

Our student branch chapters (SBC) have been active and this issue includes reports from the Delhi, Shanghai Jiao Tong University, Federal Flaminense University, University of Zagreb SBCs, and Malaysia and Japan Chapters.

Various reports are included regarding the OCEANS 2024 Halifax conference to include the Student Poster Competition, a Young Professional (YP) luncheon and talks addressing our support to the UN Ocean Decade.

Upcoming workshops and symposia are listed in the Conference Calendar and the Journal EIC again provides a list of recently released papers that are available to our members.

Our Distinguished Technical Achievement Award and Distinguished Service Award winners are reported in this issue.

Have you done something exciting lately? Received an award or professional recognition? Be sure to contact your editors about submitting an article. And don't miss the Who's Who in OES article on one of our outstanding members in each issue.

There is a wealth of other information and articles in this issue that we hope you enjoy. And, as always, we'll close by inviting you to participate in your society. Submit articles and material for the Beacon. Or… volunteer for other society activities as a participant or an elected officer. It's your society and it is here to help you reach your professional goals. Enjoy.

Executive VP Report—The Truth About Facts

Malcolm Heron, Executive VP

There is a strong debate going on in Australia, and in many other countries, about misinformation and falsehoods in the media. I was alerted by a columnist who had the opinion that some facts are "contestable." If this is the case then the word "fact" seems to have taken on a meaning that differs from the Oxford Dictionary. On the surface this looks like a self-contradiction (an oxymoron), but I think in general culture and politics we have indeed come to accept that facts are not necessarily aligned with truth. At this point let's segue into science where we have axioms – that is fundamentals that are supported by evidence, but we know that they can be challenged and sometimes discarded in favour of a new discovery.

The beauty of science is that observations and measurements prevail over theory and prediction, and even the empirical observations can be challenged by repeating the measurements. It is quite amazing that, even with this uncertainty in the very fundamentals, we have made huge advances in science and engineering for the benefit of all people. There is an analogy here with quantum mechanics where uncertainty and chaos can be engineered into precise and useful products.

One challenge that is growing in our modern world is the rise of deliberately fake information. This is a social problem exacerbated by the wide uptake of social media. But it is a challenge to IEEE-OES members when we strive to uphold the highest ethical standards in advocacy and publications. For example, we have seen much criticism of the way some scientists presented advice on COVID management. And in some disciplines (thankfully not ours) there are claims that up to 40% of published papers have results that are not reproduceable and have to be withdrawn. At one level this indicates incompetence, but at another level, when results are biased either deliberately or by personal convictions, it becomes an issue of professional ethics. There is no place for biased advice to the community or policymakers. Advocacy should be driven by science and not the other way round, so let's not have advocacy and ideology driving science.

There are many instances in science and engineering where personal ideology has biased the results and misled policy makers and the community. We are all human beings with emotions and feelings but as professionals we need to be aware of our own personal biases and be alert to advice that is not based on evidence.

To put this in perspective, the IEEE Code of Ethics: Section 1; subsection 5 states that IEEE members agree:

"…to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, to be honest, and realistic in stating claims or estimates based on available data, and to credit properly the contributions of others;…".

And this is not only a challenge, but it is our professional duty.

IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members, and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

I. To uphold the highest standards of integrity, responsible behavior, and ethical conduct in professional activities.

1. to hold paramount, the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment;
2. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;
3. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
4. to avoid unlawful conduct in professional activities, and to reject bribery in all its forms;
5. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, to be honest, and realistic in stating claims or estimates based on available data, and to credit properly the contributions of others;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

II. To treat all persons fairly and with respect, to avoid harassment or discrimination, and to avoid injuring others.

7. to treat all persons fairly and with respect, and to not engage in discrimination based on characteristics such as race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
8. to not engage in harassment of any kind, including sexual harassment or bullying behavior;
9. to avoid injuring others, their property, reputation, or employment by false or malicious actions, rumors, or any other verbal or physical abuses;

III. To strive to ensure this code is upheld by colleagues and co-workers.

10. to support colleagues and co-workers in following this code of ethics, to strive to ensure the code is upheld, and to not retaliate against individuals reporting a violation.

Adopted by the IEEE Board of Directors June 2020

IEEE
Advancing Technology for Humanity

www.ieee.org

VPTA Column

Shyam Madhusudhana, VP for Technical Activities

As we prepare to wind down 2024, I am glad to state that my first term as the VP for Technical Activities (VPTA) saw several successes—

i) Over 36 reported technical events by OES Chapters, and 10 technical events organized by Joint Chapters (with other societies).
ii) Technology Committees (TCs) exhibited healthy levels of activity. You will have seen regular reports from the Chairs in prior issues of Beacon.
iii) Increased frequency of Distinguished Lecturer (DL) talks. My aim for 2024 was to get to 10, but we have 15 talks delivered this year already.
iv) OES Summer School, piloted at Singapore OCEANS, was a roaring success. We look forward to a repeat in 2025, at Brest OCEANS.

I am excited to announce that I have been re-elected for a second term (2025–26). Out of their respective three-year terms, Atmanand (TC Coordinator) will complete two years at the end of this year while Maurizio (Chapters Coordinator) will complete one year. I look forward to continuing working with them in 2025 and beyond.

Our list of Chapters was extended in 2024, thanks to the efforts of Haiyong Zheng (who is also the Chair of the Subsea Optics and Vision TC). We now have an OES Chapter in Shandong, under the Beijing Section.

The call for DL nominations, for the term 2025–27, had ended on 31 July. The nominations (6 received) were carefully evaluated by the Distinguished Lecturer Committee comprising myself, Venugopalan Pallayil, and Malcolm Heron. While I thank Venu and Mal for their service, I am pleased to announce the addition of the following esteemed scientists to our DL roster:

- Ralph Rayner
  Sonardyne International Limited
- Tomonari Akamatsu
  Waseda University, Japan
- Weimin Huang
  Memorial University, Canada
- Ye Li
  Southern University of Science and Technology, China

Congratulations to the new appointees, and I look forward to facilitating their contributions to the Society's membership in the years ahead.

As we look forward to 2025, I am thrilled to be giving you what I consider to be the most exciting news. Following numerous extended discussions and deliberations, efforts to overhaul our TCs have concluded, and the recommendations have been vetted by the Administrative Committee. Our new slate of TCs (see below) will come into effect in 2025. Besides the apparent shake-up, we will also be doing away with the prevailing way (using verbose statements) of describing TCs. Instead, TCs will now be described using pertinent keywords. This change was aimed to simplify descriptions and bring about consistency. In addition to the below TCs, we will now also have a 'special' TC, named *Emerging Technologies & Other Oceanic Engineering Topics*, which is to be seen as a home for topics not covered by any of the other TCs. It serves as a staging mechanism until a certain topic or collection of closely-related topics achieves critical mass and sustained attention warranting creation of a dedicated TC. A 'call for nominations' was recently announced seeking candidates to serve as executives (Chairs & co-Chairs) of the new TCs. By the time this article is published, the call would have already ended. However, if you wish to contribute to any TC(s), please do not hesitate to get in touch with me or Atmanand.

Cheerio, 2024! Looking forward to another successful year and another fulfilling term as VPTA.

New slate of OES Technology Committees (and *keywords*)

Autonomous Maritime Systems
Marine & maritime systems; Unmanned vehicles; Automatic control; Navigation; Multi-asset operations

Data Analytics and AI
Numerical modelling & simulation; Pattern recognition; Algorithm development; Visualization; Data fusion; Information generation

Energy
Renewables (offshore wind, wave, tidal); Energy Storage & Transfer/Transport; Battery Technology; Electrification; Environmental considerations/implications

Living Resources
Biological Oceanography; Biodiversity Monitoring (photogrammetry, active and passive acoustics); Fauna distribution & abundance estimation; Ocean/ecosystem Health; Reef Assessments & Restoration; Fisheries; Aquaculture

Moorings and Structures
Ocean structures; Floating structures; Moorings, riggings, & anchors; Buoy technology; Observatories; Seafloor engineering; Materials Science; Pipelines; Deepwater development technology; Extreme weather infrastructure; Distributed biological observatories; Coastal and offshore construction; Coastal engineering

Optics and Imaging
Classical Optics, Quantum Optics, Photonic Devices, Imaging, Computer Vision, Optical Sensing; E-M sensing; Optics technology instrumentation; sonar imaging

Oceanography and Meteorology
Physical Oceanography; Geological Oceanography; Chemical Oceanography; Metocean; Climate Science; Marine geophysics; Hydrodynamics; Hydrography; Ocean exploration; Coastal zone management; Polar observations & monitoring

Remote Sensing
Satellite telemetry; Coastal radars HF Ocean Radar; Geophysical monitoring; Drones; SAR; Synthetic aperture sonar; Resource assessment

Metrology and Instrumentation
Sensor Development; Instrument Validation; Calibration; Sensor Survivability; Sensor fusion/synergy; Observation systems; Measurement technology (for currents, salinity, pH, etc.); Cables and Connectors

Underwater Acoustics
Acoustical oceanography; Environmental acoustics & Ocean noise; Bioacoustics; Seismo-acoustics; Sonar signal processing; Sonar imaging; Array processing; Array design; Acoustical telemetry

Underwater Communication and Positioning
Underwater acoustic & EM communication (physical layer), at-sea communication networks, underwater positioning, underwater channel modelling; Link-layer and network-layer techniques

From the Vice President for Workshops & Symposia

Gerardo "Gerry" Acosta, VP for W&S

Good to get in touch with you from these lines, to keep you updated about our OES huge activity in workshops and symposia spread all over the world. In these days that we are closing the calendar year, and we are making balances of goals and aspirations for this 2024, it is very gratifying to see that our Society once more succeeded on being the home for people willing to share experiences, knowledge, and networking around the oceans, from a technological and scientific standpoint. We will see part of the great deal of activity in workshops and symposia carried out reported in this issue of our Beacon, as well as the interesting upcoming events.

During **September** we had five exciting events. The *Ucomms Conference 2024* held during the first week of the month in Sestri Levante, Italy, co-organized with the RSMC. At Boston, MA, USA, the prestigious *2024 OES AUV Symposium* took place. Their detailed reports of it will be given in our next Beacon.

Also in Port Louis, Mauritius, from 18 to 20 September, OES was sponsoring the *Western Indian Ocean (WIO) Futures 2024*. The detailed report by Shyam, OES VPTA, is in this Beacon.

In Italy, but this time in Bolzano, OES was collaborating in *Automatica 2024* congress. It was a very successful event, with 126 abstract submissions, 167 registered attendees, 49 program committee members, and 18 technical sessions. Congratulations to the local organizing committee (LOC) and our link person, Prof. Karl von Ellenrieder. See more details in this Beacon.

Closing September, the *2024 Breaking the Surface* edition was held in Biograd na Moru, Croatia, supported by our OES, among other sponsors, and carried out by the Student Branch Chapter of the University of Zagreb. As you may see in the very good report in this issue of the Beacon, this edition was a great success, with impressive numbers: 206 attendees from 23 countries, 14 lectures, 11 tutorials, and 10 demos. Congratulations to the LOC and our link person, Prof. Nikola Mišković.

In **October**, the *2024 OES MIW - Marine Imaging Workshop* was held in Monterey, CA, USA, with the support of the local Monterey Bay Aquarium Research Institute – MBARI. Please refer to the article reporting this event in the upcoming pages. Subsequently, the *USYS - IEEE 10th International Conference on Underwater System Technology: Theory and Applications* was held in Xi'an, China, with the support of the local Northwestern Polytechnical University. In Portoroz, Slovenia, also with OES sponsorship, the *Metro Sea 2024 - IEEE International Workshop on Metrology for the Sea* took place.

At the IEEE IROS 2024, in Abu Dhabi, United Arab Emirates, on October the 18th OES supported a Forum on Marine Robotics in Ocean Decade Initiative for Sustainable Development. It was a successful event, as reported by our liaison there, Prof. Giulia De Masi.

For these three previous events you can also find their very interesting reports in this issue.

Our Society was also present at the *2024 IEEE International Workshop on Technologies for Defense and Security*, in Naples, Italy, during **November**. As well as in the *25th Biennial Conference on Biology of Marine Mammals* in Perth, Australia, during November 11th to 15th. Another exciting meeting that we recently supported was the *International Workshop on Optimizing Engineering Design with AI: A Focus on Ocean Energy Systems (OEDAI-2024)*, with a theme of Sustainability and Marine Structures, from 17 to 20 November, 2024, hosted at the IIT Madras, India.

In addition, during the last week of November (shortly after these paragraphs are being written), we also secured our presence as OES at the *IEEE International Humanitarian Technology Conference (IEEE IHTC)*. Thanks to the energy of our local Italian chapter, motivated by Prof. Maurizio Migliaccio, puts into all activities linked to the ocean.

If you wish to get involved in these workshops, or propose new ones, please contact me at vp-workshops-symposia@ieeeoes.org. In addition, keep in mind that our OES offers the possibility of both technical and financial sponsorship and co-sponsorship, as well as patronage with grants for students and young professionals. In order to consider the latter in the budget, it is necessary to submit requests for support during the first half of the calendar year. Specifically, until the last days of May for the W&S that want to be held during the following year. On our website, there is a detailed guide for these presentations (https://ieeeoes.org/conferences/workshops-and-symposia/) and if you have any questions, do not hesitate to contact me.

Have a safe and pleasant navigation and always tell me how I can help you!

VP OCEANS Report

Venugopalan Pallayil, Vice President for OCEANS (VPO)

Dear Colleagues,

2024 is coming to an end and so is my first term as VP OCEANS. My conviction is that I have put in the best of my efforts to support OCEANS organization the past two years. My contributions to OCEANS, and in general to OES, was not limited by my role as VP OCEANS. I have taken every opportunity to showcase OES and its contributions at OCEANS through the organization of special sessions and panel discussions, both as a participant and a moderator. Some of these panels were jointly organized with the Marine Technology Society, our current partner society. It was not easy to handle the dual role of General Co-Chair for OCEANS 2024 Singapore while also fulfilling my duty as VP OCEANS. Both Limerick and Singapore OCEANS have tested my patience and leadership, and I am happy that I was able to pull it off with support from our colleagues both at IEEE, OES and MTS.

Past two years have been both a great learning and rewarding experience and the desire to perform better was the primary drive for me to contest for a second term. I would like to thank the OES AdCom members for your whole-hearted support in the past two years and also re-electing me to serve as VP OCEANS for two more years. I look forward to working with you all more closely. I believe being brought up in different environments and having developed into different personalities, conflicts are on the card and resolving them through negotiations is the key. I would be a good listener, and always happy to resolve issues the best way I can. As a community we can grow only if we could create the right environment and each of us are responsible for the same. Remember, as an IEEE member we also have a responsibility to act with utmost decorum. Sorry, too much of ranting there.

We have a lot of challenges ahead as well as opportunities to explore new collaborations on OCEANS front. We have already established a partnership through an MOU with IEEE Geoscience and Remote Sensing Society (GRSS) and will explore opportunities to engage in each other's events. I believe this is a right step forward.

There were questions raised regarding the continuation of future OCEANS in the wake of MTS, our current Co-Sponsor, withdrawing from the partnership in 2026. As a non-profit scientific society, OES has a primary focus to serve its members and the scientific community at large. OCEANS has been an IEEE OES flagship conference, and as VP OCEANS I would like to ensure that it will continue to be organized as we cannot let our community down.

The first OCEANS Central Coordination Committee met and discussed the way forward. We are currently in discussion about hosting the OCEANS 2026 NA conference with a few possible locations and with Washington DC as our first preference. We should have a better picture emerging in the next couple of months. If you're interested in hosting a future OCEANS conference, please contact me. Following is the list of planned OCEANS Conferences:

- OCEANS 2026 Sanya, Hainan, China
- OCEANS 2026 North America (location yet to be decided, Washington DC is still under consideration)
- OCEANS 2027 Aberdeen
- OCEANS 2027 NA (location to be decided)
- OCEANS 2028 RoW (Australia is being considered as a potential location)
- OCEANS 2028 NA (potential location - San Deigo)

I attended the OES conference portfolio review committee (CPRC) meeting online along with the OES President and VP for Workshop and Symposia on 11 October 2024. The CPRC review usually is being held prior to the 5-year society review, which has been scheduled for November 2024 (for the period 2019-23). Overall, the Committee was appreciative of the work done by the society. The Committee, however, noted that there are two major areas that require our attention. One is on the quality of conference papers and their timely publication. Participation of more OES volunteers in the technical programme committee is important wherever OES is a co-sponsor or technical co-sponsor. The time it takes currently to upload the papers to IEEE Xplore is twice as much time as the other societies are taking. Delays in conference account closing is another area of concerns raised. Some conferences take more than 6 months and at times even a year to close their accounts. In order to expedite both activities the Local Organising Committees (LOC) are required to work closely with the Professional Conference Organisers (PCO). The CPRC also recommends keeping a database of active volunteers and recruiting new members under a 'mentor-mentee programme' and allow them to work up the ladder through active engagement. This can help alleviate issues with the volunteer shortage to some extent. The committee appreciated the YP and WiE activities at OES and encouraged to continue with them.

I shall share more on the conference organization related matters that were discussed during the IEEE Regional Conferences Coordinators (RCCs) and IEEE S/C VP-Conferences Collaboration Meeting (online) in my next report due to lack of time and space constraints.

Before closing, here is a summary of attendance and papers presented at the Halifax OCEANS.

Total Attendees	1639
Full Registration	968

One Day Registration	256
Exhibit Passes Only	349
Countries Represented	35
Number of Papers Sent for Publication on IEEE Xplore	366
Regular Papers	320
Student Poster Competition papers	20
General Posters	26

The papers are expected to be on IEEE Xplore by second week of Dec 2024.

Preparations for OCEANS 2025 Brest are going well. The call for abstracts is out and the LOC has started to seek interest from exhibitors. The plan for Summer School is progressing well. A new event the University R&D showcasing is also taking shape (more details on this in the next report).

I wanted to keep this report short, but as I started to write things down it went beyond my estimate. Thanks for taking time to read this.

From the Journal Editor's Desk

Karl von Ellenrieder, Journal Editor-in-Chief

Congratulations to the authors of our most recently approved papers. The following papers were published as Early Access papers on IEEE Xplore and will appear in a regular quarterly issue of the Journal soon. You'll find these papers online now:

- Yuhan Liu, Shahriar Negaharipour, Object Modeling From Underwater Forward-Scan Sonar Imagery With Sea-Surface Multipath
  https://doi.org/10.1109/JOE.2024.3412268
- Yongchun Miao, Jianghui Li, Yingsong Li, A Novel Tracker of Adaptive Directional Ridge Separation and Prediction for Detecting Whistles
  https://doi.org/10.1109/JOE.2024.3403255
- Elisa Castro, Claudio Iuppa, Rosaria Ester Musumeci, Maria Gabriella Xibilia, Luca Patane, Enrico Foti, Luca Cavallaro, Assessment of K-Means Algorithm to Evaluate Nearshore Wave Climate
  https://doi.org/10.1109/JOE.2024.3441808
- Yu Zhang, Xuerong Cui, Juan Li, Lei Li, Bin Jiang, Shibao Li, Jianhang Liu, Temporal Temperature Profile Prediction Using Graph Convolutional Networks and Inverted Echosounder Measurements
  https://doi.org/10.1109/JOE.2024.3429211
- Jens E. Bremnes, Ingrid B. Utne, Thomas R. Krogstad, Asgeir J. Sørensen, Holistic Risk Modeling and Path Planning for Marine Robotics
  https://doi.org/10.1109/JOE.2024.3432935
- Ya-Lun S. Tsai, Using Cross-Mission SAR Data for a Multi-decadal Coastline Change Monitoring and Assessing the Influences of SAR-Related Factors
  https://doi.org/10.1109/JOE.2024.3425968
- Charles W. Holland, Samuel Pinson, Daniel L. Orange, Cody R. Henderson, Cross-Track Seabed Imaging and Buried Object Detection With a Multibeam Sonar
  https://doi.org/10.1109/JOE.2024.3452134
- Huafeng Wu, Kun Zhang, Xiaojun Mei, Linian Liang, Zhiheng Zhang, Feng Wang, Bing Han, Dezhi Han, Kuan-Ching Li, Heuristic Strategy-Empowered Real-Time Path Following for Autonomous Surface Vessel With Adaptive Line-of-Sight Guidance
  https://doi.org/10.1109/JOE.2024.3447877
- Han Liu, Suyue Wang, Qinghe Zhang, Fangqing Wen, Wave Height Inversion on the Sea Surface Coupled With Broken-Short Waves and Free Waves Using a Fully Coherent -Band Radar
  https://doi.org/10.1109/JOE.2024.3436772
- Giulia Buttazzoni, Fulvio Babich, Alessandro Fanti, Elena Marongiu, Francesca Vatta, Massimiliano Comisso, Multifrequency Phased-Arrays With Dynamic Range Ratio Control for Coastal Monitoring
  https://doi.org/10.1109/JOE.2024.3450550
- Bushra Jalil, Luca Maggiani, Luca Valcarenghi, Convolutional Neural Networks and Transformers-Based Techniques for Underwater Marine Debris Classification: A Comparative Study
  https://doi.org/10.1109/JOE.2024.3436769
- Giovanni Battista Rossi, Gabriele Nardone, Marco Picone, Giulio Settanta, Francesco Crenna, Marta Berardengo, Testing High Directional Resolution Sea-Spectrum Estimation Methods in View of the Needs of a National Monitoring System
  https://doi.org/10.1109/JOE.2024.3436771
- Zetian Mi, Shuaiyong Jiang, Yuanyuan Li, Huibing Wang, Xianping Fu, Zheng Liang, Peixian Zhuang, A Vignetting-Correction-Based Underwater Image Enhancement Method for AUV With Artificial Light
  https://doi.org/10.1109/JOE.2024.3463840
- Fanlin Yang, Haiyang Xu, Xianhai Bu, Chengkai Feng, Mingyi Gan, A Robust Sidescan Sonar Bottom-Tracking Method Based on an Adaptive Threshold
  https://doi.org/10.1109/JOE.2024.3455432

- Jiahua Li, Wentao Yang, Shishi Qiao, Zhaorui Gu, Bing Zheng, Haiyong Zheng, Self-Supervised Marine Organism Detection from Underwater Images
https://doi.org/10.1109/JOE.2024.3455565
- John McConnell, Ivana Collado-Gonzalez, Paul Szenher, Brendan Englot, Large-Scale Dense 3-D Mapping Using Submaps Derived From Orthogonal Imaging Sonars
https://doi.org/10.1109/JOE.2024.3458108
- Yakun Ju, Ling Li, Xian Zhong, Yuan Rao, Yanru Liu, Junyu Dong, Alex C. Kot, Underwater Surface Normal Reconstruction via Cross-Grained Photometric Stereo Transformer
https://doi.org/10.1109/JOE.2024.3458110
- Xueyan Ding, Yixin Sui, Jianxin Zhang, Vector Quantized Underwater Image Enhancement with Transformers
https://doi.org/10.1109/JOE.2024.3458348
- Filippo Campagnaro, Matin Ghalkhani, Riccardo Tumiati, Federico Marin, Matteo Dal Grande, Alessandro Pozzebon, Davide De Battisti, Roberto Francescon, Michele Zorzi, Monitoring the Venice Lagoon: An IoT Cloud-Based Sensor Network Approach
https://doi.org/10.1109/JOE.2024.3459483
- Lu Shen, Yuriy Zakharov, Benjamin Henson, Nils Morozs, Benoit Parrein, Paul D. Mitchell, Target Detection Using Underwater Acoustic Communication Links
https://doi.org/10.1109/JOE.2024.3455414
- Jianmin Lin, Chen Ji, Chenyu Ying, Wen Xu, Tropical Cyclone Wind Speed Inversion Using Seafloor Rayleigh-Wave Microseisms
https://doi.org/10.1109/JOE.2024.3463702

OES Awards Ceremony at OCEANS 2024 Halifax

IEEE OES Awards Committees

The OES Awards Ceremony was held during the Tuesday Plenary at OCEANS 2024 Halifax. We are pleased to share in their awards. Congratulations!

2024 Distinguished Technical Achievement Award: Dana R. Yoerger

Dana R. Yoerger is presented the Distinguished Technical Achievement Award (DTAA) for over 4 decades of development and operation at sea of innovative remotely operated and autonomous systems for deep-sea research.

Dana R. Yoerger received the Distinguished Technical Achievement Award from OES President Brandy Armstrong.

2024 Distinguished Service Award: Hani Elshahawi

Hani Elshahawi is presented the Distinguished Service Award (DSA) for continued contributions to the Offshore Technology Conference (OTC) as member (2005-present), Vice Chair (2009-2012), Chair (2013-2020) of the OES Technical Program Subcommittee, and Vice Chair (2021), Chair (2022), Past Chair (2023) of the OTC Technical Committee.

Hani Elshahawi received the Distinguished Service Award from OES President Brandy Armstrong.

Request for Nominations for OES Awards 2025

IEEE OES Awards Committees

Nominations for the 2025 OES awards will open 24 February 2025. Although February seems far away, now is the time to start thinking about individuals or companies/institutions who are worthy of receiving these awards. Self-nominations are allowed and letters of support for a nomination are encouraged. The nomination form will be available beginning 24 February 2025, and closing 30 June 2025 (https://ieeeoes.org/menu/award-forms/) The awards and criteria for determining eligibility for each award are below.

The Distinguished Service Award (DSA): honors one OES member for outstanding service in furthering the objectives and activities of the Society.

Eligibility
The awardee shall be an OES member in good standing of Senior Member grade or higher. Eligibility and the selection process shall comply with policies and procedures set forth in the governing documents of the Society and IEEE, particularly with IEEE Policy 4.4 on Awards Limitations*.

Criteria in the Call for Nominations
Extent and impact of the nominee's contributions to the objectives and activities of the Society, including dates of significant contributions.

The Distinguished Technical Achievement Award (DTAA): honors one IEEE member for an outstanding fundamental or applied technical contribution to oceanic engineering. The award recognizes a single major invention or scientific contribution, or a distinguished series of contributions over a long period of time.

Eligibility
The awardee shall be an IEEE member in good standing of Senior Member grade or higher. Eligibility and the selection process shall comply with policies and procedures set forth in the governing documents of the Society and IEEE, particularly with IEEE Policy 4.4 on Awards Limitations*.

Criteria in the Call for Nominations:
Quality, originality, and significance of the nominee's technical contributions as evidenced by publications, patents, products, or other tangible items.

Company/Institution Award: honors a corporation or institution that has provided significant contributions to the advancement of ocean engineering and/or ocean research.

Eligibility
The awardee shall be an organization actively involved in ocean engineering and/or ocean research. Eligibility and the selection process shall comply with policies and procedures set forth in the governing documents of the Society and IEEE, particularly with IEEE Policy 4.4 on Awards Limitations*.

Criteria in the Call for Nominations
Nature and extent of the contributions to the advancement of ocean engineering and/or research.

* 4.4.H - Eligibility and Process Limitations: Individuals serving on any board or committee involved at any stage of the recipient selection or approval process for an award shall be ineligible to receive, or act as a nominator or reference for that award. This conflict-of-interest limitation shall apply to all awards given by the IEEE or any of its organizational units.

The OES Nominations and Awards Committee looks forward to your participation in the OES awards process.

Observing Platforms for Studying Climate Change and Biodiversity in Coastal Areas and Lagoons–A Focus on the Venice Lagoon Use-Case

Filippo Campagnaro, OES Young Professional for 2023–2024, Assistant Professor at the Department of Information Engineering of the University of Padova, Co-Founder of SubSeaPulse SRL

During the last day of the 2024 IEEE OES International Workshop on Metrology for the Sea (MetroSea), which took place in Portorož, Slovenia, from October 14th to 16th, our Young Professional Boost laureate Filippo Campagnaro and Maurizio Migliaccio elected to AdCom member for coming year organized a panel titled "Observing Platforms for Studying Climate Change and Biodiversity in Coastal Areas and Lagoons–A Focus on the Venice Lagoon Use-Case."

During the panel, the IEEE OES YP Boost program and the activities of the United Nations Decade of Ocean Science for Sustainable Development (UN Decade) were highlighted. It was emphasized how OES is engaged with the UN Decade through several activities under the umbrella of the OES Oceans Decade Initiative (ODI), as advances in ocean technology can significantly enhance our knowledge for protecting and preserving the sea. Traditional data collection methods in ocean observations are often time-consuming, expensive, and require physical sampling in challenging environments. Collaborations with marine biologists, aquaculturists, and oceanic engineers can offer a set of cost-effective and scalable solutions to automate this process through autonomous vessels and wireless real-time sensor networks. Only a cross-disciplinary approach can address the challenges imposed by the Decade, including (but not limited to) those related to ecosystem health assessment, building community resilience, and equitable access to data and technology, demonstrating the power of collaboration in tackling complex environmental issues. Many research activities have been performed in these aspects in recent years: this panel focused on the peculiar use-case of the Venice Lagoon located only two hours' drive from Portorož, the location of the workshop, which presents a very heterogeneous environment where the use of traditional observatories may be insufficient to study and safeguard such a delicate area, affected by strong tides and frequent floods.

During the panel four experts presented their activities related to the safeguarding of the Venice Lagoon.

First, Angela Pomaro, Senior Researcher at the Institute of Marine Sciences of the National Research Council of Italy (CNR-ISMAR), presented the activities of ISMAR in the context of several European projects and the Italian National Biodiversity Future Center (NBFC) related to observing systems for coastal areas, including the Venice Lagoon where ISMAR is located.

Second, Andrea D'Alpaos, Full Professor at the Geology Department of the University of Padova (that is located 25 miles from Venice), focused on the importance of the MOSE mobile barriers for defending Venice from floods (https://en.wikipedia.org/wiki/MOSE). He highlighted not only the positive impact of the MOSE but also the new issues introduced by such a system, which may alter the natural environment of the salt marshes and cause more corrosion, emphasizing the importance of constantly monitoring the Venice Lagoon.

Third, Fausto Ferreira, Assistant Professor at the University of Zagreb, presented the research activities conducted at the

Figure 1. Filippo Campagnaro presented the OES YP Boost program and the OES Oceans Decade Initiative.

Figure 2. Angela Pomaro presented the recent and ongoing activities of CNR ISMAR related to the Venice lagoon.

Figure 3. Andrea D'Alpaos, on the left side, presented the impact of the MOSE barriers to the Venice Lagoon ecosystem. Fausto Ferreira, on the right, presented how unmanned autonomous vehicles can be used to safeguard coastal areas.

Laboratory for Underwater Systems and Technologies (LABUST) of his university. He demonstrated how unmanned autonomous robotic surface and underwater systems can be used in an integrated underwater and above-water network to monitor water quality in real time. He focused on the measurement campaign performed in the Venice Arsenal with ISMAR.

Fourth, Filippo Campagnaro, Assistant Professor at the Department of Information Engineering of the University of Padova and co-founder of SubSeaPulse, presented the research activities he is carrying out with his colleague Davide De Battisti from the Biology Department in the context of the Italian RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART: https://www.fondazione-restart.it/) program and the NBFC. These activities, performed mainly in the Piovego River in Padova (a tributary of the Venice Lagoon) and in Chioggia, in the Venice Lagoon, highlighted how the use of a few large observatories is not enough to fully characterize the Lagoon ecosystem, which is very heterogeneous due to the several intersections between rivers and channels. This calls for the deployment of a sensor network composed of hundreds of very cheap floating devices, like the SENSWICH platform (https://ieeexplore.ieee.org/document/10742646).

After the presentations, a round table discussion started. Given that the round table covered a wider range of topics related to maritime technology and its applications, two other experts in the field joined the discussion: Maurizio Migliaccio (Full Professor of Electromagnetic Fields at Università degli Studi di Napoli Parthenope) and John R. Potter (Full Professor at the Norwegian University of Science and Technology, Norway).

The first topic addressed in the round table was the reasons limiting the use of robotics and automated monitoring systems in coastal areas and lagoons, even though recent project demonstrations have proven the technology is almost ready. Fausto Ferreira highlighted how using robotic devices in such environments is very challenging, and a lot of effort is required to enhance the technology readiness level from a prototype validated in a relevant environment to an actual product ready to be deployed and maintained. John R. Potter underlined how currently several people are needed to operate an AUV, while a scalable and practical operational system would require one person to operate several AUVs simultaneously, and we are still far from that point. Angela Pomaro and Maurizio Migliaccio highlighted how the use of technology is impaired by the fact that most deployments are not suitable for dynamic environments such as coastal areas and lagoons, making it difficult to determine if an unexpected measurement is due to a temporary malfunction of the sensory system or the dynamic nature of the environment.

The second topic addressed by the panelists centered on the Venice Lagoon, as they discussed whether or not the MOSE barriers are enough to safeguard the population living in the coastal area of Venice and the ecosystem. Andrea D'Alpaos answered that, although the MOSE may not be enough, it is essential to at least save Venice in the near future, as proven by the unexpectedly high number of times it has been operational over the years (20 times per year, i.e., five times more than the original estimate), giving us more time to better understand the flood phenomena and perform other interventions. Angela and the other panelists highlighted how the Venice Lagoon has been strongly modified over the years, deviating the natural path of several rivers reaching the Adriatic Sea and reclaiming swamps to provide land to farmers and build a commercial port, significantly diminishing the basin area where normal tidal activity would have occurred.

Finally, the panelists discussed how to limit the risk that installing new sensors to combat climate change and maritime pollution could create more pollution itself, causing more damage than benefits. They all agreed that the only way to solve this issue is by performing a comprehensive action where data is shared between institutions, avoiding the creation of several parallel sensor networks measuring the same water properties. Only with such collaboration can this risk be mitigated.

Figure 4. Round table moderated by Filippo Campagnaro, where John R. Potter and Maurizio Migliaccio joined the other panelists to discuss how technology can help safeguard coastal areas and lagoons.

OES/MTS Young Professional Luncheon Event at OCEANS 2025 Halifax

Gaultier Real, Karen Renninger-Rojas, OES Young Professionals for 2024–2025

The OCEANS Conference in Halifax, Canada (September 23-26, 2024) was another opportunity for the IEEE Oceanic Engineering Society (OES) and the Marine Technology Society (MTS) to join forces. The recurrent objective of these events is the promotion of professional development of Young Professionals (YPs) and Early Career Ocean Professionals (ECOPs). This is a recurrent activity for both OES and MTS that capitalizes on the large participation to the flagship OCEANS Conference and provides YPs and ECOPs a unique opportunity for career development, professional networking, exposure to facets of oceanic engineering inside and outside of their area of expertise, and more. These events are a unique opportunity to inform young professionals about societies such as IEEE OES and MTS. They also serve as a dedicated sharespace to receive recommendations and advice on ways to grow a network in order to build a career in the field of ocean science, engineering, technology and policy making. For this particular event, the organizers placed the cursor even further down the road by exchanging with young (sometimes very young) aspiring professionals and sharing some insights on how to find the path leading to a fulfilling career and involvement in the domain. This event is always a good metric to evaluate the sensitivity of the general audience to key aspects such as sustainability of the oceans, mitigation of climate change and impact of science in the decision-making process.

The topic selected for the event in Halifax was "Understanding the role of professional societies in the context of international collaboration." The less formal format of the luncheon was again chosen for this event, in order to provide a comfortable atmosphere and allow the many participants to engage in positive and constructive discussions with the panelists and moderator.

Three panelists with different backgrounds were invited to participate in this event. Instead of the traditional presentation with slides support from each of the panelists, a free discussion format was chosen, as it presented a stronger potential to foster interactions with the YPs and ECOPs in the audience. The three panelists were picked to be representative of various aspects of ocean science, technology, engineering and even policy making in order to diversify the nature of the exchanges with the participants.

The panelists were (by alphabetical order):

- Jovana Kornicer (Atlantic Policy Congress of First Nations Chiefs Secretariat). Jovana is a marine scientist who focuses on climate adaptation and mitigation strategies for communities and the ocean. She is currently working as the Regional Climate Leadership Coordinator at the Atlantic Policy Congress of First Nations Chiefs Secretariat. She works as a facilitator to increase First Nation community capacity in climate leadership and other related initiatives across Atlantic Canada. Jovana was representing ECOP Canada at this event.
- Francesco Maurelli (Professor at Constructor University, Bremen, Germany), who leads the Marine Systems and Robotics group at Constructor University and has worked for more than a decade in the field of autonomous marine robots. Francesco was representing IEEE OES, as he is one of the YP Boost Program Laureate (2023-2024).
- Joseph Pratt (JASCO Applied Science), who works as a mooring technician for JASCO Applied science. Joseph pursued a

Jovana Kornicer, Francesco Maurelli and Joseph Pratt, sharing their insights on one of the many interactions with the participants to the YP/ECOP event at the IEEE/MTS OCEANS Conference in Halifax, September 2024.

Karen Renninger-Rojas, YP BOOST Laureate, presenting the OES YP program at the IEEE/MTS OCEANS Conference in Halifax, September 2024. The session brought together a diverse group of attendees eager to explore and discuss the advancements in marine technology and ocean engineering.

Joshua Baghdady speaking at the IEEE/MTS OCEANS Conference in Halifax, September 2024. His extensive experience in the field guided the panel with insightful questions that resonated with the audience's interests.

M.Sc. from the University of New Brunswick before beginning his career as a technician with OTN from 2013 to October 2024. He has led missions in Canada, Cape Verde, Peru, and Australia, and now trains new technicians in the field. Joseph was representing MTS at this event.

The event was moderated by Joshua Baghdady, who works as the unmanned systems communications engineer and project manager at the Applied Research Laboratory at the University of Hawaii (ARL at UH). Joshua is the MTS ECOPs Chairperson.

The event started with a presentation about the IEEE OES YP Program, by Karen Renninger-Rojas (YP BOOST laureate), and the MTS ECOP Program, by Joshua Baghdady.

Each panelist was asked to share his or her personal view on some pre-selected topics, such as the role of professional societies, the different ways to get involved or the main challenges for ECOPs in ocean science. A particular attention was put on providing advice to aspiring young professionals in ways to grow and expand their professional network.

The event's format and content were extremely well received by a full room of 84 participants. The audience included a diverse mix of early-career professionals, students, and experts, as well as a cohort of high school students attending this type of event for the first time. This inspiring gathering fostered connections and encouraged discussions on career development and ocean engineering innovation. Attendees represented a wide range of backgrounds and experiences, highlighting the interdisciplinary and international nature of the ocean engineering community. The event provided a valuable platform for networking, mentorship, and sharing insights on advancing careers within the field.

The IEEE OES and MTS teams will continue to organize these events at future OCEANS Conferences and welcome your suggestions for topics you would like to have covered as well as feedback on past events. We would like to maximize the attendee experience. If you have any suggestion or feedback, please contact Roberto Petroccia (roberto.petroccia@ieee.org) and Joshua Baghdady (jbaghdady@gmail.com) with your feedback.

Group photo of attendees and panelists from the Young Professionals (YP) event at the IEEE/MTS OCEANS Conference in Halifax, September 2024.

Next Event at OCEANS 2025 Brest Conference

We are excited to announce an upcoming event at OCEANS 2025 Brest tailored specifically for YPs and ECOPs. This event will bring together a diverse group of early career professionals and leaders from MTS, IEEE OES and the Brest Local Organizing Committee. The discussion will be packed with valuable insights, networking, and discussions to help you advance in ocean science and technology. Participants are encouraged to register on the OCEANS Brest website (https://brest25.oceansconference.org/).

Chapter News

Submit Chapter News to Beacon Co-Editors and OES Chapter Coordinator

UKRI Chapter

UKRI Chapter Holds Successful Joint Subsea Innovation Technologies Workshop With Young Professionals Chapter in Aberdeen, UK

Reported by Brian Horsburgh, Secretary of UKRI Chapter

The two chapters joined forces to organise this in person workshop on 7 June in Aberdeen. Hosted at the Robert Gordon University Campus, the event was jointly chaired by Dr. Nazila Fough, Chair of the UKRI Young Professionals Chapter and Professor Prabhu Radhakrishna, Chair of the UKRI Oceanic Engineering Society Chapter.

Topics included presentations on "Ultracompact Underwater Digital Holographic Camera for 3D Imaging of Marine Microorganisms" by Dr. Thangavel Thevar of University of Aberdeen; "Safety and Security of Maritime Infrastructure" by Dr. Andrei Petrovski of National Subsea Centre, "Subsea: Freedom to Inspect" by Ms. Ka Henney of Oceaneering and "Corrosion Monitoring of Pipelines and Effectiveness of Ultrasonic Guided Wave Inspection" by Dr. Anil Prathuru of Robert Gordon University, among others.

20 posters by PhD students and Young Professionals were displayed during the day in the poster session.

Several members of the OES Chapter Executive Committee were involved in the organisation and presentations at the event.

OES UKRI chapter Chair, Prof. Prabhu, hailed the event a success, working jointly with Dr. Fough of Young Professionals to organise the event. "This is the largest in person workshop we have organised this year, in addition to several online and hybrid presentations. We hope to add more later this year, to make 2024 the strongest year yet for OES Chapter events."

UKRI chapter members (L to R), Brian Horsburgh, Secretary; Prof. Prabhu - Chairman; Dr. Thevar - treasurer; Dr. Zonghua Liu.

Group photo.

The winning poster author is presented with a certificate in photo by Prof. Prabhu, John Ehiabhili, Sani Lawal, Apolline Boyer & Dr. Zonghua Liu (L to R).

Japan Chapter

The 12th Underwater Technology Forum · ZERO HYBRID

Reported by Harumi Sugimatsu

The 12th Underwater Technology Forum · ZERO was held from 13:00-17:00 on 11 October 2024, on the Atmosphere and Ocean Research Institute, The University of Tokyo in Kashiwa Campus (https://www.aori.u-tokyo.ac.jp/english/access/index.html).

This time, we had 66 in-person attendees and 142 online attendees.

The highlight of the forum was a live reporting from the Deep Earth Exploration Vessel "Chikyu" on its 405th research drilling cruise (JTRACK: https://www.jamstec.go.jp/chikyu/e/exp405/). For the audience, the researchers aboard the vessel were given a virtual tour of the core laboratory and other facilities where drilled core samples are analyzed. In the venue, Asuka Yamaguchi (Forum co-organizer) explained the significance and purpose of the drilling survey and core sampling. It was a time when the audience and the researchers on board became one.

Live reporting from "Chikyu," and discussions with the audience.

The following lectures (Science in the first half, Engineering in the second half) were then given.

- Recent changes in tropical Pacific SST (sea surface temperature) patterns are a mystery
- What happened in the sea during the Noto Peninsula Earthquake? Results of shallow-sea bottom survey along the Coast of Suzu-shi and Noto-cho
- Advances in Marine Microplastics Research
- Introduction of HUGIN Endurance for two-week continuous operation

From the talk "Introduction of HUGIN Endurance for two-week continuous operation".

From the talk "What happened in the sea during the Noto Peninsula Earthquake? Results of shallow-sea bottom survey along the Coast of Suzu-shi and Noto-cho".

From the talk "Development of monitoring systems for sustainable ocean use".

- Realization of a Fishing Robot Boat by a University Startup
- Development of monitoring systems for sustainable ocean use
- Where the Seabed 2030 Program is now? Working in Monaco, Living in South France – Online talk from Monaco

In the last talk, it is presented that Seabed 2030, which aims to acquire 100% of the world seafloor bathymetry by 2030, had acquired about 6% at the start of 2017 and 26.1% as of 2024. This is a fourfold increase from the beginning, but 70% still remains unknown. This shows the difficulty of acquiring data on the seafloor.

The next 13th Forum will be held on the 11th of April, 2025, at the Institute of Industrial Science, the University of Tokyo. See you there!

Australian Council Chapter

Building Momentum and OES Special Session at IGARSS 2025

Reported by Melanie Olsen, Chapter Chair

The Australian Council OES Chapter continues to build momentum through facilitating technical talks across Australia for our members. We welcomed a technical seminar by Craig Steinberg on mass coral bleaching weather and oceanography and engaged with national marine science agencies AIMS and CSIRO to share joint monthly technical seminars.

Photo: IEEE OES Distinguished Lecturer Series Technical Seminar.

Photo: IEEE OES Australian Council Chapter Special Session at IGARSS 2025.

In September, we organised our first OES Distinguished Lecturer series virtual technical seminar, which was well attended and a resounding success. Dr. Kenneth G. Foote from WHOI spoke to ocean technologists across Australia and New Zealand regarding making defensible active-sonar measurements of pelagic fish abundance. We are grateful for the OES Distinguished Lecturer program for this opportunity.

Our OES Chapter will be hosting a special session on the Challenges for Ocean Remote Sensing in the UN Decade of Ocean Science for Sustainable Development at IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2025), which will be held in Brisbane Australia on the 3-8th of August 2025. This is a great opportunity to share your research and build connections with Australian OES members and the IEEE Geoscience and Remote Sensing Society. The paper submission portal is now open. https://2025.ieeeigarss.org/Papers/Submission.asp?SessionType=CCS&ID=2029

To lodge papers at our session, select our topic from the drop-down menu at the "Primary Session Topic - Subtopic prompt." It would be great to facilitate sharing your research with like minded peers in Brisbane next year.

Victoria Chapter

OES Victoria Chapter tours Open Ocean Robotics Facility

Reported by Nick Hall-Patch, Secretary–Treasurer

In the September 2020 OES Beacon (https://ieeeoes.org/oes-beacon/september-2020-oes-beacon/open-ocean-robotics-asv-winch-university-of-victoria-student-capstone-project/), Ryan Foxall wrote about a University of Victoria student capstone project sponsored by The OES Victoria Chapter. That project involved the design of an automated winch that the students had developed for a local engineering firm, Open Ocean Robotics, to be mounted to one of their robotic surface vehicles. Four years later, Chapter members and guests were able to tour that company's facility with Dr. Fritz Stahr, its Chief Technical Officer, as our host.

The tour started at Open Ocean Robotics' entrance, where we obtained some historical background about the company,

Open Ocean Robotics DataXplorer.

Conclusion of OES Victoria Chapter's Open Ocean Robotics Tour.

and its specialty: uncrewed surface vehicles (USVs). Julie Angus, the first woman to row across the Atlantic Ocean from mainland to mainland, is the co-founder of the company and its CEO; the idea for building uncrewed surface vessels (USV) for ocean monitoring was developed after observing extreme storm conditions during that rowing expedition. Also at this point, we were able to view earlier versions of USVs that the company had developed as well as Open Ocean Robotics' present USV, the DataXplorer™.

The USVs are about four meters long, and are light enough to be deployed on a wheeled cart by one or two people. They generate little sound while in operation, using electrical propulsion, powered by lithium-ion batteries that can be recharged with solar panels mounted on the deck. The autonomous recharging capability means that deployment for months at a time is possible. The USV's are fitted with cameras looking all around, as well as various sensors, both above and below the waterline, for basic environmental data.

A unique feature of their design is the minimal keel beyond the protective housing for the propellor, which means that they can be used in very shallow water. Self-righting in turbulent seas is provided instead by a buoyant roll bar mounted above the stern of the vessel, as seen in the accompanying Figure.

A video clarified further some of the DataXplorer details, not to mention showing us spectacular examples of the self-righting capability in the surf zone off western Vancouver Island. (This can also be seen in a video clip on the company website https://www.openoceanrobotics.com/surface-vehicles). An important component of the USV is its software, XplorerView™ Mission Control, and we were shown examples of the software in action. Although the DataXplorer can be run unattended, users can also control the USV at all times, using video and other data streamed back from the device. We were told that a trained single user could control three, and perhaps more, USV's at once using the software.

A very recent example of a USV deployment in Shinnecock Bay with Stony Brook University was also described in the video, outlining the advantages of USV deployment for water sampling for eDNA compared with more traditional methods. These included being able to sample in shallow sites, to sample at night, and perform more frequent sampling at well defined sites than a crewed surface vessel could do.

The tour concluded in the company assembly area where we were able to look over the facilities, examine the inner workings of USV's being assembled, and were able to discuss sensor possibilities and placement.

The UN Ocean Decade: A Midway Fact Check Panel at OCEANS Halifax

Laura Meyer (Chair, Ocean Decade Initiative, IEEE OES), Hari Vishnu (Member, Ocean Decade Initiative and Secretary, IEEE OES) and M. A. Atmanand (Member, Ocean Decade Initiative, IEEE OES)

The UN Decade of Ocean Science for Sustainable Development (2021–2030) was taken up through the Intergovernmental Oceanographic Commission (IOC) of UNESCO. This global program encompasses all ocean sustainability enthusiasts world-wide. The Institution of Electrical and Electronic Engineers (IEEE) being the largest professional body in the world, its chapter, Oceanic Engineering Society (OES) has taken up many activities connected with this through its Ocean Decade Initiative (ODI). The Ocean Decade Fact Check Panel convened on September 26, 2024, during the OCEANS Halifax conference organized by the IEEE OES ODI. The overarching topic was to assess the progress of the UN Decade of Ocean Science for Sustainable Development, identifying gaps, assessing the impact of societies like IEEE OES and outlining future steps. While this is too large a task to do justice to in a single panel, the idea was to look at it through a few different lenses relevant to the panel's expertise - the lens of technology, ocean engineering, the role of ocean observation systems, and the role of professional societies and networking groups. Dr. Hari Vishnu, Senior Research Fellow at the National University of Singapore and member of the ODI, moderated the session and guided the six speakers through the event. The insights shared in the panel were expected to contribute valuable perspectives for the global ocean observing community and help shape future discussions and actions, including those of the professional societies gathered at the OCEANS Halifax conference.

The following speakers were on the panel:

- Anya Waite, CEO and Scientific Director, Ocean Frontier Institute; Global Ocean Observing System (GOOS) co-chair 2020–2024; co-lead of the GOOS Carbon Exemplar and Associate Vice-President Research of Dalhousie University. Anya previously served as Head of Polar Biological Oceanography at Alfred Wegener Institute and Professor in the University of Bremen.
- Rene Garéllo, Professor Emeritus, President of IEEE France, Life Fellow IEEE, Past President of IEEE OES
- Brian Sellar, Reader at the University of Edinburgh specializing in the interfacing of field measurements, tank-testing and numerical simulations. He has led advanced multi-year in-situ measurement and wave-current modeling campaigns in tidal channels in the UK and Europe and has over 10 years of experience in this area.
- Malcolm Heron, Adjunct Professor at James Cook University and CEO of Portmap Remote Ocean Sensing Ltd, and an expert in electromagnetic wave propagation applied to ocean science, Life Fellow, IEEE and Exec-VP of IEEE OES
- Venugopalan Pallayil, Vice President for OCEANS at IEEE OES, Principal Research Fellow & Deputy Head at Acoustic Research Laboratory, National University of Singapore with considerable research experience in underwater acoustics.
- Ronnie Noonan-Birch, a marine socio-ecologist at the Ocean Frontier Institute, who focuses on the nexus of human well-being and ocean health. Her thesis on Canada's blue economy operationalized the sustainable development goals to create an assessment framework for social equity, environmental sustainability, and economic viability of the ocean industry

The panelists (L to R) Rene Garéllo, Brian Sellar, Mal Heron, Anya Waite, Ronnie Noonan-Birch and Venugopalan Pallayil with the moderator Hari Vishnu.

The discussion centered on key accomplishments, identified critical gaps, and explored opportunities for enhancing ocean sustainability, particularly in areas such as marine pollution, renewable energy, data management, and coastal ocean safety.

At the outset, Hari outlined what the Decade was about, its seven desired Decadal Outcomes and 10 Decadal challenges, and what has been reported on the progress of the Decade so far in terms of numbers, drawing from the Ocean Decade Progress Report 2022-2023. This set the context for the framework within which to understand the panelists' takes, and to get a feel of the quantitative assessment before discussing it qualitatively. In summary, the report mentions that as of June 2023, the Decade has endorsed 47 Programmes, 277 Projects, and 85 Contributions across 58 countries. These Actions have created over 25,000 knowledge products, capacity development activities have supported more than 200,000 beneficiaries, and 39 National Decade Committee's activities have impacted more than 1 million people. The decade is now the Largest global ocean science initiative ever undertaken, and will continue to engage philanthropic entities, Small Island Developing States (SIDS), Least Developed Countries (LDCs) and Early Career Ocean Professionals (ECOPs), including supporting regional task forces and coordination structures.

Achievements and Future Directions

Anya Waite started the discussion, focusing on the GOOS, which caters to Decadal challenges 7 and 8, and highlighting the gaps in current ocean observations. She noted that the Ocean Decade has successfully amplified communication around ocean science, sparking widespread conversations and projects. However, the initiative is now at a critical juncture where continued momentum depends on securing external resources. She compared the situation to a high-demand oxygen system—without sufficient input, such as funding from key contributors like the United States to IOC-UNESCO and the GOOS, the initiative risks stagnation. As the Decade progresses, the challenge is to not only maintain this momentum but also ensure efficient resource allocation and long-term sustainability. She invited a robust and diverse discussion on this topic from the panelists and audience.

Marine Pollution and Changing Ocean Relationships

Building on Anya's insights, the discussion then moved the Decadal outcome #1: A Clean ocean, and the first decadal challenge of understanding and beating marine pollution. Rene emphasized the importance of reducing marine pollution and debris and highlighted that there are hardly any beaches to be found without plastic these days. Beyond pollution reduction, there is a broader need to change how societies interact with the ocean, ensuring its sustainable use. The diversity of expertise and solutions within the Ocean Decade—such as contributions from Ocean Environmental Solutions—is vital in achieving this transformation.

The panel session was well-attended.

Offshore Renewable Energy and Data Management

One of the key contributors to ocean pollution is carbon dioxide from fossil fuel-based power plants. Dr. Brian Sellar then shifted the focus of the discussion towards engineering interventions such as ocean energy observation systems. Offshore renewable energy, particularly wave and tidal energy holds great potential for the sustainable energy transition. However, Brian highlighted the complexities of obtaining the right data—at the right place, at the right time, and at the right cost. Multidisciplinary collaboration and open data-sharing models are essential for overcoming these challenges. Furthermore, there is a pressing need for capacity building, ensuring that available resources are maximized while additional capabilities are developed. As an example, Brian pointed out the dire shortage of professionals and students in his research region in Scotland.

Sustainability and Safety in the Coastal Ocean

The panel then moved to the 7th and 8th Decadal challenges. Malcolm Heron discussed advancements in ocean observation sensors and platforms, and the gaps in best practices, standards, and access to reliable science. He pointed out that there is also a surge in unreliable literature being published based on beliefs rather than real science. For instance, despite common belief, tropical cyclones are decreasing in Australia, as the data shows. Thus, there is a need to improve the reliability of published scientific literature. He also noted that tsunami warning systems are underdeveloped, and valuable data is often underutilized. Moving forward, technologies such as artificial intelligence and distributed acoustic sensing could play a crucial role in addressing these gaps, and he outlined these two technologies as enablers in the coming years.

Role of Professional Societies

Transitioning from engineering interventions, the moderator pointed out that the Decade is not just about science and technology, but also about connecting or activating people and groups of people. With this in mind, the next panelist, Venugopalan Pallayil, was introduced to present the impact of professional societies such as IEEE-OES on the Decade. Venugopalan discussed how the OES has been able to play a central part in connecting networks of experts to present viewpoints to society and contributing to science communication, capacity building and information dissemination via several activities. These include, but are not limited to, activities at OCEANS conferences, community-level activities and Ocean educational content generation led by OES chapters across the world, and student ocean technology competitions, thus touching upon the 9th and 10th Decadal challenges - skills, knowledge and technology for all, and to change humanity's relationship with the ocean.

Ocean Observing and the ECOP Blue Economy

Ronnie underscored the critical role of ocean observation in the success of the Ocean Decade. Proper ocean observing systems, co-designed with stakeholders, are necessary to meet societal needs. Ronnie specifically touched upon how the concept of co-design is crucial to the Decade. While enthusiasm for ocean science has generated excitement, the challenge now is to convert this into a sustainable investment. Ronnie also brought to the panel the voice from the ECOP community, which although has been highly activated, connected and collaborative during the Decade, is stretched thin with too many voluntary commitments during this time. Transitioning from volunteer efforts to funded initiatives is essential for continued progress.

There was an engaging Q&A session after the panel, where some very thought-provoking questions were put forward.

The ensuing questions and discussions highlighted the following additional challenges, gaps and potential solutions/enablers for the Decade:

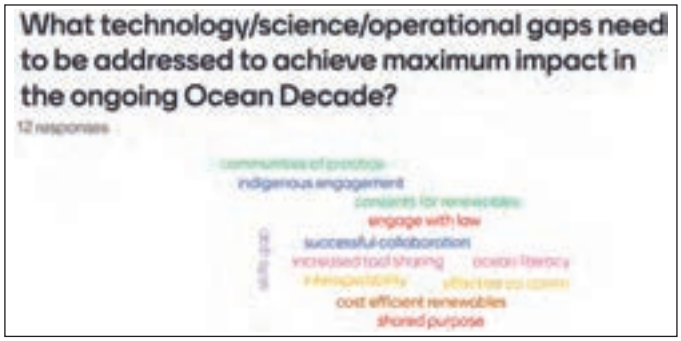
Challenges, Gaps and Solutions

Innovation and Co-Design: One key challenge is the need for interoperable systems that enable effective data exchange across regions and sectors. There is also a strong need for improved communication of regional expertise and differences, ensuring that co-designed solutions are tailored to local needs.

Funding and Sustainability: Funding continues to be a major obstacle. Engaging the industry, particularly in ocean tech, banking, and insurance sectors, is vital. There is also potential for philanthropic funding and stronger industry-academic collaborations. The GOOS, which holds one of the most comprehensive ocean data sets, is critically underfunded. A proposed solution is a "GOOS tax" to ensure continuous funding and operations.

Collaboration and Stakeholder Engagement: Collaboration is key to the Ocean Decade's success. Identifying and engaging the right stakeholders, such as Autonomous Underwater Vehicle (AUV) operators, can help optimize resource sharing. Building sustainable partnerships across sectors—academic, governmental, and industrial—will be crucial to address resource shortages and ensure the continuity of long-term projects.

Translating Data for Decision-Makers: A critical gap exists in translating scientific knowledge into actionable insights for decision-makers. Many legal frameworks governing ocean and climate policies are outdated. Updated scientific findings must be communicated to legal and policy experts to prompt necessary regulatory changes.



Responses received from the audience via an online poll, no what they considered to be the tech/science/operational gaps that need to be addressed in the Ocean Decade.

At the end of the panel, the moderator pointed out that this discussion and stock-taking exercise should continue robustly throughout the Decade to guide action and change, and mentioned that this exercise would be undertaken over the next few OCEANS conferences too. He invited the audience to provide their input on what they thought were the scientific/technological/operational gaps that needed to be tackled in the Ocean Decade, via an online poll. The responses from the audience were instructive and included broad themes such as indigenous engagement, building communities of practice, gathering consent for renewables, engagement with the law, successful collaboration, interested tool sharing, ocean literacy, effective science communication, increased tool sharing, interoperability, shared purpose and bridging the skills gap. These were reflective of the themes identified for the Decade itself under its Outcomes and Challenges.

Conclusion

The Ocean Decade Fact Check Panel highlighted significant progress in ocean science and sustainability but also identified pressing challenges—particularly in securing funding, utilizing data effectively, tackling biased science and influencing policy. Multidisciplinary collaboration, industry engagement, and innovation in data management and renewable energy are key to sustaining the momentum of the Ocean Decade. Technology enablers, such as distributed acoustic sensing and artificial intelligence, have been taking centre-stage in managing the technological needs of the Decade, but face challenges in terms of adoption and operationalization. As it moves into its second half, the initiative must focus on turning excitement and voluntary efforts into funded, actionable programs that will drive long-term positive outcomes for ocean health and resilience.

Video on OCEANS Halifax showing the different events, including the panel: https://youtu.be/0APQLZf0jqA?feature=shared

Forum "Marine Robotics in Ocean Decade Initiative for Sustainable Development" at IROS 2024

Giulia De Masi, Associate Professor at Sorbonne University Abu Dhabi and OES AdCom Member

The Forum on "Marine Robotics in Ocean Decade Initiative for Sustainable Development" has been held on 18 October 2024 as part of IROS 2024 (the 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems) in Abu Dhabi. Organized by Dr. Giulia De Masi (Associate Professor at Sorbonne University, Abu Dhabi), Dr. Federico Renda (Associate Professor at Khalifa University, Abu Dhabi) and Dr. Gabriele Ferri, (Research Scientist at NATO STO-CMRE - Centre for Maritime Research and Experimentation), and endorsed by the IEEE Oceanic Engineering Society, the UN Ocean Decade Initiative, and the Marine Robotics technical Committee of RAS (Robotics and Automation Society), the forum joined in a roundtable discussion representatives from Industry, Government, and Academia. The focus was on exploring opportunities and building partnerships to apply robotics and advanced engineering solutions in real-world ocean scenarios, showcasing how recent technological advancements could be harnessed to tackle existing challenges defined by the United Nation Ocean Decade Initiative.

This UN initiative has been proclaimed in 2017 by the United Nations General Assembly, in a global effort aimed at supporting ocean science and knowledge production to reverse the deterioration of ocean ecosystems. Spanning from 2021 to 2030, the initiative seeks to stimulate scientific discoveries and form strategic partnerships that will advance understanding of ocean systems and facilitate solutions to achieve the UN's 2030 Agenda for Sustainable Development. The IEEE Oceanic Engineering Society has actively supported the Ocean Decade by organizing events like this Forum to foster engagement and develop targeted activities.

This event gathered renowned experts from the fields of marine science and technology for a roundtable discussion on the emerging Marine Robotics revolution. Discussions at the Forum emphasized the transformative role that marine robotics and autonomous systems have played in expanding our understanding of the underwater environment. In contrast to past reliance on long-term ship surveys and human diving missions, today's autonomous systems, both surface and underwater, offer innovative approaches to continuous ocean sampling. These systems allow for greater spatial and temporal resolution in data collection at a reduced cost, opening new frontiers in real-time ocean monitoring. Panelists described and discussed the applications of these emerging technologies across various sectors, including the energy industry, shipping industry,

Panelists (L to R): Christopher Whitt, Cesare Stefanini, Francesco Maurelli, Marco Carraro, Ada Natoli, Henrik Stahl, Simona Aracri, Giulia De Masi, Federico Renda.

ocean-climate solutions, and environmental monitoring and preservation. The conversation provided insights into near-future challenges and opportunities for implementing these technologies in real-world ocean scenarios. Key topics included advancements in autonomy, artificial intelligence, and bioinspired robotics.

The panelists' contributions covered various aspects of marine technology, conservation, and sustainability, providing valuable insights into the role of robotics and innovation in advancing ocean science. Prof. Cesare Stefanini (Director of the BioRobotics Institute of School of Advanced Studies Sant'Anna, Pisa, Italy) discussed recent developments in underwater robotics, focusing on how robots are now designed to mimic natural behaviors like swimming, swarming, and feeding, which enhance their adaptability and efficiency in ocean environments and improve capabilities for data collection and monitoring. Dr. Ada Natoli (Assistant Professor, Zayed University, and Project Director and Founder of the UAE Dolphin Project Initiative, Dubai, UAE) highlighted the critical role of whales and dolphins in marine ecosystems as well as the numerous threats they are subject to due to human commercial activities. She presented findings from ten years of conservation research in the UAE, describing both the ecological value of these species and the logistical and financial challenges that come with studying them in open waters. Her talk emphasized how new technologies can make long-term conservation research more sustainable, cost-effective, and impactful. Dr. Simona Aracri (Tenured Researcher CNR (Italian National Center for Research), Genoa, Italy) addressed the limitations of traditional ocean monitoring platforms and the need for emerging robotic systems to fill gaps in marine observation, especially in remote or inaccessible areas like polar regions and abyssal plains. She advocated for reconfigurable, eco-friendly robotic platforms that align with FAIR (Findable, Accessible, Interoperable, and Reusable) data principles, encouraging a collaborative global effort to advance ocean science. Christopher Whitt (Senior Consultant appointed by Lloyd's Register Foundation to support UN Ocean Decade) spoke on how marine robotics and automation are central to sustainable ocean resource management, particularly in the context of the UN Ocean Decade for Sustainable Development. He highlighted the potential of Automated Surface Vessels (ASVs) and Unmanned Surface Vessels (USVs) to accelerate data collection and improve ecological models, thus contributing to better ocean hazard warning systems, optimized shipping routes, and sustainable industry practices. Dr. Francesco Maurelli (Associate Professor, Marine Systems and Robotics, Constructor University, Bremen and Entrepreneur, Germany) discussed the importance of training the next generation of marine robotics engineers, pointing out that specialized education programs are needed to equip young professionals with the skills to innovate in marine technology and sustainability. Dr. Henrik Stahl (Dean for the College of Marine Sciences and Aquatic Biology at University of Khorfakkan, Sharjah, UAE) explored the application of marine robotics in monitoring carbon capture and storage (CCS) sites, a critical component of climate change mitigation strategies. He explained how autonomous underwater vehicles (AUVs) and advanced sensing technologies could detect CO_2 leaks in real-time, ensuring the environmental integrity of CCS projects and minimizing potential impacts on marine ecosystems. Finally, Dr. Marco Carraro (Robotics and Control System Engineer, Saipem S.p.A., Venice, Italy) introduced Saipem's Hydrone platform, which aims to transform the traditional oil and gas sector by incorporating autonomous resident vehicles that can operate independently in underwater fields. By reducing the need for large vessels to access subsea assets, the Hydrone platform supports more sustainable and efficient subsea operations, advancing the industry toward lower environmental impact. Together, these presentations highlighted the growing importance of marine robotics and technological innovation in achieving sustainable ocean management, improving our understanding of marine ecosystems, and addressing global challenges aligned with the objectives of the Ocean Decade.

OES Conference Calendar

Contact BEACON Editors, OES VPWS and VPTA

OCEANS

OCEANS 2025 Brest
June 16–19, 2025
Brest, France
https://brest25.oceansconference.org

IEEE-OES Summer School 2025
June 20–21, 2025
Brest, France
* More info will soon be updated.

OCEANS 2025
September 29–October 2, 2025
Chicago, USA
https://greatlakes25.oceansconference.org

OTC

OTC 2025
May 5–8, 2025
Houston, USA
https://2025.otcnet.org

OTC Brazil
October 28–30, 2025
Rio de Janeiro, Brazil
https://otcbrasil.org

OES Sponsored (financial or technical)

OEDAI-2024
November17–20, 2024
Chennai, India
https://ge.iitm.ac.in/oedai-2024

UT25 Taipei
March 2–5, 2025
Taipei, Taiwan
https://ut2025.org

OES Patronaged

TechDefense 2024
November 11–13, 2024
Naples, Italy
https://www.techdefense.org

IHTC 2024
November 27–30, 2024
Bari, Italy
https://2024.ieee-ihtc.org

Workshop: Advancing Marine Mammal Research through Machine Learning
@ SMM2024
November 10, 2024
Perth, Australia
https://www.smmconference.org

UNWIS-Winter School on Underwater Network Simulation
February 10–14, 2025
Padova, Italy
https://www.subseapulse.com/unwis/

Maritime Information & Robotics
June 26–27, 2025
Ermoupolis, Syros, Greece
https://maritimesymposium.eu/

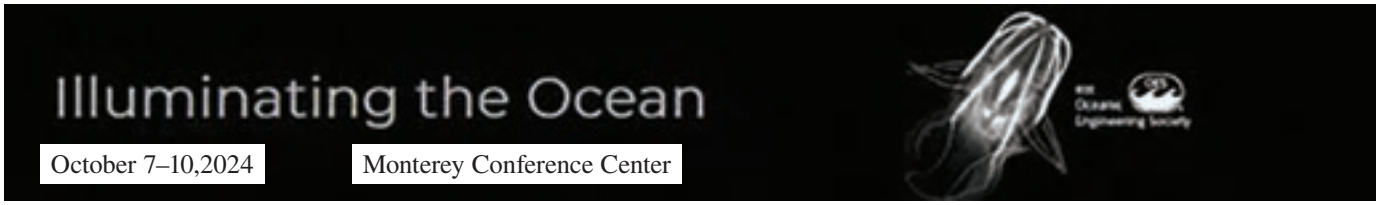
Non-OES but OES Members are Involved in

IGRSS 2025
August 3–8, 2025
Brisbane, Australia
https://www.2025.ieeeigarss.org

Please contact us if you have any information about non-OES events that OES members are involved in.

MBARI Shares Latest Tech Innovations for Visualizing Ocean Life and Ecosystems at Marine Imaging Workshop

Marike Pinsonneault, MBARI Science Communication Fellow



MBARI researchers have developed advanced imaging systems to visualize the ocezzan and its inhabitants.The Marine Imaging Workshop provided an opportunity to share MBARI's tech innovations with scientists and engineers from around the world. Image: © 2022 MBARI.

MBARI is at the forefront of ocean technology, advancing innovative solutions to visualize and understand the ocean, its inhabitants, and its ecosystems. We develop tools to assess ocean health and track how human actions affect marine life and environments.

Since 1988, MBARI's underwater robots have captured nearly 30,000 hours of deep-sea footage. This visual archive is a vital resource for studying the ocean. MBARI software engineers developed the Video Annotation and Research System (VARS) to help experts in our Video Lab annotate and analyze this trove of underwater video footage. Researchers at MBARI and our collaborators around the world have access to millions of annotations that can be sorted and retrieved by specific animal observations, each tagged with their associated depth, location, and environmental conditions. This carefully labeled imagery also helps train AI to identify marine life, further accelerating marine discovery. Our partnership with the FathomNet Program and data contributions to the FathomNet Database further enhances our ocean exploration and discovery.

The Fifth Marine Imaging Workshop offered MBARI researchers the opportunity to share their expertise with their peers from around the world. Image: Joost Daniels © 2024 MBARI.

MBARI Machine Learning Detections.

MBARI engineers develop systems to visualize the ocean in exciting new ways. Advanced laser instruments from the Bioinspiration Lab have revealed the complex structure of delicate gelatinous organisms. A sensor suite designed by the Seafloor Mapping Lab combines light and acoustics to visualize the seafloor at a centimeter scale. Drifting cameras developed by the Carbon Flux Ecology Team document sinking particles of organic material to fill in the gaps in our understanding of the ocean-climate connection. These technologies are among the many MBARI tools that enable researchers to observe both individual animal behaviors and complex ecological interactions.

MBARI's deep-sea imagery is crucial to the institute's education and outreach efforts. The SciComm Team and Video Lab

create engaging videos about MBARI's work that highlight the important role the ocean plays for all life on Earth. By sharing these productions on MBARI's social media platforms, we seek to inspire the next generation of ocean explorers. MBARI imagery is also integral to FathomVerse. Bridging research and public engagement, this mobile game developed as part of the FathomNet Program invites ocean enthusiasts to collaborate with scientists to train AI to identify marine life.

MBARI Software Engineer Brian Schlining led an interactive workshop about the Video Annotation and Research System (VARS), sharing a comprehensive overview of the software infrastructure and guiding users through the process of setting up and running a VARS system for use at their institution. Image: Marike Pinsonneault © 2024 MBARI.

Collaboration is essential for maximizing the potential of science and technology to help us understand the ocean. As a leader in marine science and technology, MBARI shares our tech innovations with our peers worldwide. This week, MBARI hosted the Fifth Marine Imaging Workshop, sharing our latest technology developments with over a hundred scientists and engineers from around the world.

Supported by the Institute of Electrical and Electronics Engineers' Oceanic Engineering Society (IEEE OES), with additional funding from the Gordon and Betty Moore Foundation, Schmidt Ocean Institute, Boxfish Robotics, and SubC Imaging, the Marine Imaging Workshop fosters an environment where researchers, enthusiasts, and industry professionals can engage with cutting-edge ocean imaging techniques, explore data analysis, and discuss the application of AI to support ocean exploration. By bringing together participants from diverse backgrounds and disciplines, the Marine Imaging Workshop promotes knowledge-sharing and collaboration. In over a dozen presentations, hands-on workshops, and posters, MBARI researchers shared their expertise in image analysis, data collection methodologies, effective data management and dissemination, and more.

Sharing MBARI research, data, technology, and expertise at events like the Marine Imaging Workshop helps the ocean exploration community grow its capacity to measure and monitor ocean health. Together with our peers, we are working to advance imaging technology to collect visual data about ocean health. The information the marine science and technology community gathers can ultimately guide responsible stewardship of the ocean and its resources.

Representation by the Numbers:

18 Countries from 6 Continents
200 Attendees with 38 Students
51 Talks – 54 Posters – 9 Tech Sessions

Local Organizing Committee:

Kakani Katija
Chair – MBARI Principal Engineer

William Kirkwood
Finance – MBARI Sr. R&D Engineer

Steve Litvin
MBARI Sr Research Specialist

Brian Schlining
Sr Software Engineer

Next MIW will be Fall of 2026 in Gibraltar

For additional information or images relating to this article, please email pressroom@mbari.org

IEEE OES MetroSea 2024 in Slovenia

Authors Franc Dimc, Pasquale Daponte, Maurizio Migliaccio

Since 2023 the IEEE OES MetroSea conference became a true international conference moving out of Italy and going to Malta. Since 2023 it was also sponsored by the IEEE Oceanic Engineering Society (OES). The new edition of IEEE MetroSea was held at Grand Hotel Bernardin – Portorož, Slovenia, on October 14-16, 2024. Portoroz belongs to the municipality of Piran.

Several important patronages helped for the best success of the IEEE MetroSea24 conference. Academic patronages come from the University of Ljubljana, the University of Sannio, the University of Napoli Parthenope, the University of Genoa, the University of Rijeka, the University of Montenegro, the University of Messina, the Technical University of Sofia, and the Gdynia Maritime University. Other patronages came from the IEEE OES Italy Chapter, the Italian Navy, the Italian National Council of Research (CNR), the OGS, and ISPRA.

Finally, it is worth to be underlined that for the first time MetroSea was included in the list of Ocean Decade Activities of the program "UN Decade of Ocean Science for Sustainable Development."

The general Chairs were Jože Guna (IEEE Slovenia Section), Pasquale Daponte (University of Sannio), Salvatore Gaglione (University of Napoli Parthenope) and Franc Dimc (University of Ljubljana).

Slovenia is a small but diverse state located in southern Central Europe. It shares borders with Italy to the west, Austria to the north, Hungary to the northeast, and Croatia to the south and southeast. The name "Slovenia" means "land of the Slavs," and the official language, Slovenian, is spoken by 2.5 million people worldwide. Part of the South Slavic language group, Slovenian, connects to a larger linguistic family of around 30 million speakers, primarily in the Balkans. As of 2024, Slovenia's population stands at approximately 2.1 million. From 1918 to 1991, Slovenia was part of the Kingdom of Serbs, Croats, and Slovenes, and later Yugoslavia, where it became the most economically advanced republic. Today, Ljubljana is the capital, with other major cities including Maribor, Kranj, Celje, and Koper, which houses Slovenia's only seaport.

Figure 1. A geographical sketch of Slovenia.

Geographically Slovenia is for its largest part mountainous and forested accounting for about 20,271 km^2, roughly one seventh of New York state. Hence, the climate is temperate continental but for the Slovene littoral and the Alps. The Slovene littoral or littoral is the westernmost part of Slovenia bordering Italy and facing the Mediterranean Sea and is characterized by a Mediterranean climate. The southern part of it belongs to the Istrian peninsula. In this area we find the urban centers of Koper, Izola, and Piran.

Piran is a town known for its medieval architecture, with narrow streets and compact houses founded well before the Roman empire incorporation in 178 BC year. The first documented description of Piran is found in text by a cleric of Ravenna, Italy, in the 7th century AC. Its name is likely to come from the ancient Greek work "πυρρός" meaning flame-coloured, yellowish-red because in the area there were some red natural stones.

From 1283 to 1797, the town became part of the Republic of Venice, where it was governed in a semi-autonomous way, with a council of local noblemen assisting the Venetian delegate. Walking in Piran you can enjoy the Venetian style and its beauty.

The conference venue was not far away from the historical center of Piran, see Fig. 2. A walk of roughly 20 minutes took one from the conference venue to the old Venetian style town of Piran.

The main square (Figs. 3 and 4) of Piran is named after Giuseppe Tartini (1692–1770), composer and violinist of the Baroque era born in Piran in the Republic of Venice. Tartini was the first known owner of a violin made by Antonio Stradivari.

The accepted conference papers were 114, with a number of international registered attendees summing to 131. All articles

Figure 2. Piran from above. The historical center is clearly visible as well as the modern Portoroz on the extreme right part.

submitted to IEEE MetroSea 2024, that have been accepted in a peer-reviewed process, have been published on IEEE Xplore Digital Library. Although this year no dedicated IEEE Journal of Oceanic Engineering (JOE) Special Issue was organized, all presenters are invited to submit their full journal papers to IEEE JOE if adhering to the journal scopes.

The Conference included 23 oral sessions and 2 poster sessions. Further, the conference schedule incorporates 3 keynote talks, 3 tutorials and 1 technical visit. The keynotes were held by Milena Horvat (Jožef Stefan Institute, Department of Environmental Sciences, Slovenia), Roberto Sabia (European Space Agency) and John R. Potter (Norwegian University of Science and Technology, Norway). All three keynotes were particularly appreciated and outstanding.

In Fig. 5 a picture of Milena Horvat lecturing is shown.

Figs. 6 and 7 show images taken during the keynote speech by Roberto Sabia entitled "ESA Ocean Remote Sensing Activities and Perspectives."

In Fig. 8 it is shown John R. Potter having his keynote on "What next for ocean sensing and monitoring?"

Figure 3. Tartini square at the center of Piran. The Giuseppe Tartini statue dominates the square.

Figure 4. Young soccer players in the Tartini square.

Figure 5. Milena Horvat during her keynote on "Metrological Challenges of Emerging Contaminants in the Marine Environment".

Figure 6. Roberto Sabia, ESA having the keynote.

Figure 7. Another moment of Roberto Sabia keynote. Using a metro map to represent the different goals and ESA missions for oceanic applications.

In Fig. 9 the Distributed Acoustic Sensing concept for underwater monitoring is shown by John R. Potter. It is a distributed system able to "listen" whales, ships and earthquakes. It is based on optical fibers that are already present on the seabed.

The conference was vibrant, enjoyable and scientific valid with participation of people from Academias, Research Centers, Operational centers and Governmental bodies.

In Figs. 10–13 some oral and poster presentation moments are shown.

Many young people attended the conference. Authors and participants came from 20 countries including Slovenia, Italy, Croatia, Norway, Belgium, Netherlands, Albania, Romania, Spain, Portugal, Poland, Great Britain, Denmark, Greece, USA, Mexico, Democratic Republic of Congo, United Arab Emirates, Saudi Arabia and Hong Kong. Parallel oral sessions and poster sessions were organized out of the Plenary Sessions.

As usual, a set of emerging and well-established technical methodologies and applications were presented during the sessions, spanning a variety of topics that attracted the participants and promoted new networking chances.

Three Tutorials were included in the program, too, see Figs. 14–15. The training on marine drones was offered by CODEVINTEC.

Figure 8. John R. Potter, NUST having the keynote.

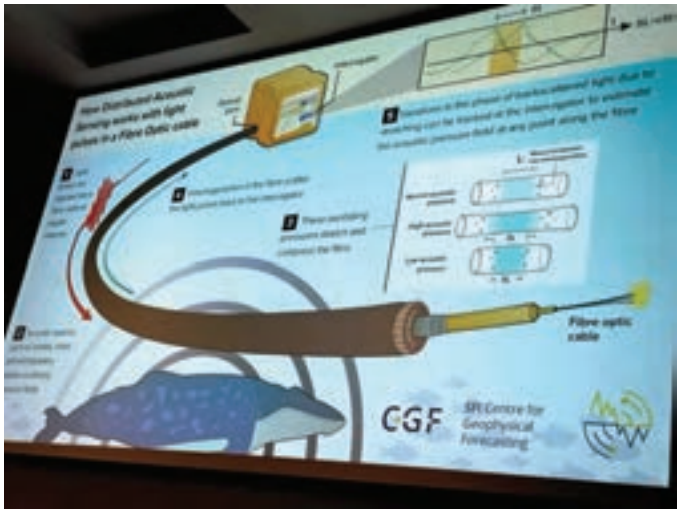


Figure 9. The DAS system illustrated by John R. Potter, NUST.

Figure 10. An oral presentation about the monitoring of a Slovenian lake.

Figure 11. Oral presentation by Giulia Buttazzoni, University of Trieste, about coastal radar monitoring.

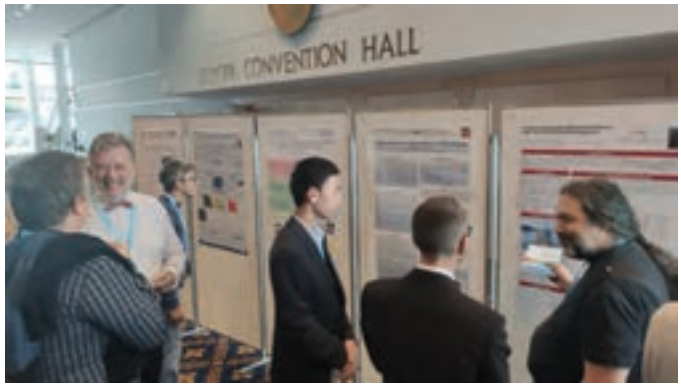


Figure 12. Poster presentation and chatting.

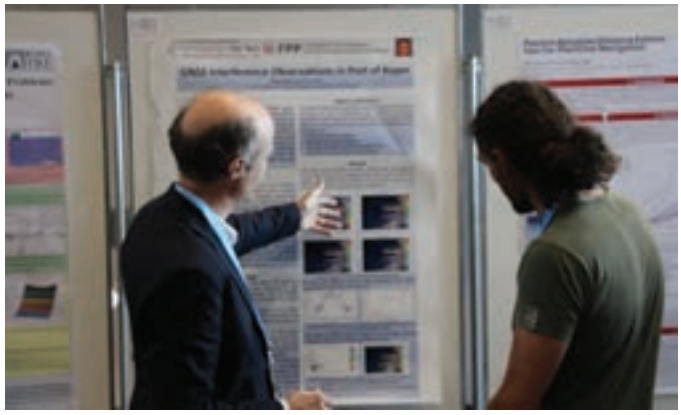


Figure 13. Franc Dimc talking with Giuseppe Grieco of CNR-ISMAR.

The participants also visited the Piran Marine Biological Station, which looks after the Vida oceanographic buoy and regularly cooperates with the OGS in Trieste.

All social events were excellent and organized with great care and professionality. The gala dinner was held on 15 October at Restaurant Arkade - Hotel Histrion.

During the closing ceremony the awards were announced. The best paper award was given to the paper "Integrating topographic and underwater measurements for comprehensive coastal area inspection: an interdisciplinary approach" by Ali Alakbar Karaki, Ilaria Ferrando, Bianca Federici, Domenico Sguerso, Matteo Guideri, Roberto Nardini and Nunziante Langellotto of University of Genoa, Italy, and Ministry of Defence, Italy. In Fig. 16 the recipient Ali Alakbar Karaki is shown.

The second-best paper was achieved by Giulia Buttazzoni, University of Trieste, with coauthors Elena Marongiu, Fulvio Babich, Alessandro Fanti, Francesca Vatta and Massimiliano Comisso for their paper on "Phase-Only Antenna Array Synthesis with Beam/null Steering Capabilities for Propagation Impairment Mitigation in Coastal Environment." The third best paper award was given to Jure Srše and Marko Perkovič, University of Ljubljana, Slovenia, for their paper on "Field Studies on Sediment Resuspension Induced by Shipping: Vessel Kinematic Measurements and Water Sampling in the Port of Koper."

During the closing ceremony Fausto Ferreira, University of Zagreb, addressed the participants as representative of IEEE Oceanic Engineering Society, see Fig. 17.

Figure 14. Tutorial on photovoltaics, organized by Laboratory of Photovoltaics and Optoelectronics, University of Ljubljana.

Figure 15. Tutorial organized by CODEVINTEC, an Italian Company, on in-depth description of autonomous hydrographic survey technologies.

IEEE MetroSea 2025 will be hosted in Genoa, Italy, (Fig. 18) 08-10 October, 2025. The IEEE Oceanic Engineerring community is warmly invited to enjoy the Conference.

Figure 16. Award ceremony: The winner for the best paper Ali Alakbar Karaki (left) and Peter Vidmar, the dean of the Faculty of Maritime Studies and Transport (right).

Figure 17. Fausto Ferreira at the closing ceremony (on stage) along with the organizers Pasquale Daponte, Franc Dimc and Salvatore Gaglione.

Figure 18. Genoa, Italy, will be the hosting city of IEEE MetroSea in 2025.

IEEE 10th International Conference on Underwater System Technology: Theory and Applications (USYS'24)

Zool Hilmi Ismail, Co-chair, Mohd Rizal Arshad, Honor Chair, Huiping Li, Co-chair, Le Li, Technical Committee, Rosmiwati Mohd Mokhtar, Technical Committee, Zainah Md. Zain, Technical Committee

The IEEE 10th International Conference on Underwater System Technology: Theory and Applications (USYS'24) was successfully held from 18 to 20 of October, 2024. This milestone event, marking a decade of advancements in underwater system technology, was organized in collaboration with the IEEE Oceanic Engineering Society (OES) Malaysia Chapter and Northwestern Polytechnical University, China.

USYS'24 brought together experts in underwater technology, showcasing a total of 120 presented papers. Held at the Xi'an Qujiang International Convention Center, the event featured numerous parallel sessions focused on cutting-edge research, technological advancements, and collaboration in underwater systems. Over three days, attendees explored topics such as intelligent underwater operations, biomimetic robotics, and advancements in underwater energy technology, contributing to the evolving field of underwater systems and sustainable marine practices.

The first day commenced with registration and a workshop on Marine Robots led by Prof. Tiezhi Sun, Jing Yan, Zhouhua Peng, and Jiajia Jiang, offering insights into innovations and applications of underwater robots. The evening concluded with a networking dinner, fostering connections among attendees from various institutions and companies worldwide.

The second day started with an opening ceremony featuring welcoming addresses by university leaders, conference chairs, and honorary chairs. Following this, the plenary sessions showcased impactful speeches:

- Academician Wei Huang opened with insights on marine technological advancements.
- Prof. Dr. Suleman Mazhar presented on biomimetic underwater robots, highlighting how nature-inspired designs enhance underwater mobility and efficiency.
- Prof. Jingdong Chen shared the potential of the naoe-FOAM-SJTU solver in simulating ship flows, an essential tool in ocean engineering.

The afternoon featured specialized technical sessions on topics including underwater navigation and control technology, underwater intelligent acoustic and optical perception, and energy technologies. Each session presented groundbreaking research papers with discussions on challenges and potential solutions in deploying underwater systems.

Figure 2. Dinner photo session featuring Honorary Chair Mohd Rizal Arshad, General Chair Guang Pan, Co-chair Huiping Li, and Zool Hilmi Ismail.

Figure 1. Delegates from the IEEE OES Malaysia Chapter with plenary speaker Prof. Dr. Suleman Mazhar from Harbin Engineering University.

Figure 3. Honorary Chair Mohd Rizal Arshad delivers a speech at the IEEE USYS'24 Conference, highlighting the history of USYS.

Figure 4. Organizing committees of the IEEE USYS'24 Conference enjoy a networking dinner, fostering connections and collaboration in a warm, convivial atmosphere.

The final day opened with presentations by industry leaders and academics:

- Prof. Decheng Wan discussed control systems for high-speed, large-scale autonomous underwater vehicles.
- Prof. Shefeng Yan emphasized the importance of underwater technology for sustainable development in oceanic research.
- Prof. Guangming Xie introduced the ALEYIN initiative for exploring natural karst formations, while Prof. He Shen highlighted advancements in unmanned underwater systems.

In the afternoon, technical sessions spanned topics such as marine engineering and oceanographic observation and safety frameworks for deep-sea operations. These sessions underscored the importance of autonomous systems and decision-making frameworks in enhancing underwater exploration safety and efficiency.

The conference concluded with an awards dinner, celebrating achievements in the field and recognizing promising research efforts. USYS'24 demonstrated the pivotal role of international collaboration and innovation in tackling challenges in underwater technology.

OES Patronage of Automatica2024.it

Karl von Ellenrieder

The organizers of Automatica2024.it would like to thank the IEEE OES for their patronage of the conference. Automatica2024.it is the annual meeting of the Italian professional society for faculty and researchers in automation, systems and control, which goes by the acronym SIDRA.

In Italy each scientific discipline is represented by its own professional society, which on the one hand serves as a source of information about ongoing technical activities and opportunities for people working in the discipline, and on the other hand lobbies for the participation of the discipline in research programs that address problems of national interest. The members of each national professional society meet annually to network, discuss trends and current research in the field, funding opportunities, etc.

The SIDRA Assembly.

This year the meeting was held at the Libera Università di Bolzano (https://www.unibz.it/). The conference was fortunate to have obtained the patronship of several IEEE societies including the OES, as can be seen here - https://automatica2024.unibz.it/

As a means of bringing in new SIDRA members, a large component of the meeting involves presentations by doctoral students and young researchers. In addition to normal presentations by PhD students from across Italy, the Italian national doctoral program in Autonomous Systems (http://dausy.poliba.it/phd/) held special oral presentation and poster sessions in which their PhD students presented their ongoing work.

As there are many research groups in Italy conducting research in the areas of marine robotics, the control of marine systems, and marine sensing (see for example https://isme.unige.it/), OES patronage of the 2024 conference provided a great opportunity to reinforce the participation of these groups within the OES and to introduce younger researchers and new students to the OES within Italy (where IEEE membership is generally very strong).

Conference highlights include the following:

- 126 abstract submissions
- 167 registered attendees
- 49 program committee members
- 18 technical sessions
- 30 DAuSy PhD student presentations and posters
- 4 round table panelists on use of AI in Controls
- 6 award committee members
- 2 best PhD theses in control & automation awards (national level)
- 2 best young author awards IEEE Control Systems Society publications
- 2 best SIDRA presentation awards

WIO Futures 2024 … Hello Africa, here comes OES!

Shyam Madhusudhana, VP for Technical Activities

The *WIO Futures 2024* conference, held on September 16th and 17th at the Labourdonnais Waterfront Hotel in Port Louis, Mauritius, was the first OES sponsored event in the Western Indian Ocean (WIO) region. The event brought together nearly eighty experts and stakeholders to discuss critical issues facing the WIO region. This conference, organized by the Charles Telfair Centre in collaboration with Curtin University's Centre of Ocean and Earth Science & Technology, addressed topics at the intersection of marine science, environmental sustainability, and the geopolitical challenges that shape the region.

The WIO region, spanning the coasts of East Africa, the Arabian Peninsula, and various island nations, is both ecologically rich and geopolitically significant. With coral reefs, mangroves, and seagrass beds vital to biodiversity and livelihoods, the region also faces existential environmental threats, including climate change, pollution, and overfishing. Adding to this complexity, the WIO is a focal point of global strategic interest, with major powers like France, China, India, and the United States positioning themselves for increased influence in the region.

The conference began with opening remarks from H.E. Kate Chamley, Australia's High Commissioner to Mauritius, who underscored the importance of collaboration between WIO nations and international stakeholders. Invited speakers presented on a broad range of topics, from scientific innovations to

Australia's High Commissioner to Mauritius, H.E. Kate Chamley, kicking-off the conference with her opening remarks.

governance challenges, and the need for sustainable ocean management in this politically charged region. In the science-focused track, Dr. Venugopalan Pallayil (National University of Singapore), Prof. Malcolm Heron (James Cook University, Australia), Prof. Christine Erbe (Curtin University, Australia) and Prof. John R. Potter (Norges Teknisk-Naturvitenskapelige Universitet, Norway) presented scientific innovations that help better understand and protect the ocean. A parallel track focused on geopolitical

Prof. Christine Erbe emphasizing the "importance for researchers to establish sustainable relationships with the industry towards ensuring substantive studies on marine themes" during the first of the panel discussions at the conference.

issues in the region. Assoc. Prof. Roukaya Kasenally (University of Mauritius) outlined the region's strategic importance and called on Small Island Developing States (SIDS) to adopt a solidarity strategy towards maintaining their sovereignty. Veronique Garrioch (Sustainability and Relationships Manager at IBL Seafood) discussed the geopolitical challenges of the tuna industry in WIO, highlighting the impact of international competition on local economies. Vassen Kauppaymuthoo, an oceanographer, stressed the need for regional collaboration and integration, deploring the tendency to address challenges only at the local or national level. Dr. Vonintsoa Rafaly (University of Copenhagen) recalled the power of local communities to unite to make their voices heard, referring to the May 2024 advisory opinion of the International Tribunal for the Law of the Sea.

The morning session of Day 1 featured a panel discussion titled *Funding Flows and Research Priorities: Unpacking the Political Economy of Ocean Science in the Western Indian Ocean*. Moderated by Dr. Daniel Marie (Director, Mauritius Oceanography Institute), the panel comprised Prof. Christine Erbe, Dr. Poonam Veer Ramjeawon (Mauritius Research and Innovation Council), Gina Bonne (Chargée de Mission, Commission de l'océan Indien), and Sébastien Sauvage (Director, Eco-Sud). The panelists discussed at length the political economy of funding for marine research in the WIO region and emphasized the need for long-term collaboration between researchers, industry, and governments to ensure sustainable funding for ocean science.

The first day's programming wound down with an evening social at Odysseo Oceanarium followed by a second round table, titled *Navigating Research Challenges in the Western Indian Ocean's Complex Landscape* and moderated by Dr. Emilie Wiehe (University of Guelph, Canada). Panelist Dr. Pallayil called for closer collaboration with international universities and the private sector, while Dr. Christian Bueger (University of Copenhagen) stressed the need for better cooperation between political and natural sciences to design the ocean as an interconnected space. Mr. Raj Mohabeer (Chargé de mission, Secrétariat Général de la Commission de l'océan Indien) called for more action-based research, and Dr. Riad Sultan (University of Mauritius) pointed out the influence of economic interests on funding for oceanographic research and called for regular publication of collected data to better inform policy strategies.

Prof. Ranjeet Bhagooli (University of Mauritius) presenting his work on correcting misidentification of closely-related coral species with variable thermal bleaching responses.

Evening panel discussion at Odysseo Oceanarium.

Day 2 was dedicated for research presentations by young and emerging scientists from Mauritius. Prof. Ranjeet Bhagooli (University of Mauritius) and his students (Maukshada Kamakshi Ramkalam, Shakeel Yavan Jogee, Sruti Jeetun, Melanie Virginie Ricot, and Ashfaaq Korimbocus) presented their studies on topics such as coral growth anomalies, coral responses to thermal stress, changes in reef habitats, distributions of molluscs and reef fish, and marine conservation strategies. Dr. Lisa Ah Shee Tee shared Reef Conservation's (a Mauritius-based

Dr. Myriam Blin (co-organizer) delivering the event's closing remarks.

NGO) work on the voluntary conservation of marine areas as an alternative to traditional marine protected areas, and Svetlana Barteneva (Marine Megafauna Conservation Organisation; a Mauritius-based NGO) presented her work photo-identification of sperm whale individuals in Mauritian waters. These sessions not only highlighted the environmental pressures facing the region but also showcased the critical role of research in tackling these challenges.

The conference concluded with closing remarks by myself and co-organizer Dr. Myriam Blin (Charles Telfair Centre), who emphasized the importance of continued dialogue and cross-border cooperation in addressing the multifaceted issues impacting the Western Indian Ocean.

The *WIO Futures 2024* conference, first such event to be organized under the OES' banner in the region, marked a key milestone in connecting scientists, policymakers, and industry leaders in the region towards forging new partnerships for marine research and sustainable ocean governance. By integrating scientific innovation with practical policy strategies, the event set the stage for future collaborations aimed at protecting the region's marine ecosystems while addressing the geopolitical complexities of the area. By bringing together a diverse group of participants, the event succeeded in highlighting the importance of cross-sectoral and cross-border collaboration.

Contribute to our world-class technical program across a wide variety of topics* including:

*Topics apply to all areas in the upstream oil and gas industry

- **Automation & Reduced Manning**
- **Carbon Capture Utilization and Storage &**
- **Carbon Footprint**
- **Decommissioning & Abandonment**
- **Deep Sea Mining**
- **Digital Transformation, Digital Technologies & Data Management**
- **Drilling Technology & Offshore Drillings Rigs and Systems**
- **Energy Transition, Renewable Energy & Sustainability**
- **Field Development, Megaprojects & Revitalization**
- **Floaters and Mooring Systems**
- **Flow Assurance**
- **Geoscience & New Frontiers Exploration and Production**
- **Health, Safety, and Environment – Governance,**
- **Regulation & Human Rights**
- **Installation/Construction/Pipelay and Operations**
- **Integrity Management & Life Extension**
- **Materials Technology**
- **Methane Emissions and Emissions Control**
- **Metocean & Ocean Engineering**
- **Offshore Electrification – Power Generation, Transmission and Distribution**
- **Offshore EOR and Unconventional Resources**
- **Offshore LNG & Gas Monetization**
- **Offshore Pipelines, Terminals and Transportation Systems**
- **Offshore Service Vessels**
- **Offshore Wind Power**
- **Pre-Salt Development**
- **Project Economic Analyses and Management**
- **Reservoir Engineering**
- **Riser Systems**
- **Risk and Reliability Analyses**
- **Subsea Production and Processing Systems**
- **Topside Production, Processing & Facilities**
- **Well Technology and Systems**

For more information and to submit an abstract go to:
https://otcbrasil.org/call-for-papers/

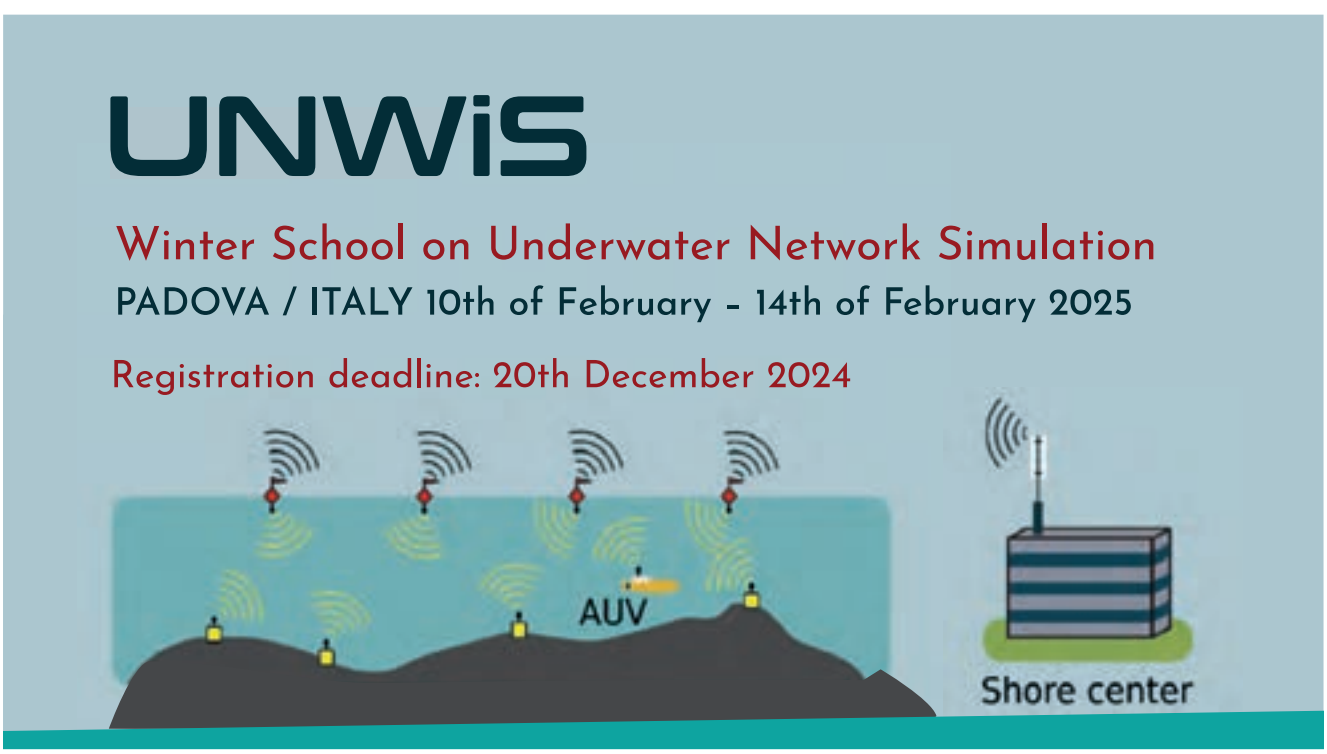
Deadline: 11 March 2025 at 11:59 PM CST
(NO EXTENSIONS WILL BE PROVIDED)

UNWiS

Winter School on Underwater Network Simulation

PADOVA / ITALY 10th of February – 14th of February 2025

Registration deadline: 20th December 2024

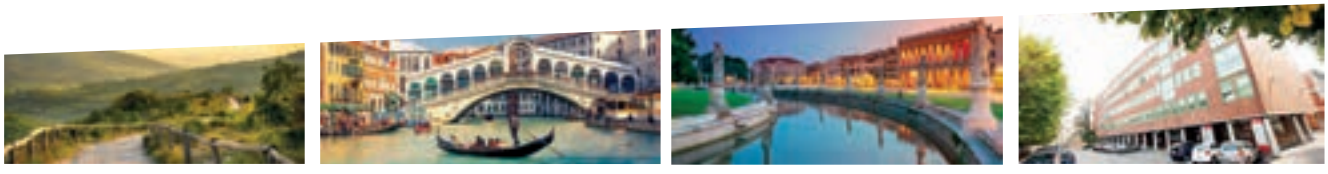


Focused on the **DESERT Underwater network simulation and experimentation framework**, the third edition of **UNWiS** will be split into two parts:

- **Theoretical**: lectures that will allow students to learn the concepts and procedures to perform network simulations and develop software modules
- **Experimental:** To implement the code, run simulation experiments and analyze the results

https://desert-underwater.dei.unipd.it

Required equipment: laptop with Linux OS (recommended Ubuntu LTS), a Linux virtual machine.
Required knowledge: basic C/C++ and Linux OS knowledge.
Used tool: DESERT Underwater is a complete set of public C++ libraries that extend the NS-MIRACLE simulator to support the design and implementation of underwater network protocols.
Registration page: https://www.subseapulse.com/unwis/
Registration deadline: December 20th, 2024.



organized by:

SIGNET

W&M

SUBSEAPULSE

Università degli Studi di Padova

Dipartimento di Ingegneria dell'Informazione

sponsored by:

IEEE Oceanic Engineering Society

supported by:

IEEE Oceanic Engineering Society

IEEE Symposium on Maritime Informatics & Robotics
26 & 27 June 2025, Ermoupolis, Syros, Greece

Dimitris Zissis, University of the Aegean, Greece

Welcome to the Maritime Symposium 2025 in Syros!

For those of you who have visited other Greek islands, Syros stands out with its rich maritime history and industrial legacy. It is fitting that this symposium, focused on maritime innovation and blue technology, takes place on an island that was once a hub of pioneering advancements.

Shipping and shipbuilding were central to this thriving economy, and the entire island was deeply connected to the maritime industry. The port of Hermoupolis hosted one of the Mediterranean's most intricate transit warehouses, and Syros was home to Greece's first ship register and the Hellenic Steamship Company, founded in 1856.

Today, Syros's legacy calls on us to confront new complex challenges. With the exponential growth of data, artificial intelligence, and autonomous technologies, we stand at the forefront of a radical transformation in the way ships operate—and in how society functions at large. Massive amounts of data are reshaping the maritime industry at an unprecedented rate, offering the potential to make ships greener, safer, and more efficient.

In this historic setting, we honor the spirit of Syros's innovation and resilience as we face the task of building a sustainable and technologically advanced maritime future. Together, let us explore how we can harness these new technologies to drive progress, honoring Syros's legacy while pioneering the next wave of maritime innovation.

The Symposium will feature selected presentations and panel sessions presenting recent developments in autonomous systems, robotics, IoT, Artificial Intelligence, big data analytics and machine learning, and the applications they enable in the maritime domain. The event will include the 3rd edition of the Aegean Ro-Boat Race.

For the General Chairs and PC

Professor Dimitris Zissis

Call for Papers

We invite contributions within a broad range of topics relevant to marine robotic systems and maritime informatics, ranging from sensing, communication and networking to security, robotics, vision and system integration. Specific topics include, but are not limited to:

- Maritime sensor architectures
- Maritime robotics, sensors and applications (e.g. ports, robotic cranes)
- Swarm marine robotics applications
- Underwater network (all layers) and system architectures
- Communications and signal processing
- Cooperative marine systems and learning
- Human-robot interaction in marine settings/ human-in-the-loop
- Applications for marine systems, including autonomous vehicles
- Modeling, simulation, testbeds, and standardization for underwater systems and platforms
- Community data infrastructure and public datasets
- Underwater application requirements presented by end users
- Situational awareness
- Ocean observation
- Remote sensing
- Blue Technologies
- Data analytics and machine learning in marine contexts
- Internet of Things (IoT) applications in marine environments
- Smart ports and logistics

Website: https://maritimesymposium.eu/

Important dates

15 November 2024: Registration and Paper Submissions open
28 February 2025: Deadline for Paper Submissions

SYMPOSIUM ON
MARITIME
INFORMATICS
& ROBOTICS
26 & 27 JUNE 2025
ERMOUPOLIS, SYROS
APOLLON THEATRE

ORGANISERS

SUPPORTERS

A Blast from the Past! . . . O Canada!

Bob Wernli–Beacon Co-Editor-in-Chief and Photographers Stan Chamberlain and Manu Ignatius

This year's OCEANS 2024 Halifax conference is the latest in Canada. Photos of Canada's past OCEANS conferences are shown below. Not shown are OCEANS in Victoria in 1993 and Halifax in 1997, 1987 and 1974.

OCEANS 2024 Halifax–Rene Garello briefing the audience on the upcoming OCEANS 2025 Brest conference.

OCEANS 2024 Halifax–The audience.

OCEANS 2014 St. John's Ice Breaker Reception.

OCEANS 2008 Quebec Opening Ceremony.

OCEANS 2008 Quebec Ice Carving.

OCEANS 2007–Canada Place & Vancouver Convention and Exhibition Center.

OCEANS 2007 Vancouver–Joe Vadus & Ferial El-Hawary & Ken Takagi & Shinichi Takagawa.

OCEANS 2024 Halifax–An Overview

Mae L. Seto, Technical Program Chair, Christopher Whitt, General Co-Chair and Amy Deeb, Student Poster Competition Co-Chair

Located on North America's east coast, Halifax is Canada's largest centre for ocean research, innovation, and industry. From September 23–26, 2024, Halifax welcomed the worldwide oceans community to OCEANS 2024 Halifax. The conference was held downtown at the Halifax Convention Centre. 1600+ conference attendees were registered with 90 exhibiting organizations. What was notable about this conference was the extensive papers, panels and activities that spanned a wide range of interests to the theme of *Aligning Diverse Communities for Tomorrow's Oceans.*

The Halifax Convention Centre was the venue for OCEANS 2024 Halifax.

Local Organizing Committee

A dedicated team of volunteers and assistants from university, government and industry contributed to the success of OCEANS 2024 Halifax.

The LOC and other assistants responsible for the OCEANS 2024 Conference. Co-Chairs Christopher Whitt (foreground, left) and Jim Hanlon (foreground, right) hold the plaque recognizing the team's efforts.

LOC member list

General Co-Chair	Christopher Whitt
General Co-Chair	Jim Hanlon
Technical Chair	Mae Seto
Finance Chair	Krista Martell
Exhibit Chair	Jim Hanlon
Student Poster Competition Chair	Amy Deeb Jordan Ross
Members-at-Large	Cathy Hogan Sheila Patterson Bridget Archibald Scottina Jackson
Publicity	Sara Simpson
Volunteer Coordinator	Samantha Best
Panels and Townhalls	Hunter Alloway
MTS Liaison	Zdenka Willis
IEEE OES Liaison	Diane DiMassa
Diverse Attendance Committee	Lucija Prelovec Anna Naylor
Secretariat Support	Kes Morton Pisces Research Project Management

Participation

There were over 1600+ attendees registered for which 500 were affiliated with exhibitors. 90 organizations in total were represented. In addition to the traditional paper presenters and exhibitors, there were indigenous members, lawyers, policymakers, Coast Guard, Canadian Armed Forces, innovators, analysts, technologists, and practitioners.

Technical Program

The program was designed around the theme of *Aligning Diverse Communities for Tomorrow's Oceans.* It spanned the usual oceans topics as well as topics of local interest to industry, government, and academia. It was noteworthy that there were 12 marine robotics sessions and sessions in space-based ocean observation, climate change, renewable energies and the Arctic. The 3 underwater acoustics sessions had a heavy emphasis on marine mammal mitigation driven by local interest. Accounting for no-shows on the schedule, a total of 320 papers were presented distributed over 70 sessions. A record within recent OCEANS conferences. The sessions were generally well-attended.

It was standing room only in the underwater acoustics sessions.

Plenaries

OCEANS 2024 was pleased to have the following plenaries. IEEE and MTS award winners were also recognized during the opening plenary.

Indigenous Welcome

- Albert Marshall: Mi'kmaq natural resources and environment spokesperson

Elder Albert Marshall provides Mi'kmaq wisdom and perspectives on the oceans and current issues.

Opening Plenary: Diversity in the Ocean Sector and the Changing Workforce

- Rear-Admiral Josée Kurtz, Canadian Armed Forces

Canadian Armed Forces Rear-Admiral Kurtz delivers an informative and inspiring plenary to open OCEANS 2024 Halifax.

Plenary Panel: The Impact of Public Sector Policy on Ocean Technology Innovation:

- Justin Manley — Founder, Just Innovation, Inc.
- Carl Goudman — Director, U.S. Integrated Ocean Observing System (IOOS)
- Paul Snelgrove — University Research Professor of Ocean Sciences and Biology at Memorial University of Newfoundland
- Ken Paul — member of Wolastoqey First Nation at Neqotkuk (New Brunswick); principal of Pokiok Associates, Lead Fisheries Negotiator and Research Coordinator for the Wolastoqey Nation

Plenary panel on Impact of Public Sector Policy on Ocean Technology Innovation.

Panel Discussions

The panels complemented the technical paper sessions and brought different players to the conference in keeping with the theme. There was a record number of panels (35) to foster dialog on timely topics that include: carbon removal and reduction; space-based observations; global shipping; autonomous surface ships; ocean sustainability; offshore wind; growing the blue economy; arctic defence; AI; digital twinning; protecting at-risk species; ocean-going robots, interoperability through standards and more. Effort was made to schedule panels, so they do not conflict with technical papers on the same topics.

Student Poster Competition

The OCEANS Student Poster Competition drew over 110 submissions this year and after a rigorous two-round review, 21 outstanding students were invited to travel to Halifax and register for the conference supported by a grant from the Office of Naval Research Global. The 20 competitors who attended presented their research, networked with professionals, and met like-minded students from all over the world. We congratulate the winners and wish all of the participants the best in their future oceans careers.

The contestants from the Student Poster Competition along with the Student Poster Competition Chairs, judges and MTS supporters. Congratulations to all students who qualified for the competition.

Social Events

Welcome Reception

The Ocean Sunset Welcome was the first social event and occurred on the first day. With a drink in-hand, many conference attendees found their collaborators or reconnected with colleagues and friends at OCEANS 2024.

Ocean Sunset Welcome was the first social event of the conference. It occurred at the end of day 1.

Exhibitor Reception

On Tuesday afternoon, delegates enjoyed additional networking time on the exhibit hall floor, as the Canada Pavilion hosted a welcome reception after the afternoon break, followed closely by the traditional exhibitor reception with extended exhibit hall hours. There were samples of local delicacies on offer and the hall was full of energy until closing time.

Gala Dinner

The gala dinner was a hit. Halifax departed from the traditional sit-down dinner and tried a new approach. After the announcements and recognitions of the LOC, the 'meal' of the evening started. The meal was in the form of a wandering tapas event amongst 25 vendors and food stations to sample the best of Halifax cuisine. There was sufficient diversity there to satisfy a wide variety of appetites and preferences. This was followed by music and a dance. This format allowed attendees to speak with people other than the ones at their table to facilitate networking. Reviews to date on the gala dinner have been very positive.

Exhibition

There were 90 organizations exhibiting that ranged from local start-ups to established companies to universities to government agencies. Due to the Space-Based Ocean Observation sessions and themes, MDA Space and NASA Ecological Conservation Program were there. Exhibitors came from Canada, Australia, France, Iceland, Italy, Japan, Norway, Portugal, Sweden, UK and the U.S.

Attendees wandered amongst 25 food vendors and filled their plates with the cuisine they preferred at the gala dinner.

Attendees mixing and re-grouping between servings of tapas which enhanced networking and socializing at the gala dinner.

OCEANS 2024 Halifax is grateful to its patrons for their support. This includes NOAA, Esri, Province of Nova Scotia, NASA Ecological Conservation Program, Sea Bird Scientific, Ocean Networks Canada, Mitre and IORE.

Ancilliary Events

OCEANS 2024 Halifax also hosted an HKN (eta-kappa-nu) induction ceremony for eligible attendees from all over the world. This was performed by the Canadian Atlantic Section HKN chapter Lambda Theta. In total, 9 conference attendees were inducted.

OCEANS 2024 Halifax Co-Chair Christopher Whitt (with yellow sash) and to his right, OES President Brandy Armstrong, with 9 newly inducted HKN members from multiple nations.

Technical Tours

The Halifax Convention Centre is downtown, which is only a few blocks from Dalhousie University – home to world renowned ocean research laboratories and facilities. Tours of Dalhousie University's Faculty of Engineering were hosted. Attendees learned about the leading-edge research in marine: robotics, underwater acoustics, materials and advanced manufacturing, communications, sensing, water resources, and hydrogen. They also toured facilities like the above-water and the underwater anechoic chambers. Many lively discussions were held between Nova Scotia's leading oceans researchers and the conference attendees. It ended up being another networking opportunity for many.

Overall, OCEANS 2024 Halifax was well-attended. Certainly one of the larger events post-pandemic. The emphasis to bring together diverse players and communities to deliberate and decide on the ocean of tomorrow was successful as much more than the academic community and exhibitors were at OCEANS. OCEANS 2024 Halifax would like to thank the participants, exhibitors and patrons for their contributions. We look forward with anticipation to OCEANS 2025 Brest. See you soon!

Career Networking Exhibition Tour (CNET) at OCEANS 2024 Halifax

Giulia De Masi, Associate Professor at Sorbonne University Abu Dhabi and OES AdCom Member

On Saturday, October 26th, during the OCEANS Conference in Halifax, the Career Networking Exhibition Tour (CNET) took place in the exhibition hall, continuing a tradition from previous editions of the event. This initiative is specifically tailored for students nearing the end of their studies or young professionals in the early stages of their careers. Organized by OES volunteers, including Giulia De Masi, Francesco Maurelli, and Luyuan Peng, the event aims to facilitate connections between students' educational backgrounds and interests with opportunities in the job market, particularly in terms of internships and job openings.

Over the first two days of the exhibition, I had the opportunity to visit 130 exhibition booths and preselect 25 of them, all of which expressed interest in participating in CNET by offering internships or job opportunities. A total of 20 students and young professionals registered for the event. Divided into small groups, they engaged in face-to-face meetings with the exhibitors who had agreed to participate. After the tour, participants provided highly positive feedback, expressing great satisfaction, and finding the experience valuable for their career development. This marked yet another significant milestone for the OES!

One of the groups of students at the CNET tour.

The Student Poster Competition at OCEANS 2024 Halifax

Dr. Shyam Madhusudhana, OES Student Poster Competition Chair
Photo credits: Manu Ignatius

Col. Normal Miller envisioned and created the Student Poster Competition (SPC), and it was first implemented at the Seattle OCEANS conference in 1989. It has been a feature of OCEANS conferences ever since. Open for participation to undergraduate and graduate students from colleges and universities around the world, the SPC is a flagship event of the MTS/OES OCEANS conferences. From the pool of aspiring applicants, typically 15-20 students are selected to participate in the Competition, based on two stages of reviews of their submitted abstracts. Selected candidates enjoy a waiver of conference registration fees and receive financial support towards their travel and accommodation costs. We thank the Office of Naval Research—Global (ONR-G) for their continued financial support of SPCs. The prize money for this edition of the SPC was provided by the sponsoring societies OES and MTS.

The Halifax OCEANS' Local Organizing Committee's (LOC) SPC co-Chairs Jordan Ross and Amy Deeb bravely decided to have "more than a full house" and invited more than the usual 20 candidates to the final round of the Competition. Out of over 110 submissions received, 21 abstracts were short-listed for the final program. One of the candidates could not present due to issues with procuring a visa in time. A large faction of participants was from North America—6 from the

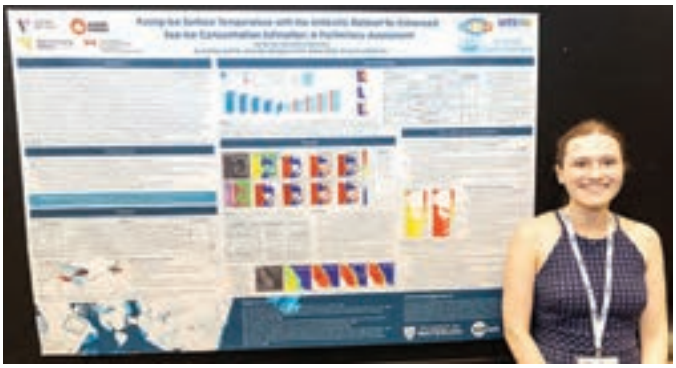
Local Organizing Committee SPC co-Chair Amy Deeb welcoming student participants during the orientation (top). A well-attended awards ceremony (bottom).

Student participants, jury members, SPC Chairs from the LOC and the sponsoring societies OES and MTS.

USA and 4 from Canada. Asian participants included 3 from Japan, 1 from China, and 1 from India. There were 2 participants each from Italy and the UK and 1 from Germany. The poster sessions were very well attended, and the students seemed to have enjoyed their time at the conference. We had a panel of 5 judges who generously offered their time, speaking to each participant and scoring their posters. We are grateful for their support. The awards ceremony was held prior to the exhibitors' luncheon on the final day of the conference. Participation certificates were awarded to all participants. The top three winners received cash prizes along with attractive plaques.

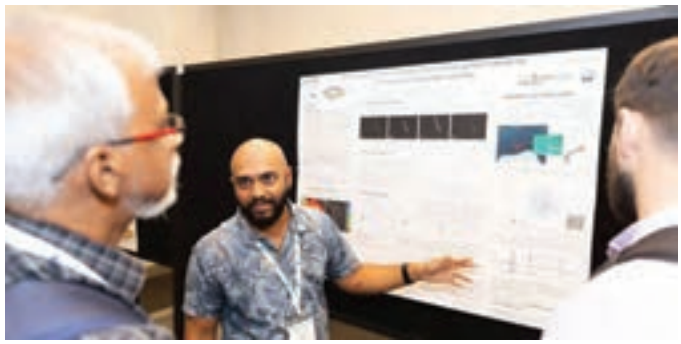
The list of participants (including the prize winners) together with their affiliation, poster title and an abstract of their poster are given below. Apologies to the participants whose photos aren't included.

First prize (Norman Miller Award) (Certificate and $3,000)
Lily de Loe, University of Waterloo, Canada
Fusing ice surface temperature with the AI4Arctic dataset for enhanced sea ice concentration estimation: A preliminary assessment



Abstract—While Arctic sea ice mapping supports several key applications (e.g., navigation, climate monitoring), its accuracy is impacted by remote sensing uncertainties and data limitations. The recent AI4Arctic dataset combines Sentinel-1 Synthetic Aperture Radar (SAR) imagery, AMSR2 brightness temperature (TB) measurements, ERA-5 reanalysis data, and ice charts to improve deep learning-based mapping approaches. Nevertheless, AI4Arctic excludes thermal infrared data and it is critical to explore the use of these products, which may improve predictions where SAR and passive microwave measurements are challenging to interpret. This study investigates the use of VIIRS ice surface temperature (IST) for improving SIC predictions. Our work builds on a competitive U-Net architecture, which estimates three parameters for automated sea ice mapping: SIC, stage of development, and floe size. A 30-scene subset of the AI4Arctic dataset is selected based on established criteria, and co-registered with VIIRS IST data. The impacts of fusing IST with other remote sensing data at the input- and feature-levels are explored using two fusion architectures. Experimental trials are conducted using these models, spanning six input channel combinations. Predictions are compared using evaluation metrics and SIC maps. When using IST measurements in combination with the original input channels, both the input- and feature-level approaches outperform the baseline model. This preliminary study suggests that IST data, in combination with TB measurements, improves predictions where ambiguous textures are present in SAR imagery or PM data is not able to contribute.

Second Prize (Certificate and $2,000)
Tony Jacob, University of Rhode Island, USA
Active Sonar-Driven Iceberg Wall Following Path Planner for Autonomous Underwater Vehicles



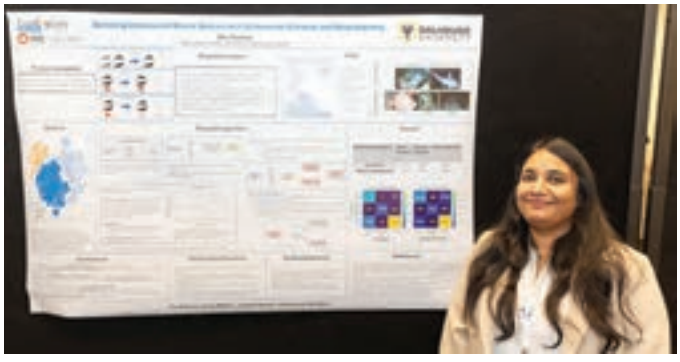
Abstract—Autonomous Underwater Vehicles (AUV) are potential candidates for mapping icebergs in a safer manner compared to using manned ships. However, iceberg drifts and irregular contour pose challenges for AUVs when maneuvering around the iceberg at a constant stand off distance autonomously. To this end, in this paper, we present a novel approach for generating guidance path for an AUV based on an Occupancy Grid Map (OGM) constructed from the measurements from a Mechanical Scanning Imaging Sonar (MSIS). The method consists of three components: MSIS data pre-processing, path generation and waypoint selection, to realize the autonomous iceberg wall-following behaviour. The presented method is generalized and can be utilized for other online wall following applications. The autonomy system is validated in a simulation environment where the AUV has successfully circumnavigated different icebergs at desired standoff distance of 20 meters and has produced an overall root-mean-square-error less than 4m.

Third Prize (Certificate and $1,000)
Jason Noel, University of Rhode Island, USA
Advances in Fiber Optic Microtethered Systems for Deep-Sea Sensing and Exploration

Abstract—The field of deep-sea oceanographic research is commonly restricted to large research vessels and bulky underwater equipment requiring complex deployment schemes. Most equipment is in some way tethered to the deployment vessel, apart from fully autonomous systems. Typical tethers are heavily reinforced industrial grade cables, supplying power and communication to the subsea payloads. By utilizing fiber optic microtethers, specifically Fiber Optic Fishing Line (FOFL), small profile oceanographic sensor payloads and remote operated vehicles (ROVs) can be deployed from any size vessel of

opportunity with minimal resources. The goal of developing these tethers further is to not replace, but operate alongside current reliable research methods, enabling deep-sea access to the ocean for a broader community of scientists and students. Here we present our improvements on FOFL, the Fiber Optic Reel System (FOReelS), and various sensing payloads designed to be deployable with FOFL on the FOReelS. We present performance data of the opto-mechanical properties of the microtether, alongside the successful development and deployment of three static modular payloads and two mobile ROVs in the field.

Devi Ayyagari, Dalhousie University, Canada
Detecting Unexpected Marine Species with Underwater Cameras and Deep Learning



Abstract—Integrating machine learning with audio and video monitoring for automating marine ecosystem monitoring is in its early stages but advancing rapidly. Typically, these models exhibit robust performance on marine classes and environments on which they have been trained; however, they often misclassify previously unseen marine classes with high confidence, erroneously assigning them to known categories. This study addresses the challenge of detecting previously unseen marine categories in underwater video data, while accurately classifying the examples of seen classes. We propose a system that leverages the features extracted from machine learning classifiers, and unseen marine classes from the publicly available OzFish dataset to accurately identify unobserved species in a low-lit, low-resolution underwater video dataset obtained by the Department of Fisheries and Oceans, Canada. We report accuracy scores of 83.0% and 85.2% for ViT and ResNet18 architectures, respectively, on an extensive test set of 46,641 images with both seen and unseen classes. This methodology marks a significant advancement toward the development of automated, scalable marine monitoring systems capable of adapting to varying species distributions and environmental changes.

Jesse Chen, Memorial University of Newfoundland, Canada
Quantification of the Effects of Preprocessing Filters on the Performance of GNSS-R Based Sea Ice Detection

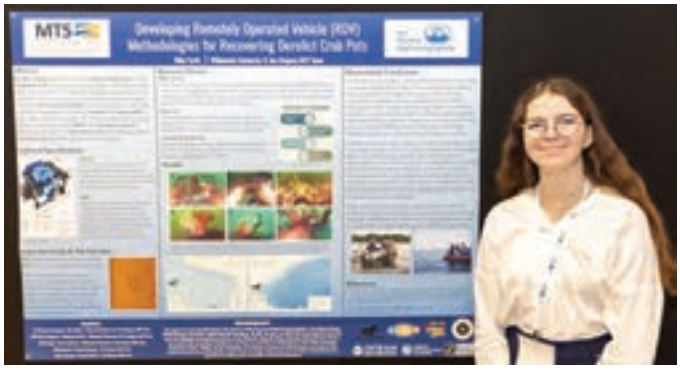
Abstract—This study examines the influence of preprocessing techniques on the performance of Global Navigation Satellite System Reflectometry (GNSS-R) based sea ice detection. Preprocessing techniques evaluated in this study include precipitation screening and SNR thresholding. SNR thresholds are tested with -3 dB, 0 dB, +3 dB, and no threshold configurations. Precipitation screening is tested in three scenarios, containing all data, precipitation free data, and only precipitation contaminated data. Performance impact is determined by recording the sea ice detection accuracy, precision, and recall using the preprocessed datasets. The binary classification is conducted using two models: a histogram thresholding approach and a Bayesian approach. From these tests it was found that the inclusion of precipitation contaminated data did not result in an appreciable change to classification accuracy, precision, or recall. For SNR thresholding, classification accuracy peaks for the histogram thresholding approach when a SNR threshold of -3 dB or 0 dB is applied. For the Bayesian approach, peak accuracy is achieved with a -3 dB threshold. These results indicate that an SNR threshold of <0 dB results in superior classification accuracy and that precipitation may be considered negligible for sea ice detection purposes.

Davide Eccher, University of Trento, Italy
Physical Layer Authentication via Underwater Acoustic Multipath Channel Crafting

Abstract—With the increasing number of actors in the underwater environment and the development of new applications, such as large-scale monitoring and autonomous underwater vehicle control, securing underwater communications is becoming a primary necessity. Security was not prioritized in the past due to the constraints of underwater acoustic communications, which cannot sustain the overhead of typical cryptographic techniques. In this paper, we propose a method to authenticate a network device by exploiting the physical properties of the acoustic channel. In particular, our method hinges on the uniqueness and quasi-reciprocity of the channel, from which the authenticator (Alice) node can extract several parameters such as the number of multipath channel components, their delay and amplitude. These values are similar on both ends of a link between Alice and a legitimate transmitter (Bob), and can be used as a seed to craft a new artificial channel, that is then applied to transmissions from Bob to Alice. With this procedure,

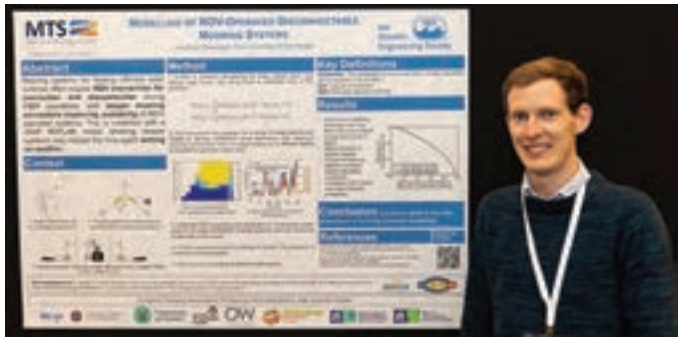
Alice can distinguish Bob from an impersonating attacker (Eve), given a previous message exchange history. Eve can try to bypass the protocol by estimating the channel parameters and by trying to replicate Bob's signal by crafting a similar channel. In our tests, we observe that the estimation error for Eve, caused by her wrong channel estimates, becomes significant even for short distances betwen Eve and Bob. This error results in a discrepancy between the signal generated by Eve and the one expected by Alice, and reveals Eve as an attacker.

Ella Ashford, Willamette University, USA
Developing Remotely Operated Vehicle (ROV) Methodologies for Recovering Derelict Crab Pots



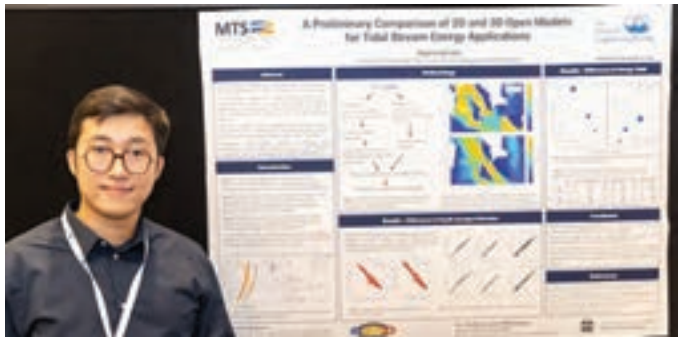
Abstract—Derelict crab pots pose a major risk to marine biodiversity and the Dungeness crab (*Metacarcinus magister*) fishery in Washington State. These traps continue to fish after loss, resulting in a reduction of crab population which threatens local economies and ecosystem health. The current diver-based methods for recovering these lost, discarded, or otherwise abandoned crab pots are expensive and inaccessible for many small coastal communities. This project proposes the use of Remotely Operated Vehicles (ROVs) and geospatial analysis techniques as an alternative low-cost recovery methodology enabling community-driven derelict gear location and retrieval. A comprehensive methodology is developed inclusive of site selection, surveying, ROV-based crab pot recovery, and disposal. This methodology was tested in the coastal waters of Jefferson County, Washington State, where thirty crab pots were located and twenty approved to be removed. Additionally, the study outlines a model for community-based research that involves stakeholders, students, and invested residents in this marine resource management. It is demonstrated that the ROV-based method is an effective low-cost and community-driven way to recover derelict crab pots on a localized scale.

Jonathan Glasspool, The University of Edinburgh, UK
Modelling of ROV-Operated Disconnectable Mooring Systems in Wave Dominated Environments



Abstract—Floating offshore wind turbines (FOWTs) hold immense potential for unlocking previously inaccessible offshore wind resources, with recent advancements positioning the technology on the brink of commercial success. Central to the success of FOWT projects is the optimization of operations and maintenance (O&M) procedures, particularly concerning mooring system design and the utilization of Remotely Operated Vehicles (ROVs). This paper presents an analysis of mooring line disconnection activities using state-of-the-art ROV technology, focusing on the impact of mooring connector depth with the Arven Offshore Wind Farm serving as a case study. Utilizing a simplified two degree of freedom dynamic ROV model and hindcast metocean data, the study examines the station-keeping ability of an ROV subject to wave perturbations, evaluating the effect of depth on mooring connector operational availability. Results indicate that deeper mooring connector installations substantially enhance mooring connector availability from less than 10 % at 5 m depth to over 90 % at 20 m depth, thereby reducing weather- related delays and improving operational efficiency. Furthermore, a sensitivity analysis on ROV power highlights potential avenues for enhancing accessibility without necessitating mooring design modifications. These findings underscore the importance of integrating FOWT O&M strategies and installation considerations with mooring design at an early stage by accounting for realistic performance of ROV-operated tasks, ultimately contributing to the competitiveness and success in the offshore wind sector.

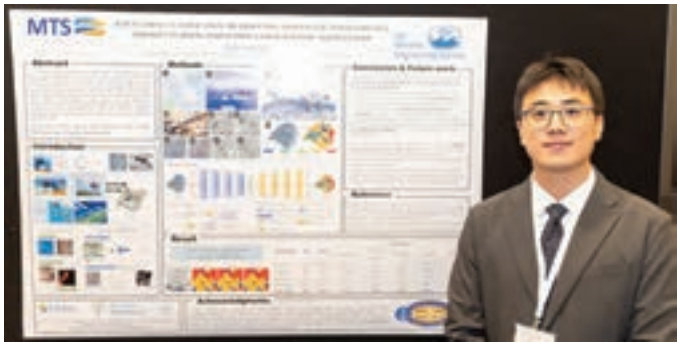
Raymond Lam, The University of Edinburgh, UK
A preliminary comparison of 2D and 3D open models for tidal stream energy applications



Abstract—The tidal energy sector is transitioning from deploying single tidal turbines to large-scale arrays. Efficient and high-performance numerical modelling is crucial for determining the array layouts and accurately predicting the annual energy yield of tidal farms. For this, 2D and 3D regional-scale

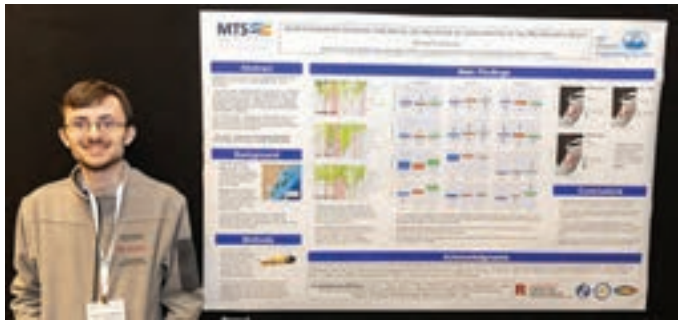
hydrodynamic models have been developed to assess wide-area tidal resources and model turbines over large areas and extended time periods. Although 2D models are more computationally efficient than 3D models for predicting regional flow, the differences in flow prediction performance between 2D and 3D regional-scale models requires further study for tidal energy applications. This study compares 2D and 3D flow predictions at the European Marine Energy Centre (EMEC) tidal energy test site in Scotland using the open software Telemac2D and Telemac3D. Both models are validated against Acoustic Doppler Current Profiler (ADCP) measurements obtained from a legacy UK tidal project (ReDAPT, 2010-2015). Our analysis evaluates the differences in depth-averaged velocities and energy yield predictions between the 2D and 3D model at two locations which are approximately 80 m apart but with large variation in flow regime observed in our previous studies. The evaluation is conducted on three different turbine scenarios with turbines occupying different regions in the water column. Our approach to 2D model evaluation uses a simplified power law assumption to convert depth-averaged velocities into velocity profiles and showed significant deviations in predicted energy yield compared to the 3D approach, which directly calculates power-weighted rotor averaged velocity taken from the velocity profiles. Model prediction differences are shown to be greater for turbine rotors located higher in the water column. The findings motivate further studies on modelling tool selection for tidal energy applications, taking into account machine type and levels of spatio-temporal variation at the side under study.

Bangzhang Ma, The University of Tokyo, Japan
A new coral classification method using speed sea scanner-portable and deep learning-based point cloud semantic segmentation



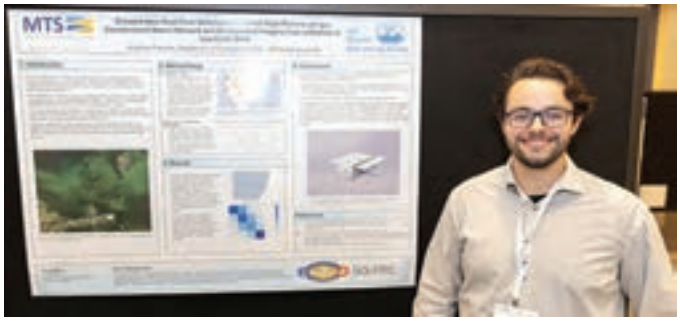
Abstract—Traditional coral classification methods based on underwater images have many limitations in coral surveys, such as light attenuation, color distortion, and complex backgrounds, which affect their accuracy and reliability. To overcome these challenges, we propose a new coral classification method using Speed Sea Scanner-portable (SSS-P-P) and deep learning-based point cloud semantic segmentation. SSS-P can efficiently acquire high-resolution coral images, and we further build coral point clouds through Structure from Motion (SfM) technology. The point cloud semantic segmentation technology can accurately identify and classify corals and other seafloor features. Experimental results show that this method significantly outperforms traditional image segmentation techniques in coral classification accuracy and detection efficiency, providing strong technical support for the research and protection of coral ecosystems.

Nicholas S. Occhiogrosso, Rutgers University, USA
Glider-observed seasonal and spatial distributions of zooplankton in the Mid-Atlantic Bight



Abstract—As secondary producers, zooplankton are essential in the energy flow within marine ecosystems, acting as a trophic link between photosynthetic primary producers and predatory organisms such as migratory fishes and marine mammals, including the critically endangered North Atlantic right whale (*Eubalaena glacialis*). However, the distribution of zooplankton, and drivers of those distributions, are not well studied in the highly productive Mid-Atlantic Bight coastal shelf ecosystem. This region exhibits strong variability that occurs over multiple time scales, from seasons to years to decades, and is located within the broader U.S. Northeast shelf that is rapidly warming and is susceptible to ongoing ocean acidification. Furthermore, offshore wind construction is scheduled to begin in New Jersey coastal shelf waters within the next few years, and potential impacts of offshore wind construction and operation on the oceanography and local ecology are currently unknown. Therefore, establishing a baseline dataset of oceanographic and ecological parameters is crucial to inform not only future studies focused on determining trends in zooplankton distribution but also the offshore wind planning process toward responsible development. Autonomous underwater vehicles (AUVs) called gliders can reliably collect high-resolution data over a wider depth range and often at a lower cost compared to vessel-based sampling. Active acoustic approaches using multi-frequency echosounders make it possible for AUVs to observe marine pelagic species' distributions more directly, and when paired with other oceanographic and ecological sensors, provide insight into how seasonal changes in ocean conditions overlap with the distribution of fish, marine mammals, and their prey. In this study, gliders were used to collect a suite of oceanographic and ecological variables covering three distinct seasons (Spring 2023, Fall 2023, Winter 2024). Variables measured and included in this analysis were temperature, salinity, depth, chlorophyll-a, pH, colored dissolved organic matter, and zooplankton abundance and biomass.

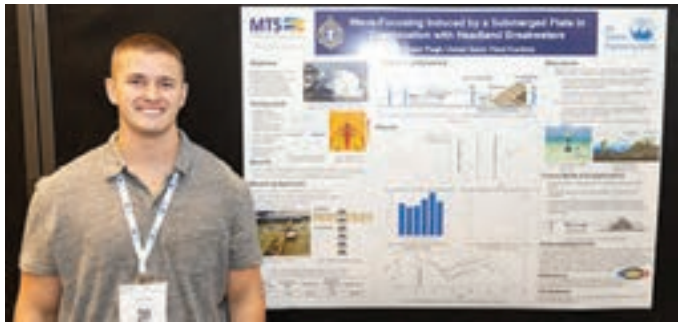
Jonathan D. Parsons, Dalhousie University, Canada
Onboard Near-Real-Time Detection of Harmful Algal Blooms using a Convolutional Neural Network and Multispectral Imagery from a Satellite in Low Earth Orbit



Abstract—Freshwater harmful algal blooms (HABs) pose significant ecological and public health risks worldwide. Detecting HABs soon after they form is critical to managing the damage they cause. While in-situ measurements are more accurate at detecting and measuring their toxicity levels, satellite imagery is more adept at capturing the spatial and temporal dynamics of these blooms over large geographic regions. Satellites can also more persistently monitor for HABs. In the past, empirical methods and machine learning methods have used multispectral satellite imagery to estimate HAB biomass. To build upon the current body of research, this paper investigates an approach to expedite HAB detection by utilizing a convolutional neural network (CNN) deployed onboard a CubeSat in low Earth orbit to detect HABs in near-real-time. The CNN is trained with multispectral imagery from the Sentinel-2 satellite constellation aggregated with in-situ cyanobacteria cell counts from the Seabass CAML dataset.

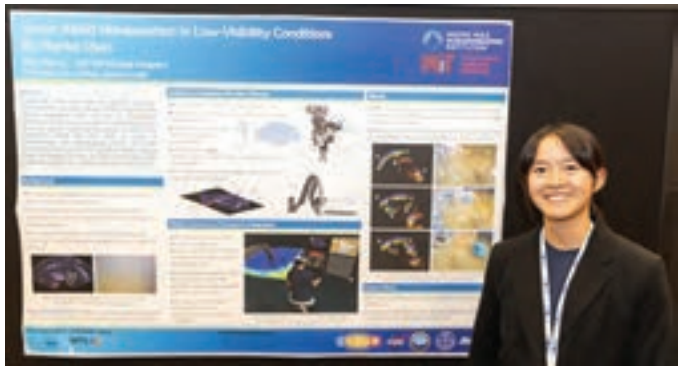
The results successfully demonstrated the capability of a CNN to detect cyanobacterial blooms using multispectral imagery. After classifying HAB predictions into 5 severity classes, the best performing model achieved a RMSE of 1.33 between HAB severity levels. Training the CNN on 30m GSD imagery with RGB and red edge (B05) bands achieved a RMSE of 1.83 between HAB severity levels, which was inadequate for detecting HABs in small inland water bodies. Improved performance was observed with 10m ground sample distance (GSD) band combinations. The best performing networks utilized all of Sentinel-2's 10m and 20m spectral bands.

Logan A. Paugh, United States Naval Academy, USA
Wave Focusing Induced by a Submerged Crescent-Shaped Plate in Combination with Headland Breakwaters



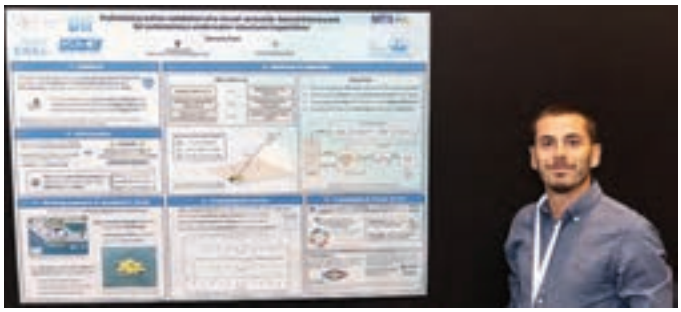
Abstract—As the rise in sea level becomes increasingly evident, various techniques to increase renewable energy production and reduce coastal erosion have become popular topics of study. In particular, interest has grown in varying geometries of submerged plates to focus waves and create reliable conditions for wave energy production. Through the principles of reflection, refraction, diffraction, and shoaling, these plates have been found to focus waves to specific locations. This study investigated wave focusing induced by a submerged crescent-shaped plate through a physical model experiment measuring wave transformation through a combined headland breakwater - focuser system. Through initial mapping of the wave height diffraction profile, we found that while wave attenuation occurred during early stages of propagation, constructive interference can be seen shoreward. By combining the concept of wave energy focusing and coastal protection methods such as headland breakwaters, experiments showed that the focal point of wave energy amplification was magnified due to the unique pattern of diffraction caused by the breakwaters. Through the combination of the two systems, wave energy converters (WECs) could be positioned in a more controlled environment while also helping to reduce shoreline erosion.

Amy Phung, Massachusetts Institute of Technology, USA
Sonar-Aided Manipulation in Low-Visibility Conditions by Novice Users



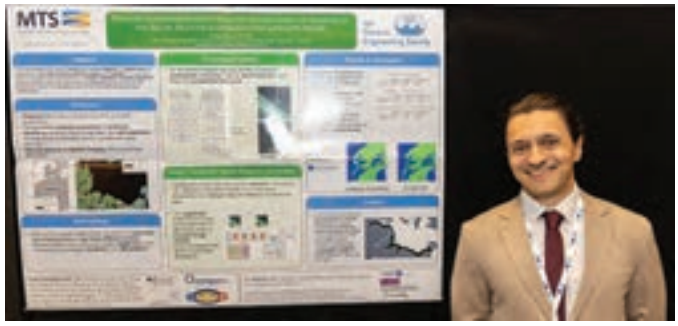
Abstract—Underwater intervention tasks in the deep ocean are typically completed with remotely operated vehicles (ROVs) equipped with robotic manipulator arms, and rely on optical-based perception of the scene to guide the manipulation tasks. However, the performance of optical sensors is highly degraded in turbid water conditions, which can arise from a variety of causes. This work investigates the use of an imaging sonar and doppler velocity log mounted on the wrist of a manipulator for close-range scene mapping to aid in underwater intervention. We integrate this sonar-based perception method with a shared autonomy framework to facilitate safe intervention tasks by users without ROV piloting experience in turbid environments, and conduct experiments to validate our system.

Simone Tani, University of Pisa, Italy
Preliminary online validation of a visual-acoustic-based framework for autonomous underwater structure inspections



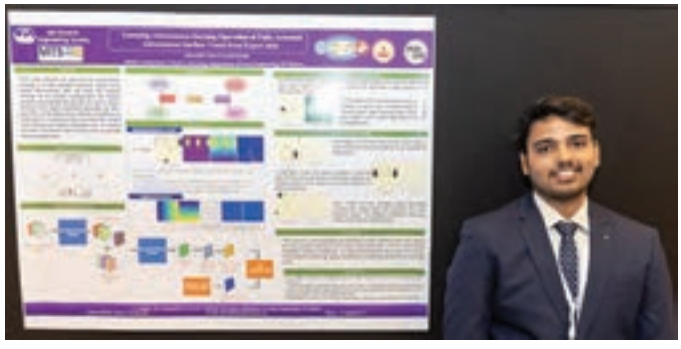
Abstract—This paper presents the preliminary experimental validation of a visual-acoustic-based framework for the autonomous inspection of critical underwater infrastructures using Autonomous Underwater Vehicles (AUVs). The goal is to evaluate the feasibility of a strategy that enables an AUV to navigate relative to a target while maintaining a desired configuration. The proposed target relative navigation approach employs a minimal sensor suite - comprising a frontal stereo camera, a frontal acoustic range sensor, and an inertial unit - to provide information on the relative orientation and distance of the AUV from the inspection surface. This information is used to compute control actions that allow the vehicle to dynamically adjust its pose relative to the facility, adhering to specific mission requirements. The system was validated through an at-sea experimental campaign, during which a reference AUV performed relative navigation tests in front of a port dock. During the experiments, the target relative navigation solution was integrated into the robot software architecture to provide online feedback, thus enabling the AUV to maintain the desired distance and orientation relative to the dock. The results demonstrate the effectiveness and robustness of the proposed relative navigation approach, confirming its feasibility for enhancing the autonomous capabilities of underwater robots in marine infrastructure inspection tasks. Even under deliberate perturbations introduced via joystick by an operator, the AUV successfully maintained a reference distance from the harbor quay and regulated its orientation to zero, ensuring the frontal perception payload remained aligned with the target.

Alexandru Umlauft, University of Rostock, Germany
Towards transformer-based semantic segmentation of seagrass in the Baltic Sea with high-resolution satellite images



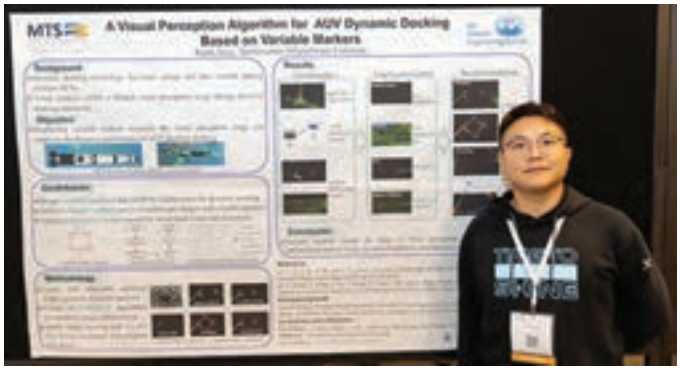
Abstract—Seagrass meadows are blue carbon hotpots. Mapping is an integral part to manage and understand meadows and their dynamics and thereby assist conservation and restoration efforts. Since traditional monitoring methods often become unviable at large spatial scales, satellite remote sensing has emerged as a supplementary tool. However, this approach is often constraint by the sensors' spatial resolution and required training data. Here, we test a transformer-based approach to segment seagrass and compare it against a ResNet50 and MobileNetV3 on very high-resolution (VHR) Pléiades data (0.5 m spatial resolution). Our cross-validation approach demonstrates high performances of all methods, with transformers and CNN approaches being almost equal in performance (~ 95 %), whereby our small dataset might have promoted overfitting. Large seagrass areas are well recognised, while very small patches of just a few pixels size are detected less accurately. However, the smallest patches detected by our models are only few meters in size, demonstrating that VHR data allows to resolve significantly more spatial details compared to data of publicly available medium-resolution sensors like Sentinel-2.

Akash Vijayakumar, Indian Institute of Technology Madras, India
Learning Autonomous Docking Operation of Fully Actuated Autonomous Surface Vessel from Expert data



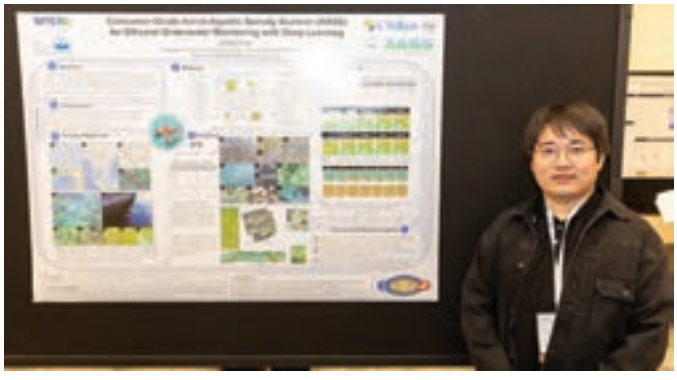
Abstract—This paper presents an approach for autonomous docking of a fully actuated autonomous surface vessel using expert demonstration data. We frame the docking problem as an imitation learning task and employ inverse reinforcement learning (IRL) to learn a reward function from expert trajectories. A two-stage neural network architecture is implemented to incorporate both environmental context from sensors and vehicle kinematics into the reward function. The learned reward is then used with a motion planner to generate docking trajectories. Experiments in simulation demonstrate the effectiveness of this approach in producing human-like docking behaviors across different environmental configurations.

Runfa Xing, Northwestern Polytechnical University, China
A Visual Perception Algorithm for AUV Dynamic Docking Based on Variable Markers



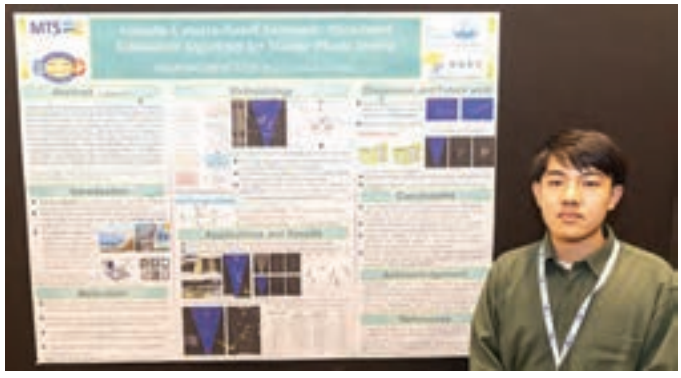
Abstract—Autonomous Underwater Vehicle (AUV), as a key instrument for ocean exploration, utilizes dynamic docking technology to enable energy replenishment and data transfer among multiple AUVs, thereby extending the mission radius. A critical step in AUV dynamic docking is terminal visual positioning and perception. However, current unchanged markers based on point light sources cannot meet the requirements for perception range and dynamic performance. This paper designs a variable marker based on a line light source, whose emission angle can adaptively change according to the docking distance, thus increasing the sensing range and reducing dead zones. Faced with the issues of reduced brightness and increased noise for variable markers underwater, adaptive image enhancement is achieved by combining algorithm Recursive Least Square (RLS) with the image enhancement algorithm Multi-Scale Retinex with Color Restoration (MSRCR). The straight-line fitting algorithm for layer segmentation, combined with line light source information, effectively improves the success rate of visual perception and addresses the issue of key point loss in motion. This paper conducts visual recognition experiments on variable visual markers underwater, verifying the feasibility and accuracy of the proposed visual perception algorithm.

Zhao Fan, The University of Tokyo, Japan
Consumer-Grade Aerial-Aquatic Speedy Scanner (AASS) for Efficient Underwater Monitoring with Deep Learning



Abstract—Traditional marine monitoring techniques, such as line intercept transects, are often inefficient. While contemporary studies utilize autonomous underwater vehicles (AUVs) and the novel Portable Speedy Sea Scanner (P-SSS) to enhance marine monitoring, their widespread adoption is hindered by high costs and labor-intensive operations, with the data quality often failing to justify the investment. This study introduces a novel self-designed amphibious unmanned aerial vehicle (AASS), integrated with deep learning technology, which combines aerial and aquatic imaging capabilities. It surpasses traditional towed underwater survey tools and AUVs in ecological monitoring effectiveness. The research presents the AASS, enhanced with Super-Resolution Reconstruction (SRR) and an improved YOLOv8 detection network. The AASS system significantly improves data acquisition efficiency, capturing high-resolution images that precisely identify and categorize underwater targets. The SRR technique addresses issues like motion blur and low resolution, enhancing the YOLOv8 model's detection accuracy. Notably, the RCAN model achieved the highest mean average precision (mAP) of 78.6% for detecting reconstructed underwater images, with a x4 magnification in image quality showing superior mAP compared to the Bicubic method. These results affirm the efficacy of the proposed method in enhancing underwater ecological monitoring.

Xiaoteng Zhou, The University of Tokyo, Japan
Acoustic Camera-Based Automatic Abundance Estimation Algorithm for Marine Plastic Debris



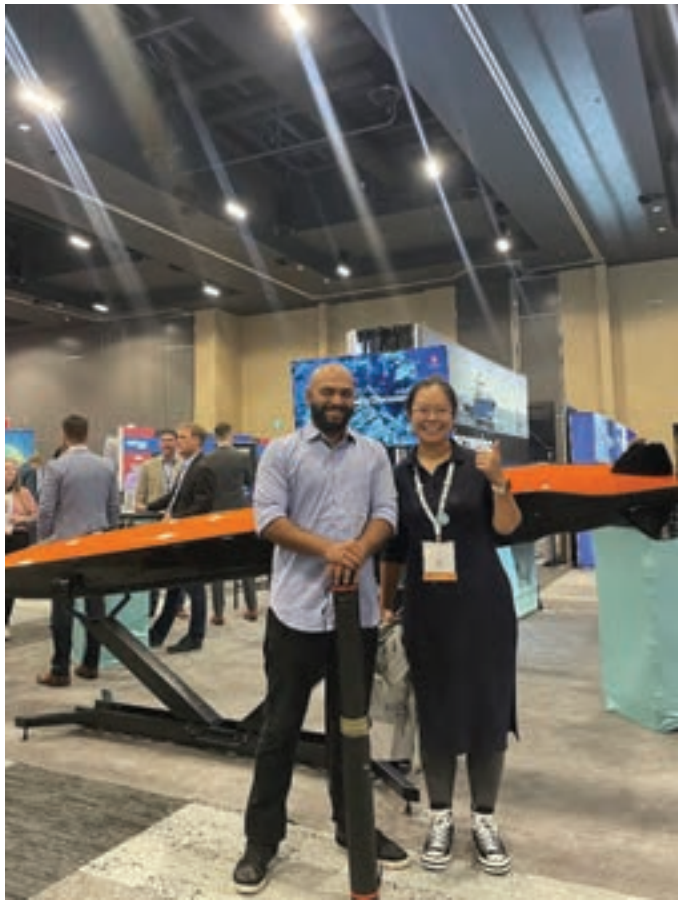
Abstract—The debris emitted by human society flows into the ocean in large quantities, among which plastic debris has the most serious impact, causing irreversible harm to ecosystems. Effectively perceiving marine plastic debris and estimating abundance is crucial for making cleanup solutions. However, current abundance estimations of debris mainly focus on the water surface, as optical and primary satellite sensors cannot work well in low-visibility underwater environments. Many investigations have shown that there is a lot of plastic debris below the ocean surface and even on the seabed, thus requiring the development of debris abundance estimation techniques applicable to various underwater visibility conditions. This study proposes an abundance estimation algorithm for marine plastic debris based on machine vision and the high-resolution acoustic camera, also known as forward-looking sonar, which can be used in low-visibility marine environments. The proposed approach was validated in a circulating water tank experiment and the results show that our proposal could effectively estimate debris abundance, potentially replacing time-consuming and labor-intensive manual investigation.

SPC Experience at OCEANS 2024 Halifax

Tony Jacob, OCEANS 2024 Halifax SPC Second Prize Winner

My advisor had mentioned the significance of the OCEANS conference and pushed me to apply for it on the SPC track. It felt like an achievement in itself, in knowing that my work was selected for the Student Poster Competition (SPC). I got to know that I was selected for OCEANS '24 Halifax Student Poster Competition while recovering from a knee meniscus injury. Yes, I was walking with the help of crutches and was wearing knee braces during the Summer of 2024. An unfortunate skateboarding accident. Now I was tasked with recovering as fast as possible to attend the conference in Canada while also preparing my work in a poster format. The former of which was more mentally challenging. Fortunately, I strength trained and got back into being bipedal just in time.

It would be my first time participating in a conference of this scale. I was able to meet people from all over the world and share with them the work that I was invested in. I had to abstract out the project in varying degrees pertaining to how well versed the crowd was with respect to the field of marine robotics. The more I explained, the richer my intuition got. A true testament to the Feynman technique. I was fortunate to have engaged with government agencies, private companies and other academic institutions during the conference. Their outlooks and interest in my project illuminated various applications and possibilities that I would have overlooked otherwise. Such conversations solidified my efforts for advancing my work in the right direction. The highlight for me was when I had the opportunity to explain my work to Prof. Venu from NUS. I had known him previously via his research work, but at that moment he was earnestly critiquing mine. A truly surreal



With Luyuan Peng from National University of Singapore.

experience. The SPC allowed me to travel and witness beautiful Halifax. I truly enjoyed spending the daybreaks at the small cafes. I had the opportunity to have the best croissant I have ever had at Espresso 46. Rudy's Catering Service had this breakfast sandwich made with the local artisan bakery's Challah Bun, which allowed me to experience the local food culture.

Overall, I had a fantastic time with OCEANS '24. I was able to engage in conversations regarding my research work with people whom I never would have met otherwise in addition to making connections with colleagues with whom I shared the research interests. I am grateful for the support from the Office of Naval Research (ONR) and the IEEE Oceanic Engineering Society (OES), as their contributions made this experience possible. I would like to formally thank them for providing me with this opportunity.

Fusing ice surface temperature with the AI4Arctic dataset for enhanced sea ice concentration estimation: A preliminary assessment

Lily de Loë*
Systems Design Engineering
University of Waterloo
Waterloo, ON, Canada
Email: lcbdeloe@uwaterloo.ca*

Linlin Xu
Geomatics Engineering
University of Calgary
Calgary, AB, Canada
Email: linlin.xu@ucalgary.ca

K. Andrea Scott
Mechanical Engineering
University of Waterloo
Waterloo, ON, Canada
Email: ka3scott@uwaterloo.ca

***Abstract*—While Arctic sea ice mapping supports several key applications (e.g., navigation, climate monitoring), its accuracy is impacted by remote sensing uncertainties and data limitations. The recent AI4Arctic dataset combines Sentinel-1 Synthetic Aperture Radar (SAR) imagery, AMSR2 brightness temperature (TB) measurements, ERA-5 reanalysis data, and ice charts to improve deep learning-based mapping approaches. Nevertheless, AI4Arctic excludes thermal infrared data and it is critical to explore the use of these products, which may improve predictions where SAR and passive microwave measurements are challenging to interpret. This study investigates the use of VIIRS ice surface temperature (IST) for improving SIC predictions. Our work builds on a competitive U-Net architecture, which estimates three parameters for automated sea ice mapping: SIC, stage of development, and floe size. A 30-scene subset of the AI4Arctic dataset is selected based on established criteria, and co-registered with VIIRS IST data. The impacts of fusing IST with other remote sensing data at the input- and feature-levels are explored using two fusion architectures. Experimental trials are conducted using these models, spanning six input channel combinations. Predictions are compared using evaluation metrics and SIC maps. When using IST measurements in combination with the original input channels, both the input- and feature-level approaches outperform the baseline model. This preliminary study suggests that IST data, in combination with TB measurements, improves predictions where ambiguous textures are present in SAR imagery or PM data is not able to contribute.**

I. Introduction

Diminishing ice extent contributes to increasing variability in Arctic conditions [1], [2]. Consequently, accurate mapping of sea ice cover is necessary to support safe marine navigation for Arctic shipping operations [3]. Further, loss of sea ice cover negatively impacts remote northern communities as reduced ice extent changes regional ecosystems, contributing to food insecurity and loss of traditional practices and culture [4], [5]. The importance of sea ice monitoring for understanding the Arctic's changing climate cannot be undervalued. However, resources such as ice charts, which were developed for marine navigation, are subjective and time- and resource-intensive, prompting interest in higher-resolution automated mapping approaches [6].

Sea ice concentration (SIC) is one important indicator in Arctic monitoring, which drives long-term risk mitigation. Accurate estimates of SIC, which measures the percentage of total ice cover in a region, are sensitive to climate change. Further, high resolution maps of SIC are effective at illustrating the marginal ice zone (MIZ), a transition zone between ice and open water [6]. Algorithm-based SIC products exist, which provide an alternative to ice charts. These include daily mean SIC maps that merge predictions from either thermal-infrared and passive microwave (PM) [7], or optical-thermal and Synthetic Aperture Radar (SAR) data [8]. Additionally, recent advancements in deep learning have demonstrated promising results with U-Net architectures, [9]–[12], and alternative models for fusing remote sensing measurements [13], [14]. These works predominantly use SAR and passive microwave data; however, both present limitations. The high spatial resolution of SAR is sensitive to changes in ice conditions, and unlike optical data its measurements are unobstructed by atmospheric effects and light levels. However, SAR struggles to differentiate between ice and water that exhibit similar roughness, resulting in ambiguous textures, which leads to misclassification [9]. Passive microwave sensors record brightness temperature, which is relevant for estimating SIC [13], [15]–[17]. However, the coarse resolution of these sensors makes them ineffective in regions that require high spatial resolution, such as near land or narrow waterways [18].

This study investigates if incorporating VIIRS thermal-infrared data can enhance SIC predictions in regions that pose challenges for SAR and PM data. We adapt an existing, competitive U-Net architecture by Chen et al. [12], and compare SIC estimates over varied input combinations to quantify the importance of ice surface temperature (IST) for model predictions. Further, we analyze the impacts of fusing IST data at the input- and feature-levels on model accuracy. This work is structured as follows: Section II introduces the U-Net architecture, fusion approaches, and dataset. Section III describes the method of scene selection, co-registration approach, architectures and experiments, and process for evaluation. The results of these experiments are discussed in Section IV in the

979-8-3315-4008-1/24/$31.00 ©2024 IEEE

context of evaluation metrics, analysis of SIC maps, and use of ice chart labels. Finally, conclusions and future work are presented in Section V.

II. Background

Our work improves the multi-task U-Net architecture by Chen et al. [12], which estimates three relevant parameters for sea ice mapping: SIC, stage of development (SOD), and floe size (FLOE). SOD relates to ice age and thickness, while FLOE characterizes the degree of break-up [6]. Combined with SIC, these parameters accurately depict ice conditions. This U-Net architecture won the Artificial Intelligence for Earth Observation (AI4EO) AutoICE Challenge in 2023, achieving the highest overall score (86.39%) and SIC R^2 score (92.02%) [6]. Its performance on the AI4Arctic dataset, introduced below, provides a baseline comparison for SIC maps incorporating VIIRS IST data.

A. U-Nets

U-Net architectures are an extension of fully convolutional networks, which use locally connected layers. The architecture is characterized by its U-shaped structure, which is constructed from encoding and decoding paths, bridged by skip connections. U-Nets are found to outperform convolutional networks on segmentation tasks, particularly in the field of medical imaging [19]. As introduced in Section I, this architecture is increasingly applied to sea ice mapping [9]–[12]. Additionally, works presented in the AI4SeaIce article series establish the basis for the use of U-Nets in the AutoICE challenge [6].

B. Fusion Approaches

In the context of deep learning, data fusion refers to a model combining data from multiple input sources. Chen et al. [12] employs input-level data fusion, where the model combines raw input channels prior to feature selection. Using this approach, the model learns features based on the combined data, which may capture complementary information that cannot be extracted from a single input. Conversely, feature-level fusion combines features learned from separate inputs. This approach is beneficial for fusing inputs from different data sources, allowing the model to better identify salient features. Malmgren-Hansen et al. [13] and Rogers et al. [14] both employ feature-level fusion; each model accepts input channels with different resolutions, which are combined to make pixel-wise predictions.

C. Dataset

This study combines data from the AI4Arctic dataset and the VIIRS IST product. A summary of data used by the models is provided in Table I, corresponding to the input channels from Chen et al. [12], and the VIIRS IST data.

1) AI4Arctic: The AI4Arctic dataset includes SAR imagery and auxiliary data, brightness temperature (TB) measurements, reanalysis data, and ice charts from the Canadian and Greenland Ice Services, which are used as labels [20]. The dataset is comprised of 533 co-registered scenes from January 2018 to December 2021; a preliminary 30-scenes were selected from January 2018 to April 2019 based on compatibility with VIIRS IST data. Sentinel-1 HH and HV, Extra Wide Swath images are noise corrected using the NERSC algorithm [21]. Incidence angle and distance-to-nearest-coast measurements are provided as supporting data. The Advanced Microwave Scanning Radiometer 2 (AMSR2) provides H and V polarized brightness temperature measurements at 6.9, 7.3, 10.65, 18.7, 23.8, 36.5, and 89 GHz. Spatial resolution varies by channel; 6.9 GHz offers the coarsest resolution (48 km), whereas 89 GHz offers the finest resolution (4 km) [22]. The AI4Arctic ready-to-train dataset, used in this study, provides normalized data. Brightness temperature measurements and ERA5 reanalysis data are gridded to a 2 km resolution; numerical weather prediction parameters include 10 m wind speed, 2 m wind temperature, total column water vapor, total column cloud liquid water, and skin temperature. The ice charts, distance maps, and dual polarized SAR images are gridded to 80 m pixel spacing, which is up-sampled from the original SAR resolution of 40 m. Gridded latitude and longitude coordinates, as well as the acquisition date and time, are provided for reference and used as spatial-temporal encodings.

2) VIIRS: The Visible Infrared Imager Radiometer Suite (VIIRS) flies on the Suomi National Polar-Orbiting Partnership

TABLE I
Descriptions of the data types and features used by the baseline architecture from Chen et al. [12], in addition to the VIIRS channel.

Data Type	Feature	Number of Channels
Sentinel-1	Dual-polarized (HH and HV) SAR images	2
	Gridded incidence angle measurements from the instrument to the ground, corresponding to each SAR image	1
	Distance-to-land map indicating the nearest coast, per pixel	1
AMSR2	18.7 and 36.5 GHz H and V brightness temperature measurements	4
ERA5	East and northward 10 m wind speed components	2
	2 m wind temperature	1
	Total column water vapor	1
	Total column cloud liquid water	1
Auxiliary	Gridded Latitude	1
	Gridded Longitude	1
	Acquisition Month	1
VIIRS	Ice surface temperature measurements	1

(SNPP). IST data is available in the form of 6-minute, L2 Swath scenes with a spatial resolution of 750 m. The VIIRS product follows the approach used for MODIS to calculate IST: an algorithm converts VIIRS calibrated radiances from band M15 (10.763 μm) and M16 (12.013 μm) into brightness temperatures and calculates IST using a split-window method [23]. This data is accesible through the VIIRS L1B calibrated radiances product, which is comprised of eleven moderate-resolution refelctive solar bands (M1-M11), and five thermal emissive bands (M12-M16) [24]. IST data is measured in Kelvin; the product also contains flags for features such as land, ocean, and cloud. Targeted uncertainty for this product is ± 1 K over the range of 213-275 K [23]. Flag data is masked by the model, and IST data is normalized using mean and standard deviation.

III. Methodology

In this study, we select and co-register a 30-scene subset of the AI4Arctic dataset, adapt the the U-Net structure from Chen et al. [12] to fuse IST data at the input- and feature-levels, and assess the impacts of IST on model predictions using a combination of quantitative metrics and qualitatitive analysis.

A. Scene Selection and Data Co-Registration

Scene selection criteria include the time between sensor acquisitions, overlap in Sentinel-1 and VIIRS coverage regions, and the percentage of a VIIRS scene that 1.) is unobstructed by cloud cover and 2.) contains IST measurements that register as ice. For each Sentinel-1 scene, the acquisition date and latitude-longitude bounds were extracted; retrieval of the corresponding VIIRS scenes from the National Snow and Ice Data Center (NSIDC) was automated. Scene selection criteria are summarized in Table II. Maximum acquisition window was set in line with the thresholds from Malmgren-Hansen et al. [13] and Rogers et al. [14]. A minimum area of intersection between the Sentinel-1 and VIIRS scenes ensures that sufficient VIIRS IST data would be present in the image, as regions of fill are masked and do not contribute to model predictions. Finally, rough thresholds for the percentage of cloud and ice were defined to filter out inadequate scenes prior to visual analysis. Two IST thresholds were defined: the first because temperatures near to or exceeding 271 K may yield limited useful features [23], and the second to confirm the presence of thicker ice. Visual analysis is required for both criteria because the percentage of cloud or IST present in the region does not consider the distribution of this data (e.g., concentrated regions versus small cloud formations evenly distributed throughout).

The overlapping region of each VIIRS scene is co-registered per pixel with the Sentinel-1 SAR images using a nearest neighbour approach. Viable scenes are selected using the criteria defined above. VIIRS data at coordinates outside of the corresponding Sentinel-1 scene is discarded from the interpolation. A set of latitude-longitude grids are provided, which contain 21x21 coordinates; these grids are up-sampled to match the resolution of the SAR image, and the nearest neighbour algorithm is applied to every coordinate in the Sentinel-1 grid to obtain the co-registered VIIRS scene. This approach allows for custom nearest neighbour criteria, differentiating between IST data, flags, and coordinates that exceed the bounds of the Sentinel-1 scene. In each trial, a 70:15:15 split is used for the train, test, and validation datasets, which achieves even spatial-temporal representation. This study reports cross validation results; thus, the scenes are labelled as belonging to either the train or test dataset in Figure 1. Scene acquisition months are summarized in Table III.

TABLE II
Summary of criteria used in evaluating VIIRS data.

Criterion	Condition
Acquisition Date	Same day
Period between Sentinel-1 and VIIRS Acquisitions	$\leq$ 8 hours
Overlap between Sentinel-1 and VIIRS Scenes	$\geq$ 75% of the Sentinel-1 scene
Percentage of Cloud Cover in VIIRS Scene	$\leq$ 50%; visual analysis
Range of IST Values in VIIRS Scene	$\geq$ 50% below 271 K; $\geq$ 15% below 260 K; visual analysis

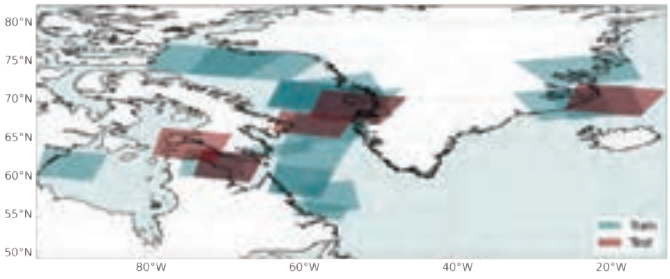


Fig. 1. Coverage region for the 30-scene dataset. Scenes primarily cover the Eastern Arctic, Newfoundland, and Central West and Northwest Greenland. However, scenes are also representative of conditions in the Foxe Basin, Qaanaaq, and Southeast and Central East Greenland. All scenes in the test set overlap–either partially or fully–with the train dataset.

B. Architecture

We assess the impacts of IST data on SIC predictions using both input- and feature-level data fusion. The baseline U-Net architecture features four sets of encoder and decoder blocks. SOD and FLOE are treated as a classification using cross-entropy (CE) loss, where the output of the final decoder block is fed into separate 1x1 convolution layers with output channels corresponding to the number of discrete classes. Concurrently, SIC, measured using the R^2 score, is treated as a regression. The decoder output is fed into a regression layer and mean squared error (MSE) loss is used. Use of down-scaling and patches in training improves model predictions due to the resultant, larger receptive field. This approach broadly captures a scene's contextual information, improving predictions that are scored against coarse, polygon-based ice chart

TABLE III
SUMMARY OF ACQUISITION MONTHS FOR THE 30-SCENE DATASET. SCENES FROM JUNE TO OCTOBER WERE OMITTED DUE TO EXTENSIVE CLOUD COVER AND LIMITED AVAILABILITY, WHICH WOULD INCREASE TEMPORAL SPARSITY.

Year	Month	Number of Scenes
2018	January	2
	February	1
	March	3
	April	1
	May	1
	November	1
	December	6
2019	January	6
	February	2
	March	4
	April	3

labels. The architecture is summarized, in full, in Table IV. [12]

TABLE IV
SUMMARY OF THE OPTIMIZED ARCHITECTURE AS DEFINED IN CHEN ET AL. [12]. THE ORIGINAL PAPER TRAINED THE MODEL FOR 300 TOTAL EPOCHS; HOWEVER, THIS WAS REDUCED TO DECREASE TRAINING TIME.

Model Specification	Details
Optimizer	Stochastic Gradient Descent with Momentum
Learning Rate	0.001
Weight Decay Coefficient	0.01
Batch Size	16
Iterations per Epoch	500
Total Epochs	100
Learning Rate Scheduler	Cosine Annealing (CA)
CA Epochs till Restart	20
Down-scaling Factor	10
Data Augmentation Operations	Rotation, flip, random scale, cutmix
Patch Size	256
Loss Functions	SIC: MSE, SOD and FLOE: CE

Input-level fusion appends VIIRS IST as an additional channel in this architecture, whereas feature-level fusion concatenates features learned from IST with those learned from the other features after they have been processed by the U-Net. In the feature-level fusion, IST data is fed separately through a double convolutional block, which is the same structure used by Chen et al. [12] in their encoder and decoder blocks. These architectures are illustrated in Figure 2.

Six combinations of the 17 input channels (Tabel I) are tested to quantify the impacts of VIIRS IST data on model predictions, and to compare the relative importance of the input types. These experiments are summarized in Table V. Exp_i_baseline establishes the accuracy of the winning AutoICE model when using this study's 30-scene dataset. Exp_i_no_amsr compares the baseline architecture using VIIRS IST in place of AMSR2 brightness temperature, while Exp_i_no_amsr_no_viirs omits both data types to establish the importance of each input channel in combination with SAR. Exp_i_all_inputs includes all baseline input channels, in addition to VIIRS IST. Exp_f_all_inputs and Exp_f_no_amsr follow the same convention; however, VIIRS IST enters a separate double convolutional block, and is fused with the remaining channels after the U-Net. The ERA5 and auxiliary input channels are used across all trials to restrict the number of input channel combinations. All experiments are conducted using an NVIDIA Tesla V100-SXM2-32GB GPU, 128 GB of memory, and Pytorch version 2.0.1 with CUDA 11.8. These resources are accessed using the Cedar cluster, supported by the Digital Research Alliance of Canada.

C. Evaluation

The AutoICE challenge evaluated model accuracy using the coefficient of determination (R^2 score) for SIC, and the F1 score for SOD and FLOE. A combined score for performance across these metrics was developed, which assigns higher weighting to SIC and SOD (2/5) than FLOE (1/5). R^2 is used as the metric for SIC because it accounts for relative proximity between target and predicted classes. SIC is reported as 11 classes, discretizing concentrations linearly in tenths from 0 to 100% ice coverage. Conversely, the F1 score is a measure of predictive performance, and accounts for imbalances between the number of pixels belonging to each sea ice class. SOD predictions are classified as either open-water or five stages of ice age, while FLOE predictions classify polygons as either open-water or six classes of FLOE size. The F1 score is used because unlike SIC, classifications for SOD and FLOE are not ordered. [6]

In this study, we only evaluate the impacts of IST on SIC. SOD, FLOE, and combined scores are reported in the appendix (Section VI) because the baseline model predicts all three parameters. Thus, weights corresponding to SOD and FLOE, which are backpropagated, may impact SIC predictions. Chen et al. [12] found that use of spatial-temporal encodings improved the accuracy of SOD predictions. Here, the reduced size of the 30-scene dataset is sparse in space and time, therefore the spatial-temporal encodings provide limited context. Additionally, the baseline model reported a low overall FLOE accuracy of 70.70% [6]; because the intent of this study is to compare use of IST to the baseline, the architecture was not optimized to improve the F1 score for FLOE. In addition to the evaluation metrics, the model also produces a set of sea ice maps, which are compared to the ground truth sea ice charts at 80-meter pixel spacing, per scene in the test and validation sets.

Evaluation metrics are reported as the average result of holdout cross-validation. The 30-scene dataset is split into a 25-scene train dataset and a 5-scene test dataset. Each run, five scenes from the train dataset are assigned to validation, and this process is repeated five times for each experiment, which obtains the average result across the train dataset.

IV. RESULTS AND DISCUSSION

The performance of each model is reported in Table V, while Figures 3, 5, and 6 compare predictions across experiments for three of the five test scenes. Overall, the results

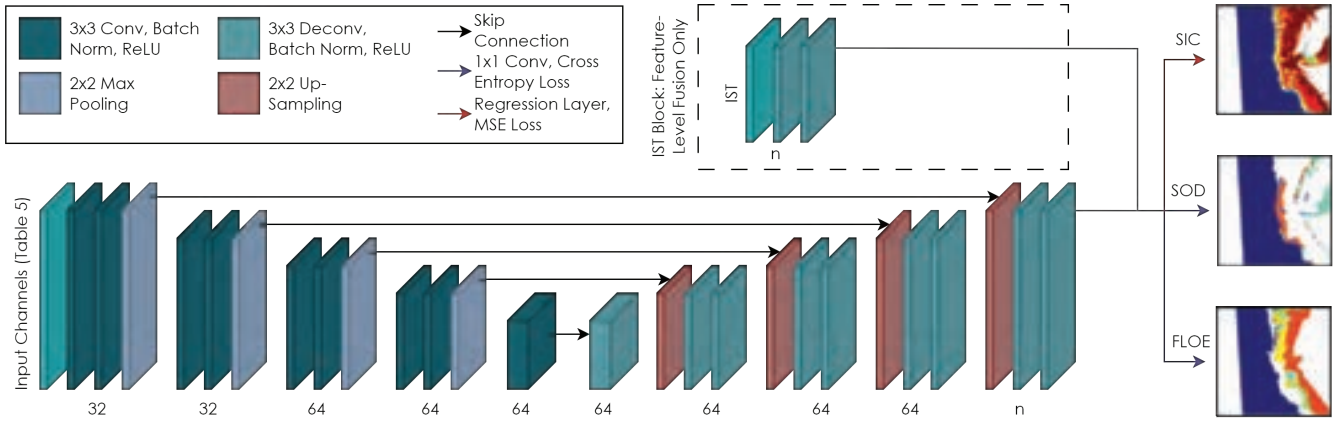


Fig. 2. Comparison of the input- and feature-level fusion architectures. The double convolutional block used in feature-level fusion of IST is boxed, and features learned from IST are fused with features learned from the AI4Arctic channels after the U-Net. n = 32 for input-level fusion, while n = 16 for feature-level fusion.

TABLE V
SUMMARY OF INPUT CHANNELS AND SIC R^2 SCORES, BY EXPERIMENT, CORRESPONDING TO 25 VALIDATION AND 5 TEST SCENES. METRICS ARE REPORTED AS THE MEAN CROSS-VALIDATION SCORE ± THE STANDARD DEVIATION. SCENES CONTAINING A LOWER PERCENTAGE OF IST DATA (I.E., GREATER CLOUD COVERAGE OR LOWER OVERLAP WITH SENTINEL-1) WERE ASSIGNED TO THE VALIDATION SET, WHICH IMPACTS SCORES AND STANDARD DEVIATION.

Experiment Name	Data	Channels	Validation R^2 [%]	Test R^2 [%]
Exp_i_baseline	**U-Net:** Sentinel-1, AMSR2, ERA5, Aux.	16	88.95 ± 1.60	93.14 ± 3.18
Exp_i_all_inputs	**U-Net:** Sentinel-1, AMSR2, ERA5, Aux., VIIRS	17	**89.73 ± 2.41**	**95.31 ± 0.85**
Exp_i_no_amsr	**U-Net:** Sentinel-1, ERA5, Aux., VIIRS	13	79.20 ± 11.03	93.68 ± 1.79
Exp_i_no_amsr_no_viirs	**U-Net:** Sentinel-1, ERA5, Aux.	12	77.92 ± 12.04	88.24 ± 1.98
Exp_f_all_inputs	**U-Net:** Sentinel-1, AMSR2, ERA5, Aux. **DConv:** VIIRS	17	89.18 ± 2.21	94.68 ± 1.23
Exp_f_no_amsr	**U-Net:** Sentinel-1, ERA5, Aux. **DConv:** VIIRS	13	76.03 ± 12.06	90.32 ± 5.47

demonstrate that use of IST data, in combination with input channels from the AI4Arctic dataset, outperforms the baseline model. Exp_i_all_inputs achieves the highest R^2 score (95.31%), while Exp_f_all_inputs reports a comparable, but lower accuracy of 94.68%. Notably, input-level fusion of IST without brightness temperature (Exp_i_no_amsr) marginally outperforms the baseline model. Lastly, fusion of Sentinel-1 data with only the ERA5 and auxiliary channels achieves the lowest R^2 score across all experiments. Results across the validation set report lower overall accuracy but exhibit the same general trends. These scores are attributed to the distribution of scenes across the train and test datasets. Specifically, there is a higher percentage of scenes with a lower percent overlap or higher percent cloud cover (Table II) in the train dataset, which reduces the amount of IST data present in the scene.

A. *Predicted SIC Maps*

Figures 3, 5, and 6 contrast model performance across varied ice conditions. Figure 3 features a MIZ, and includes mixed ice conditions in the tributaries and inland regions. Figure 5 is in part a MIZ, which contains polygons with mixed SICs. Both scenes include large regions of open water. Lastly, Figure 6 assesses the model's ability to predict full ice cover.

1) January 22, 2018: Exp_i_all_inputs best captures the shape of the marginal ice zone in Figure 3 (b). In contrast, Exp_f_all_inputs (e) overestimates the region of 90% SIC, and predicts a MIZ comprised of bands of discrete concentrations, which decrease in the direction of the open-water region. Both models eliminate the incorrect region of mid-range concentrations, which is reported by the baseline (boxed in (a)). Models without AMSR2 (Figure 3 (c), (d), and (f)) achieve worse predictions, particularly in the channel between the island and peninsula, and in the tributaries. This behaviour is attributed to wind roughening in the SAR images, seen boxed in the top row of Figure 3, which the models mistake for ice when AMSR2 data is omitted. IST data is relevant for ice, not open water. Further, analysis of this data (Figure 4) illustrates two facts: 1.) mid-range concentrations in the ice chart are represented as mixed-pixel regions of high and low IST, which do not reflect the same variation in SIC, and 2.) the resolution of the VIIRS product is still too large to capture the smallest tributaries, causing the model to rely on the ambiguous SAR data. Thus, TB measurements, while inaccurate near land, allow models to learn the blurry pattern of water and ice in regions where SAR textures are ambiguous. However, comparing input- and feature-level fusion without TB (Figure 3 (c) and (f)) to Figure 3 (d), which uses neither AMSR2 nor VIIRS, IST data is seen to improve predictions even in the absence of TB measurements. This result is significant; comparing Exp_i_no_amsr and Exp_i_no_amsr_no_viirs

(Table V), there is a 5.98% improvement in accuracy. Here, the higher resolution IST data still improves predictions at the mouths of the tributaries and in the channel relative to (d), where ambiguous SAR texture leads to incorrectly predicted ice cover in the scene.

2) January 5, 2019: Comparing the SIC maps in Figure 5, all models report a gradual transition between SIC classes, estimating mid-range concentrations where the ice charts report discrete classes. Because ice charts report SIC over a polygonal region and lack pixel-level detail, it is unclear if the models incorrectly predict these regions. Despite this limitation, the scene still provides relevant context on the use of IST data by the two fusion approaches. The feature-level fusion approaches (Figure 5 (e) and (f)) predict greater variability in higher concentrations, impacting R^2. Conversely, input-level fusion learns complimentary features between IST and the lower resolution TB data (Figure 5 (a) and (b)), reducing the amount of predicted 100% SIC. Notably, the feature-level fusion best approximates open water; Exp_i_all_inputs and Exp_i_baseline both predict scattered regions of 10% concentration, which is underrepresented in the dataset. Finally, Exp_i_no_amsr_no_viirs produces the smoothest MIZ boundary (boxed in (d)), modelling the feature present in the HH SAR imagery.

3) December 13, 2018: Unlike the previous scenes, the entirety of Figure 6 is classified as full ice cover. Here, brightness temperature measurements improve predictions across both fusion approaches. Analysis of the SIC maps in (b) and (e) suggests that Exp_f_all_inputs more accurately reports full ice cover, producing a comparable prediction to Exp_i_baseline. In comparison, Exp_i_all_inputs learns the dark feature–either open water or thin ice–present in the SAR imagery as a region of lower concentration due to complementary patterns in the IST measurements.

B. Comparison of Input- and Feature-level Fusion

Overall, Exp_i_all_inputs achieves the highest R^2 score, best capturing the shape of the marginal ice zone, and outperforming Exp_i_baseline. Exp_f_all_inputs reports comparable R^2, and analysis of the SIC maps suggests that this model most accurately reports full ice cover and open water. However, relative to the ice charts, feature-level fusion of IST over-reports variability in SIC, impacting R^2. With input-level fusion, the model learns features from the combined channels, capturing complementary information that better estimates the polygonal regions of the ice charts. Across the two approaches, use of IST in combination with TB measurements consistently improves predictive accuracy, and produces less variation between scene scores. The larger standard deviations in the validation scores are attributed to the set containing a wider range of scenes, with a higher percentage of missing IST data. Ultimately, relying on ice charts alone to assess the quality of predictions made on finer resolution data presents limitations. While Exp_i_all_inputs performed best overall, alternative labels are required to assess which fusion approach more accurately reflects real ice conditions. Beginning work to address this limitation is discussed in the following section.

C. Pixel-wise SIC Labels

We investigated using pixel-wise SIC estimates, derived from the VIIRS Level-1B calibrated radiances (VNP02MOD [24]) and Level-1 terrain corrected geolocation (VNP03MOD [25]) products. Following the method presented by Kern et al. [26], top of atmosphere reflectance data from three reflective solar bands (M4, M5, and M7) is used to calculate surface albedo. From these measurements, surface broadband shortwave albedo is estimated using the channel bandwidths as weights. Thresholds from Kern et al. [26] are applied to classify pixels as open water or ice. Finally, SIC maps are generated at 12.5 km resolution, matching PM products, by summing gridded regions of ice-classified 750 m pixels. A visual comparison of preliminary SIC maps was conducted against University of Bremen ice concentration data, [27], to verify this approach.

An example scene is provided in Figure 7. Land is masked, and SIC estimates are rounded to the nearest tenth to match the existing classes. Because the 30-scene dataset is predominantly sampled from December to April, when daylight hours are reduced, a preliminary search found few scenes for comparison within our dataset. As additional scenes are added, this will increase the percentage of scenes with daylight acquisition periods that overlap with the AI4Arctic dataset. Future work will adapt the model to accept pixel-wise SIC labels derived using this process. Currently, the models accept pixel-wise labels, but each label is assigned as the SIC reported in its polygon, instead of the SIC at that location. This new data can be used to evaluate models that predict only SIC, or can be co-registered with the existing ice charts for use in the multi-task framework. Following additional analysis, these labels could provide an improved method of evaluating the fusion approaches presented above.

V. Conclusion

This study investigates the use of VIIRS IST measurements as a method for improving SIC predictions in regions that present challenges for the use of SAR and passive microwave data. Work builds on a competitive, multi-task U-Net architecture, which won the AI4EO AutoICE Challenge in 2023. The study uses a 30-scene subset of the AI4Arctic dataset, which is fused with VIIRS IST measurements using input- and feature-level data fusion approaches. Compatible VIIRS scenes are selected based on a set of established criteria, and the data is co-registered with Sentinel-1 SAR imagery using a nearest neighbour approach. The input-level architecture concatenates VIIRS IST with the AI4Arctic dataset, and all input channels are fed into the U-Net. The feature-level architecture fuses VIIRS IST with the remaining inputs after the U-Net architecture; IST features are extracted using a separate double convolutional block. Experimental trials evaluate the two approaches using six combinations of input channels, and the winning AutoICE model is used as a baseline to quantify

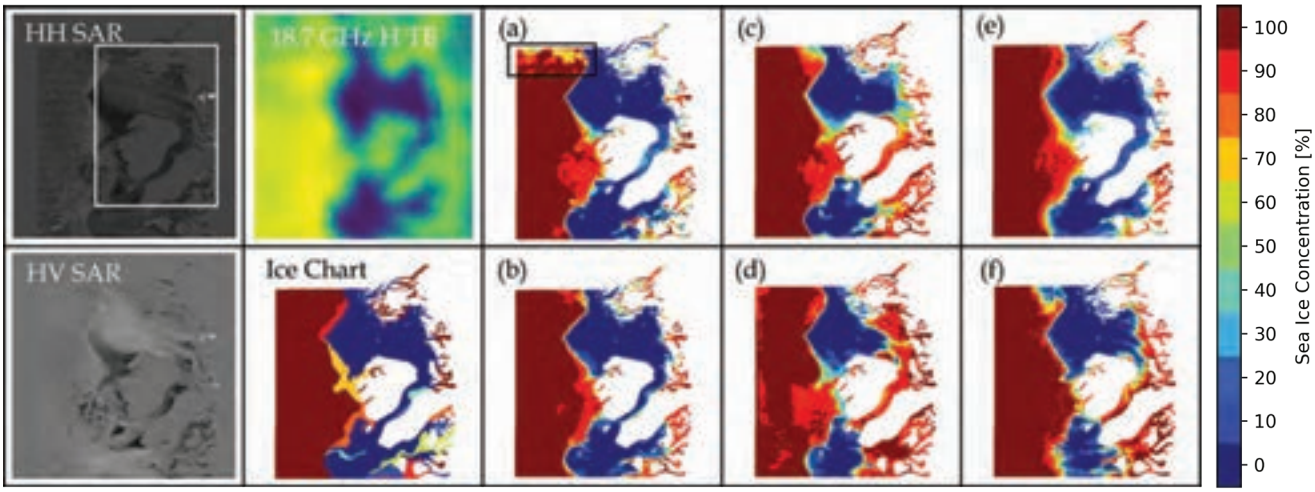


Fig. 3. Predicted SIC maps by model, compared to the HH/HV-polarized SAR scene, 18.7GHz H-polarized TB measurements, and corresponding ice chart for 2018-01-22 on the west coast of Greenland. Boxes denote regions and features of interest, which are referenced in Section IV. Model predictions are presented in the following order: (a) Exp_i_baseline, (b) Exp_i_all_inputs, (c) Exp_i_no_amsr, (d) Exp_i_no_amsr_no_viirs, (e) Exp_f_all_inputs, (f) Exp_f_no_amsr.

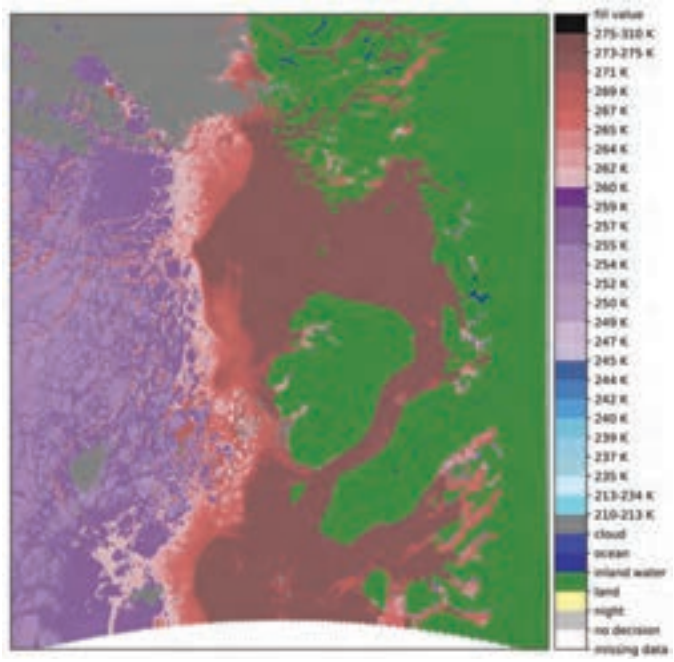


Fig. 4. VIIRS IST data corresponding to the 01-22-2018 scene (Figure 3) on the west coast of Greenland.

the impacts of IST data on model performance. Results are reported in terms of R^2 score, which measures SIC accuracy. Visual analyis of the predicted SIC maps are also compared to ice chart labels.

Overall, use of IST data in combination with TB outperforms the competitive baseline model, improving predictions in regions where ambiguous textures are present in the SAR image. Further, even though this work uses a sparser dataset than the AutoICE challenge, both the input- and feature-level fusions of IST achieve more accurate SIC predictions than the original study, and the baseline using this dataset. Input-level fusion of IST with the baseline input channels achieves the highest accuracy. Feature-level fusion, which best predicts open-water and full ice cover, overestimates variability in SIC relative to the ice charts, ultimately impacting R^2. Predictions may further improve with a larger dataset, where the model can better leverage other input features, such as spatial-temporal encodings.

Future work will expand the dataset to address spatial-temporal sparsity, and increase the percentage of IST measurements per scene. Additionally, preliminary findings on the use of VIIRS reflectance data to derive pixel-level labels of SIC will be incorporated in the architecture, addressing the limitations presented by ice chart labels. These promising preliminary findings motivate further study of the use of thermal-infrared data in sea ice mapping.

ACKNOWLEDGMENT

We gratefully acknowledge the generous support of the OCEANS 2024 Halifax conference organizers, Marine Technology Society, and IEEE Oceanic Engineering Society, as well as the Office of Naval Research in providing a grant for conference attendance. Additionally, we acknowledge the AI4Arctic dataset authors and NASA's Level-1 and Atmosphere Archive & Distribution System (LAADS) and National Snow and Ice Data Center (NSIDC) for providing access to the data used in this study. As well, we thank the University of Waterloo AutoICE team for providing access to the baseline model. Funding and compute resources are generously provided by Environment and Climate Change Canada and the Digital Research Alliance of Canada, respectively. This research is supported by the Vector Scholarship in Artificial Intelligence, provided through the Vector Institute. We also acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC) and the University of Waterloo.

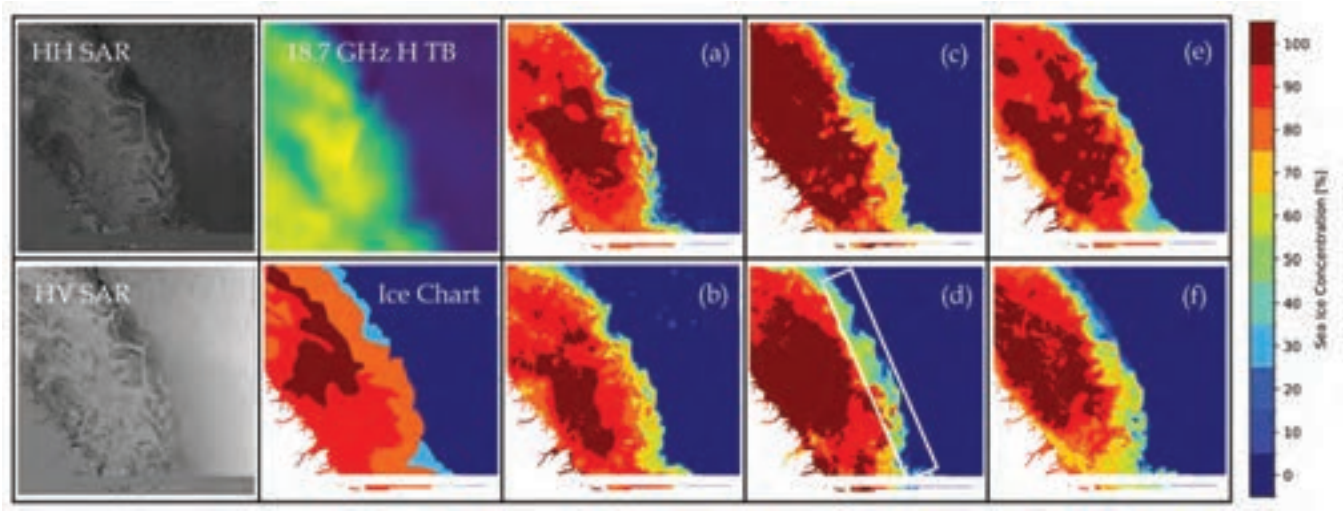


Fig. 5. Predicted SIC maps by model, compared to the HH/HV-polarized SAR scene, 18.7GHz H-polarized TB measurements, and corresponding ice chart for 2019-01-05 on the northern coast of Quebec, CA, along the Laborador Sea. Boxes denote regions and features of interest, which are referenced in Section IV. Model predictions are presented in the following order: (a) Exp_i_baseline, (b) Exp_i_all_inputs, (c) Exp_i_no_amsr, (d) Exp_i_no_amsr_no_viirs, (e) Exp_f_all_inputs, (f) Exp_f_no_amsr.

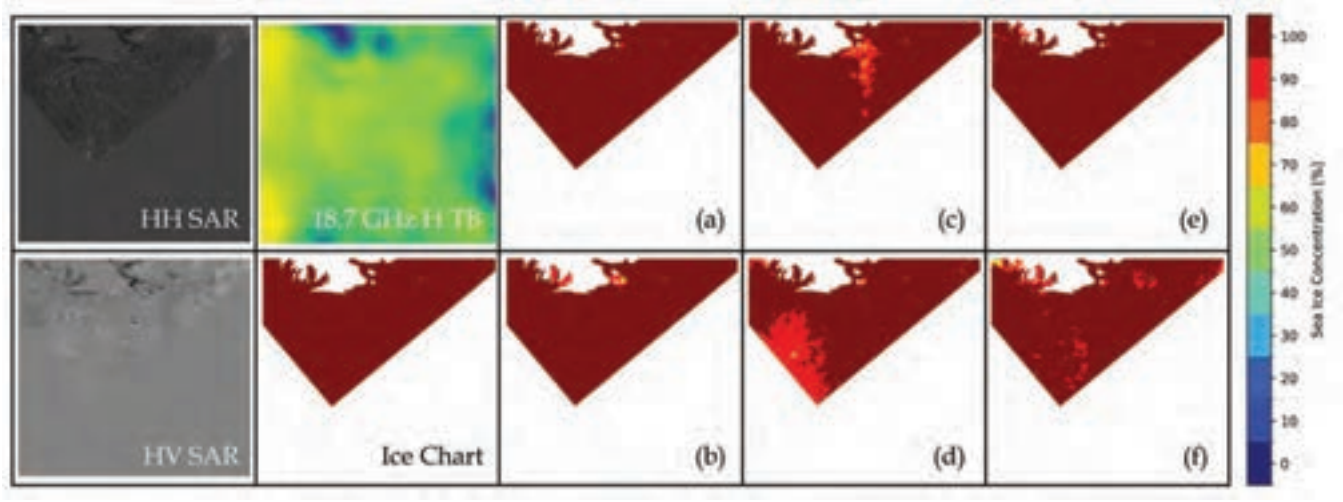


Fig. 6. Predicted SIC maps by model, compared to the HH/HV-polarized SAR scene, 18.7GHz H-polarized TB measurements, and corresponding ice chart for 2019-12-13 along the west coast of Greenland. Model predictions are presented in the following order: (a) Exp_i_baseline, (b) Exp_i_all_inputs, (c) Exp_i_no_amsr, (d) Exp_i_no_amsr_no_viirs, (e) Exp_f_all_inputs, (f) Exp_f_no_amsr.

REFERENCES

[1] W. Meier et al., "Sea Ice: Arctic Report Card 2023," National Oceanic and Atmospheric Administration, Tech. Rep., 2023, doi: 10.25923/f5t4-b865.

[2] G. Boutin, T. Williams, P. Rampal, E. Olason, and C. Lique, "Impact of wave-induced sea ice fragmentation on sea ice dynamics in the MIZ," *EGU General Assembly 2020*, May 2020, doi: 10.5194/egusphere-egu2020-8657.

[3] N. Melia, K. Haines, and E. Hawkins, "Sea ice decline and 21st century trans-Arctic shipping routes," *Geophyical Ressearch Letters*, vol. 43, no. 18, pp. 9720–9728, 2016, doi: 10.1002/2016GL069315.

[4] N. Asadi, P. Lamontagne, M. King, M. Richard, and K. Scott, "Probabilistic spatiotemporal seasonal sea ice presence forecasting using sequence-to-sequence learning and ERA5 data in the Hudson Bay region," *The Cryosphere*, vol. 16, no. 9, pp. 3753–3773, 2022, doi: 10.5194/tc-16-3753-2022.

[5] J. Ford, W. Gough, G. Laidler, J. MacDonald, C. Irngaut, and K. Qrunnut, "Sea ice, climate change, and community vulnerability in northern Foxe Basin, Canada," *Climate Research*, vol. 38, no. 2, pp. 137–154, 2009, doi: 10.3354/cr00777.

[6] A. R. Stokholm et al., "The AutoICE Challenge," *EGUsphere [preprint]*, 2023, doi: 10.5194/egusphere-2023-2648.

[7] V. Ludwig, G. Spreen, and L. Pedersen, "Evaluation of a New Merged Sea-Ice Concentration Dataset at 1 km Resolution from Thermal Infrared and Passive Microwave Satellite Data in the Arctic," *Remote Sensing*, vol. 12, no. 19, 2020, doi: 10.3390/rs12193183.

[8] C. König, T. König, S. Singha, A. Frost, and S. Jacobsen, "Combined Use of Space Borne Optical and SAR Data to Improve Knowledge about Sea Ice for Shipping," *Remote Sensing*, vol. 13, no. 23, 2021, doi: 10.3390/rs13234842.

[9] K. Radhakrishnan, K. A. Scott, and D. A. Clausi, "Sea Ice Concentration Estimation: Using Passive Microwave and SAR Data With a U-Net and Curriculum Learning," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 14, pp. 5339–5351, 2021, doi: 10.1109/JSTARS.2021.3076109.

[10] Y. Wang and X. Li, "Arctic sea ice cover data from spaceborne synthetic

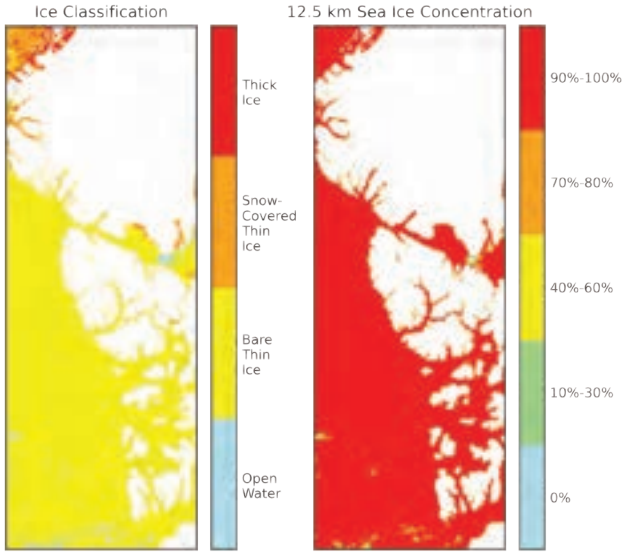


Fig. 7. Example sea ice classification (left) and SIC labels (right) for 2018-05-02, encompassing the top of Greenland and Ellesmere Island.

aperture radar by deep learning," *Earth System Science Data*, vol. 13, no. 6, pp. 2723–2742, 2021, doi: 10.5194/essd-13-2723-2021.

[11] A. Stokholm, T. Wulf, A. Kucik, R. Saldo, J. Buus-Hinkler, and S. M. Hvidegaard, "AI4SeaIce: Toward Solving Ambiguous SAR Textures in Convolutional Neural Networks for Automatic Sea Ice Concentration Charting," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1–13, 2022, doi: 10.1109/TGRS.2022.3149323.

[12] X. Chen et al., "MMSeaIce: Multi-task Mapping of Sea Ice Parameters from AI4Arctic Sea Ice Challenge Dataset," *EGUsphere*, 2023, doi: 10.5194/egusphere-2023-1297.

[13] D. Malmgren-Hansen et al., "A Convolutional Neural Network Architecture for Sentinel-1 and AMSR2 Data Fusion," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 59, no. 3, pp. 1890–1902, 2021, doi: 10.1109/TGRS.2020.3004539.

[14] M. Rogers, M. Fox, A. Fleming, L. van Zeeland, J. Wilkinson, and J. Hosking, "Sea ice detection using concurrent multispectral and synthetic aperture radar imagery," *Remote Sensing of Environment*, vol. 305, 2024, doi: 10.1016/j.rse.2024.114073.

[15] J. Chi, H. Kim, S. Lee, and M. Crawford, "Deep learning based retrieval algorithm for Arctic sea ice concentration from AMSR2 passive microwave and MODIS optical data," *Remote Sensing of Environment*, vol. 231, 2019, doi: 10.1016/j.rse.2019.05.023.

[16] T. Feng, X. Liu, and R. Li, "Super-Resolution-Aided Sea Ice Concentration Estimation From AMSR2 Images by Encoder–Decoder Networks With Atrous Convolution," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 16, pp. 962–973, 2023, doi: 10.1109/JSTARS.2022.3232533.

[17] Q. Liu, R. Zhang, Y. Wang, H. Yan, J. Xu, and Y. Guo, "Short-term Forecasting of Sea Ice Thickness Based on PredRNN++," *Journal of Physics: Conference Series*, vol. 2486, no. 1, 2023, doi: 10.1088/1742-6596/2486/1/012017.

[18] W. Meier and J. Stewart, "Assessing the Potential of Enhanced Resolution Gridded Passive Microwave Brightness Temperatures for Retrieval of Sea Ice Parameters," *Remote Sensing*, vol. 12, no. 16, 2020, doi: 10.3390/rs12162552.

[19] O. Ronneberger, P. Fischer, and T. Brox, "U-Net: Convolutional Networks for Biomedical Image Segmentation," *arXiv*, 2015, doi: 10.48550/arXiv.1505.04597.

[20] J. Buus-Hinkler et al., "Ready-To-Train AI4Arctic Sea Ice Challenge Dataset," 11 2022, doi: 10.11583/DTU.21316608.v3.

[21] A. Korosov, D. Demchev, N. Miranda, N. Franceschi, and J.-W. Park, "Thermal Denoising of Cross-Polarized Sentinel-1 Data in Interferometric and Extra Wide Swath Modes," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1–11, 2022, doi: 10.1109/TGRS.2021.3131036.

[22] C. Soriot, C. Prigent, C. Jimenez, and F. Frappart, "Arctic Sea Ice Thickness Estimation From Passive Microwave Satellite Observations Between 1.4 and 36 GHz," *Earth and Space Science*, vol. 10, no. 2, 2023, doi: 10.1029/2022EA002542.

[23] M. Tschudi, G. Riggs, D. K. Hall, and M. O. Román, "VIIRS/NPP Ice Surface Temperature 6-Min L2 Swath 750m, Version 1," NASA National Snow and Ice Data Center Distributed Active Archive Center, 2017, doi: 10.5067/VIIRS/VNP30.001.

[24] R. Wolfe, G. Lin, P. Zhang, J. Dellomo, and B. Tan, "VIIRS/NPP Moderate Resolution 6-Min L1B Swath 750m, Version 2," NASA Level-1 and Atmosphere Archive & Distribution System Distributed Active Archive Center, 2022, doi: 10.5067/VIIRS/VNP02MOD.002.

[25] ——, "VIIRS/NPP Moderate Resolution Terrain-Corrected Geolocation 6-Min L1 Swath 750m, Version 2," NASA Level-1 and Atmosphere Archive & Distribution System Distributed Active Archive Center, 2022, doi: 10.5067/VIIRS/VNP03MOD.002.

[26] S. Kern et al., "Satellite passive microwave sea-ice concentration data set intercomparison using Landsat data," *The Cryosphere*, vol. 16, no. 1, pp. 349–378, 2022, doi: 10.5194/tc-16-349-2022.

[27] C. Melsheimer and G. Spreen, "AMSR2 ASI sea ice concentration data, Arctic, version 5.4 (NetCDF) (July 2012 - December 2018)," 2019, doi: 10.1594/PANGAEA.898399.

VI. Appendix

TABLE VI
SUMMARY OF EVALUATION SCORES ACROSS THE VALIDATION SET, BY EXPERIMENT. METRICS ARE REPORTED AS THE MEAN CROSS-VALIDATION SCORE ± THE STANDARD DEVIATION.

Experiment	Combined	SOD F1	FLOE F1
Exp_i_baseline	82.98 ± 6.88	80.47 ± 10.11	76.06 ± 12.06
Exp_i_all_inputs	81.70 ± 6.61	78.86 ± 7.63	74.55 ± 18.16
Exp_i_no_amsr	74.24 ± 10.60	70.18 ± 10.91	72.43 ± 13.25
Exp_i_no_amsr_no_viirs	74.61 ± 9.90	74.81 ± 10.49	67.56 ± 10.85
Exp_f_all_inputs	82.28 ± 6.33	77.48 ± 8.35	78.10 ± 13.25
Exp_f_no_amsr	72.71 ± 11.49	69.24 ± 12.46	73.03 ± 14.48

TABLE VII
SUMMARY OF EVALUATION SCORES ACROSS THE TEST SET, BY EXPERIMENT. METRICS ARE REPORTED AS THE MEAN CROSS-VALIDATION SCORE ± THE STANDARD DEVIATION.

Experiment	Combined	SOD F1	FLOE F1
Exp_i_baseline	72.51 ± 2.47	52.16 ± 4.36	71.96 ± 5.19
Exp_i_all_inputs	75.42 ± 2.91	57.64 ± 5.53	71.23 ± 7.92
Exp_i_no_amsr	69.58 ± 2.23	45.89 ± 4.57	68.78 ± 4.93
Exp_i_no_amsr_no_viirs	65.94 ± 1.11	43.40 ± 2.97	66.41 ± 2.50
Exp_f_all_inputs	72.89 ± 4.01	50.64 ± 9.19	73.81 ± 5.18
Exp_f_no_amsr	68.67 ± 4.92	46.15 ± 8.99	70.37 ± 7.50


16-19 JUNE 2025
Le Quartz Congress Centre Brest France
OCEANS
CONFERENCE & EXPOSITION
OCEANS 2025 BREST
OCEANS: INFINITY IS THE LIMIT
OCEANS: INFINITY IS THE LIMIT
IEEE Oceanic Engineering Society
MTS
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Graphic Design: severinechaussy.com

OCEANS Conference

The **OCEANS Conference** is a major forum for scientists, engineers and end-users throughout the world for presenting the latest research results, ideas, developments and applications in all areas of Oceanic Engineering systems.

OCEANS 2025 Brest program will be built around the theme "**Oceans: Infinity is the Limit**", with an emphasis on the impact of climate change in the oceans and from the oceans. The technical sessions will provide a review of recent advances in oceanic engineering, science and technology.

OCEANS 2025 Brest will comprise both a SCIENTIFIC CONFERENCE (oral and poster presentations) and a large State of the Art EXHIBITION in the field of **Engineering and Marine Technology**. Both will take place in the Brest downtown cozy conference center "Le Quartz".

Local Organizing Committee

General Chair
René Garello
IMT Atlantique / IEEE OES

Honorary co-chair
Christophe Lerouge
Director IMT Atlantique

Technical Chair
Christophe Laot
IMT Atlantique

Co-chairs
Jérôme Mars *(GIPSA-Lab, Université Grenoble Alpes)*
Isabelle Quidu *(ENSTA Bretagne)*

Treasurer
Pascal Lorenz
IEEE France

Exhibit Chair
Céline Liret
Scientific Director, Oceanopolis, Brest

Student & Student Posters & Posters
Frédéric Maussang *(IMT Atlantique)*
Pierre-Jean Bouvet *(ISEN Brest)*

Tutorial Chair
Julien Bonnel
Woods Hole Oceanographic Institution / IEEE OES

Local Arrangement
Olivia Lahens
Technopôle Brest-Iroise

Conference Center
Clémentine Floch
Brest'Aim Events - Le Quartz Congrès

City of Brest

Brest in Finistère, Pen Ar Bed, the beginning of the world: steep cliffs, long sandy beaches, sharp reefs and the blue of Armor ("land of the Sea"), the hills and green of Argoat ("land of the Woods").

Brest in Brittany, a rich heritage of Breton culture: language, music, dance and a "spirit" – open to the world, curious about others and willing to share its wealth and diversity.

Brest's geographical location, combined with the know-how of local companies, research institutes and a strong oceanographic tradition have all made Brest a focal point of excellence regarding the ocean. This location reinforces, both nationally and internationally, the strong position held by Brest and its region in:

OCEANS 2025 BREST Emphasis
> Environmental Engineering,
> Energy from the Oceans,
> Digital Ocean,
> Industrial activities related to the ocean

Contact: r.garello@ieee.org
https://brest25.oceansconference.org


OES
IEEE Oceanic
Engineering Society
SUMMER
SCHOOL
An initiative poised to enrich the academic and professional journey of graduate students and early-career professionals in the realm of oceanic engineering
When : June 20-21, 2025 (Immediately after OCEANS Brest)
Where: Pôle Numérique Brest Iroise
REGISTRATIONS OPEN SOON
FREE
1.2 Radio oceanography

Who's Who in the IEEE OES

Dana Yoerger, Senior Scientist Dept of Applied Ocean Physics and Engineering, Woods Hole Oceanographic Institution

I was born in Massachusetts, USA, and we moved to Maryland when I was young. I got an excellent education and was active in music and sports. My parents, Roy and Patricia, along with my teachers deserve much credit for my success.

I can recall one event that shaped my life. I was in 8th grade and brought home a mediocre report card. Additionally, my teacher had given me a grade of unsatisfactory in something called "homeroom cooperation." My mother knew precisely what that meant: I was not giving my studies the attention they deserved. She said in a calm, measured voice: "you have lots of ability and you have opportunities your father and I never had. Are you going to take advantage of that or not?". That challenge from my mother turned my life around.

I spent a year in Belgium as an exchange student, hosted by the Turksin family. After that, I began my academic career at the Massachusetts Institute of Technology (MIT), where I majored in Mechanical Engineering. I really enjoyed the MIT environment, and the friends I made in my undergraduate days are still a big part of my life 50 years later. In my graduate work, I concentrated on control systems, particularly those operated jointly by people and computers. My mentor, Prof. Thomas Sheridan, a pioneer in the field, was an excellent advisor. We were trying to understand how people and underwater robots could work together. I also benefited from time spent at the Naval Ocean Systems Center, where I was tutored by experienced ocean engineers.

After completing my PhD, I was working as a post-doc in Sheridan's lab and looking for a job. The job market for academic positions was "hot" and I was considering a number of good offers. One day, Prof. Sheridan called me and said "Our Office of Naval Research sponsors are sending us a visitor. I hear he's a little crazy but I think you might like to meet him". That visitor was Dr. Robert Ballard from the Woods Hole Oceanographic Institution (WHOI) on Cape Cod, Massachusetts. Ballard explained he was building a new generation of remotely-operated robots to explore the oceans and to work with the U.S. Navy. After spending 15 minutes with Ballard, I knew I wanted to work at WHOI. The environment at WHOI would offer unique challenges: as a member of the scientific staff, I would be expected to publish in the peer-reviewed literature. But I would also have many opportunities to build new robots and take them to sea, both to improve them and to use the robots to help our colleagues obtain data and samples to support their research. Forty years later, Ballard and I continue to work together and to this day I have a hard time keeping up with him (Figure 1)!

While in graduate school I got married and we had two daughters. After moving to Cape Cod we had two more girls. Now I have 6 grandchildren and they are a big part of my life. None of them have followed in my footsteps, but they have all found their place in the world. They are all doing well and I'm very proud of them.

Earlier I mentioned the friends I made as an undergraduate at MIT. They came from all over the U.S., some local from Massachusetts and others from other states like Alaska, Idaho, and California. They were very active in the outdoors and they introduced me to rock climbing, skiing, fly fishing, and white-water boating. I was lucky that they were experts in those sports and they were also generous and patient teachers. While I'm a bit past my rock climbing days, those other activities are still very important to me and I pursue them on my own, with new friends, and with my old friends as often as I can. Our trips have taken me to the wild rivers of Idaho, hiking and skiing in places like Yosemite and Jackson Hole, and fly fishing in Yellowstone and in the Alaskan tundra We ski together every

Figure 1. Yoerger with Dr. Robert Ballard and the Benthos RPV, which we used to test our concepts for ROV operations (Photo courtesy of Woods Hole Oceanographic Institution Archives).

Figure 2. Winter backpacking in New Hampshire with my friends from my undergraduate days at MIT. Photo: Dana Yoerger.

Figure 3. Yoerger and Dr. Albert Bradley with the Autonomous Benthic Explorer (ABE). Photo: Dana Yoerger.

winter (Figure 2). I am very grateful to have experienced those great places in the company of good friends.

My WHOI career went through a number of phases. Initially, I worked on towed systems, remotely operated vehicles, and we pioneered the use of dynamic positioning systems on our vessels. I began spending significant time at sea and I made good friends with my fellow engineers and our collaborating scientists and the vessel crews.

Another big change happened in my career when Albert Bradley and Barrie Walden invited me to join them in a proposal to build the vehicle that became the Autonomous Benthic Explorer (ABE) (Figure 3). After we developed ABE to the point that it could make high-resolution maps of the seafloor, my life was never the same. We took ABE all over the world, working on vessels from the U.S., UK, Germany, China, and Australia. We made many discoveries and helped launch the careers of many scientists. We finally lost ABE off the coast of Chile in 2010. Tears were shed, but we were gratified to receive condolences from all over the world. ABE even got an obituary in the New York Times.

Fortunately, by then we had built ABE's successor Sentry, which carries on that legacy to this day (Figure 4). We greatly expanded our capabilities to map the seafloor and the near-bottom environment. In addition to our seafloor work, we mapped the deep plume from the Deepwater Horizon oil spill. I sailed on a cruise with Sentry and the submersible Alvin earlier this year. I really enjoyed seeing how seamlessly those vehicles work together serving both science and engineering research.

My work now focuses on robots that explore the biodiversity of the midwater ocean. Our *Mesobot* robot has explored the waters of the Gulf of Mexico, offshore near Woods Hole, offshore from California, Hawaii, and most recently American Samoa (Figure 5).

While I often consider retirement, for now I'll keep working as long as I enjoy our projects and the people I work with (Figure 6).

Figure 4. Dr. Michael Jakuba helping to launch Sentry at the Deepwater Horizon oil spill. Photo: Dana Yoerger.

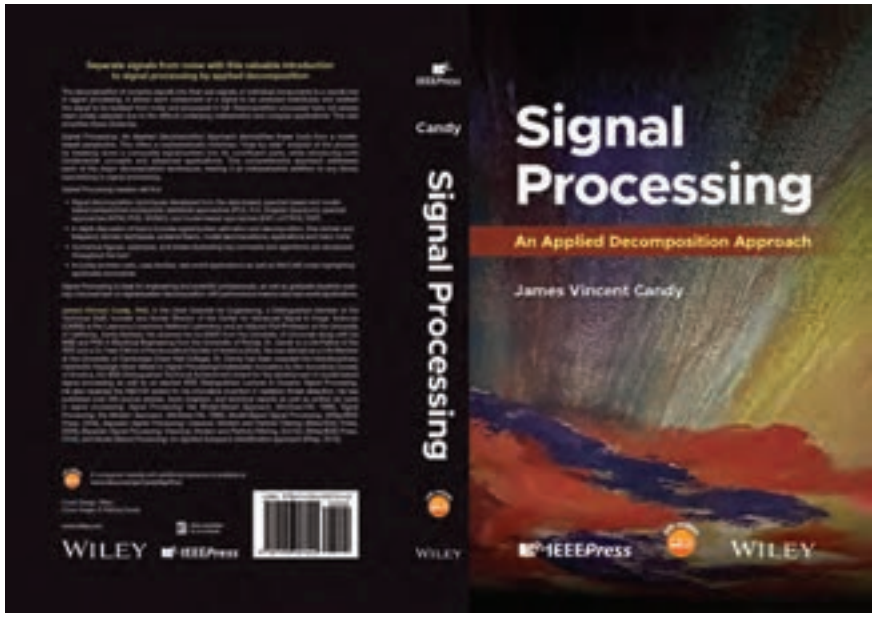
Figure 5. With Mesobot and the Mesobot team in Bermuda during the pandemic. Left to right Fred Marin, Dr. M. Jordan Stanway, Eric Hayden, William Pardis, Molly Curran, and Yoerger: Photo Evan Kovacs.

Figure 6. Yoerger landed this King Salmon in Alaska with more than a little help from Jake Schoolfield, our guide. Catch and release, of course! Photo: David Pinsky.

OES Members in Print

Jim Candy's New Signal Processing Textbook

James V. Candy
Chief Scientist for Engineering, Lawrence Livermore National Laboratory
Adjunct Full Professor, University of California, Santa Barbara



This new text is focused on the decomposition of complex signals into independent sub-signals or, equivalently, components enabling subsequent analysis and design. Decomposing a signal into its constituent components not only enables an effective mechanism for analysis, but also provides a means to process each individual component more effectively, while mitigating disturbances and noise.

Decomposition techniques have evolved historically as the Fourier decomposition of a signal and/or system into sinusoidal components for subsequent frequency domain analysis, to statistical decompositions in classifications, to modal decompositions in structural analysis, to wavelet decompositions providing a novel domain for subsequent analysis of variable signals. This text is focused on such a decomposition essentially decoupling signals and their underlying systems into more manageable independent sub-signals or subsystems enabling effective analysis and subsequent designs.

Request for OES AdCom Nominations

Nominees for the Term 2026 January 1–2028 December 31

IEEE OES Nominations and Appointments Committee

The IEEE OCEANIC ENGINEERING SOCIETY is governed by an Administrative Committee of 18 members. Six are elected each year to serve three-year terms. Members are limited to two consecutive terms, although they may be reelected after a lapse of one year. This will be the thirty-eighth election to be held to determine the membership of our Administrative Committee (AdCom).

This year, the Nominations and Appointments Committee is chaired by the Past President. The committee is charged with proposing a slate of nominees each year. For this election, twelve members of the OES will be nominated to fill six positions on the AdCom for the three-year term: 2026 January 1–2028 December 31.

Qualifications for Administrative Committee membership are membership in the IEEE and OES, and a willingness to serve the oceanic engineering profession. The Society wishes to have the Administrative Committee characteristics to reflect characteristics of the IEEE membership. I ask that each of you identify and nominate qualified candidates for the Administrative Committee. Self-nomination is encouraged.

The nomination Packet should include a Letter of Nomination accompanied by a one-page biographical sketch of the proposed candidate with picture and one-page statement from the proposed candidate giving:

- Their views of the opportunities and challenges facing the Society
- Steps to be taken to advance the IEEE Oceanic Engineering Society, including Ideas for potential initiatives and projects
- How they plan to contribute to standing and ad hoc committees
- Volunteering experience both within and outside OES

Elected Ad Com members should expect:

- To represent the OES membership by attending board meetings, reviewing and accepting reports, and making decisions on Society policy and financial matters

- To participate in administrative activities required to run the society (tasks will be assigned, including participation in standing, and/or ad hoc committees)
- To spend two or more hours per week on average on communications (email, phone, virtual meetings) which may not be evenly distributed throughout the year
- To attend four to six teleconferences, and travel to at least one and up to two in person AdCom meeting per year. In-person meetings are typically two days in duration.

The election will be conducted in accordance with our Bylaws. Follow this link to read the Bylaws: https://ieeeoes.org/about-us/bylaws-of-the-ieee-oceanic-engineering-society/).

The Bylaws specify that general nominations close on **March 1**, and nominations by petition close by **April 15**, 2025.

Please submit nominations to the undersigned starting 2025 January 1. Please do not delay your efforts in finding and nominating qualified candidates. Send your nominations to:

IEEE OES Nominations and Appointments Committee past-president@ieeeoes.org

AdCom Commitment

- Attend AdCom meetings and decide on Society matters
- Participate in work to run the Society
- 2+ hours per week on average
- 4-6 Teleconferences, 1-2 in-person meetings

OES AdCom Meeting 2024 September.

Welcome New and Reinstated Members

From 9 August through 11 November 2024
Total: 82 (incl 39 student)

Australia
Abbas Tabandeh
Jinhong Yuan
Reem Essam Mohamed Kamal Sherif
Ashish Doshi

Canada
Timothy Loncarich
Maike Luiken
Anne E Young
Maxime Berger

China
Yu Li
Zhongwei Shen
Caoze Cao
Lu Cao
Zhutao Ding
Wang Haochi
liu yonghui Liu
YuTao Wang
Ying Xiong
Chengwei Xu
Yuanju Cao
Chao Wu

Colombia
Julian Mateo Hernandez Cavadia
Oscar David Gutierrez Molina
Samuel Alejandro Moreno Corredor
Carlos Alberto Perez Gonzalez
Cristian Stiven Suarez Palma
Maria Lucia Suarez Rodriguez
Angel Estiben Torres Gaitan
Angie Vargas
Angela Lizeth Vargas Cumaco

Cyprus
Alberto Sposito

Denmark
Abdelhakim Khaled Amer

Ecuador
Jacqueline Rivas Oviedo

Egypt
Omar Mohamed

India
Vivek Mathur
Bino J
Afsar Ali M
Boopathi Muthusamy
Selvarajan R
Arun V
Bhavana Venkata Ramalingeswara Rao
Srinivas Chamarthi
Swagata Sarkar

Ireland
Aoife Orla Igoe

Italy
Silvio Del Pizzo
Romolo Di Bernardo
Alberto Topini

Japan
Ryuugo Mochizuki

Korea, Republic of
Jae-Sik Lim

Lebanon
Kevin Nabil El Murr

Mauritius
Ranjeet Bhagooli

Singapore
Lijun Jiang

South Africa
Shahir Dhunraj Dukhan

Spain
Vicente Diaz

Taiwan
Po-Yin Chang

United Kingdom
Luke Hugh Prentice
Lu Shen
Mehrnaz Taheri
Blair Thornton

USA
Nicholas McGrann
Nastasia Pollas
Hannah Rose Arnholt
J Michael Oconnor
Donna Ann Dulo
Benedict J Occhiogrosso
Sungho Kim
Jason Edwin Noel
James Tudor
Michael F Beach
Theresa Clare Wainwright
Alfred Hunt
Xiangyu Wang
Thomas Gerald Liblik
Shivani Sakri
Eric Wendel
Zheng Fan
Azadeh Razavi Arab
Adam J Sampson
Amy M Carr
Brianne Tengan
Marvin J Slepian
Emrecan Demirors
Anna Michel

How to Receive Paper Copies of Each Beacon

Although digital versions of the Beacon newsletter are available on the OES website (https://ieeeoes.org/publications/oes-beacon/), only OES members can receive printed copies of each Beacon.

Here is how to get your paper copies of the OES Beacon in the future. Introduction is also on the above OES website.

1) OES members need to contact the IEEE Contact Center at 1-800-678-4333 or 1-732-981-0060- Monday thru Friday- 8:00 AM- 4:30 PM EST.
2) Or . . . send the IEEE Contact Center an email at contactcenter@ieee.org with your name, IEEE member number and your request to receive your paper copy of the OES Beacon.

Please enjoy the BEACON newsletter.

BEACON Newsletter archive website

Experience of Attending IEEE OCEANS SINGAPORE 2024 CONFERENCE

Puja Dube, Priya Pandey, Shweta Yadav, Deeksha Varshney, Research Scholars, Indian Institute of Technology Delhi-OES Student Branch Chapter

The privilege of presenting our work at OCEANS 2024 in Singapore was a transformative experience for four members of the IIT Delhi OES Branch chapter: Priya Pandey, Shweta Yadav, Deeksha Varshney, and Puja Dube. This opportunity left an indelible mark on both our professional and personal journeys. As April unfolded, excitement filled the air as we prepared for the OCEANS conference in Singapore. The anticipation was palpable as we stepped into the bustling convention center, surrounded by the vibrant energy of scientists, engineers, and enthusiasts from around the world, all united by their passion for the oceans.

The start of the IEEE OCEANS 2024 Singapore Conference signaled the commencement of a dynamic gathering of marine technology and oceanic research professionals. We, attendees, were warmly welcomed to both the conference and the exhibition, providing ample opportunities to discover cutting-edge innovations and connect with peers. Each day of the conference encapsulated a deep dive into cutting-edge research presentations, interactive workshops, and insightful discussions. The program featured two main keynote speeches, three tutorial sessions, numerous technical sessions, and a student poster exhibition, alongside regular social events, and panels such as WIE and YP, fostering a holistic and immersive experience for attendees.

Day 1 of the IEEE OCEANS Conference commenced with a series of technical tutorials led by esteemed experts in underwater research. We participated in informative sessions covering topics such as Detection of Underwater Signal, Data meets Model Predictive Control, and AUV Technology, led by Prof. Roee Diamant, Luka Mandić, Quinn Shemet, and Brian Kieft. These sessions adeptly broke down complex concepts, making them accessible to all attendees. Later in the day, the atmosphere was lively at the OES/MTS Student Mixer event, where

Welcome Speech by the General Chair, Venugopalan Pallayil.

Ocean Observing Platforms and Technologies.

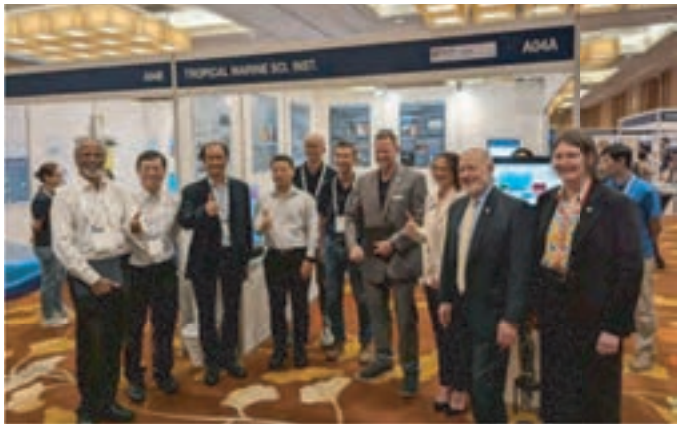
young minds gathered to connect and exchange ideas against the backdrop of the city skyline. Amidst discussions ranging from marine conservation projects to the latest underwater technologies, friendships formed effortlessly, reflecting the global community's shared passion for the oceans. We had the opportunity to meet with Brandy Armstrong, Executive Vice President of IEEE OES, and Dr. Fahreen Fauziya, exchanging valuable ideas. Young professionals and leaders from the Oceanic Engineering Society and Marine Technology Society provided guidance and support, enhancing our conference experience and fostering collaboration for the week ahead.

On Day 2 of the IEEE OCEANS Conference, we witnessed the grand opening of the event and the exhibition, fostering a dynamic exchange of ideas and innovations. Following this, Priya, Shweta, and I attended keynote sessions by Dr. Rick Spinrad and Dr. Megan Cronin, which provided valuable insights into oceanic research and exploration. We also actively participated in technical sessions featuring conference papers, delving into the latest advancements in marine technology and research. I found sessions such as "Enhanced Kalman Equalization via Channel Prediction for Single-Carrier MIMO Underwater Acoustic Communications" by J. Tao and "A Channel-estimation-aided Underwater Acoustic Localization

OES/MTS Mixer.

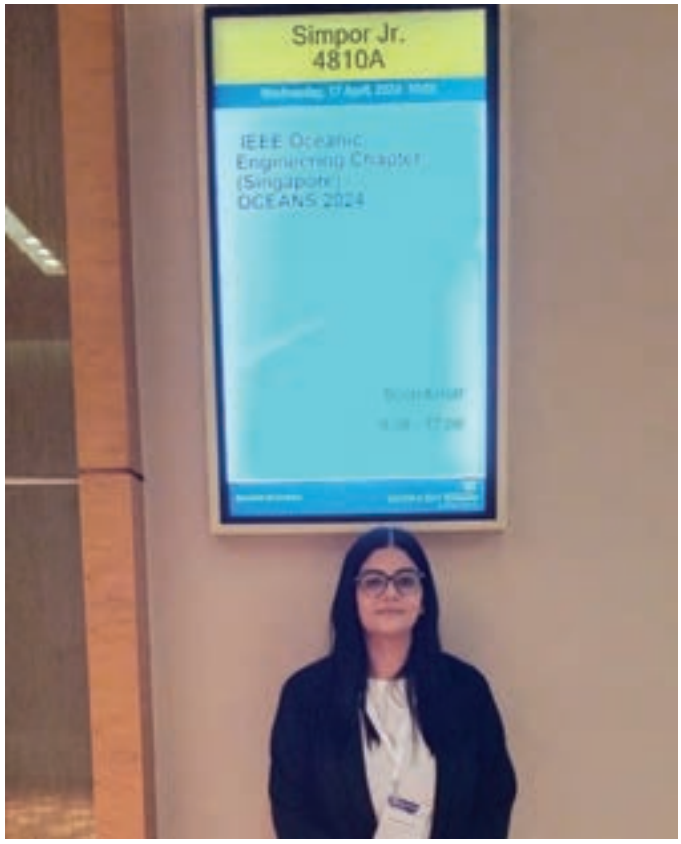
Venugopalan Pallayil and Brandy Armstrong.

OES members meet.



Exhibition Hall.

Shweta Yadav Presenting Her work.



Deeksha Varshney for Technical Session.

Priya Pandey with OES VP Professional Activities.

Method in the Integrated Communication and Positioning System" by Y. Li particularly informative. Shweta Yadav presented her paper on "**Underwater Imaging Method using a Moving Single Acoustic Vector Sensor and Acoustic Source"** and served as the session chair for our session, which focused on Advances in Underwater Imaging and Vision. We received valuable feedback from fellow presenters, aiding our journey towards promoting ocean sustainability and prosperity. Networking opportunities with exhibitors, speakers, and fellow attendees enriched our experience, allowing us to connect with professionals from diverse fields related to the ocean. The day concluded with an engaging OES Member Meet, where we had the opportunity to network with esteemed scientists such as Dr. Hari Vishnu and Dr. Venugopalan Pallayil. Interacting with other OES student members facilitated valuable networking opportunities, potentially paving the way for future collaborations.

Day 3 of the IEEE OCEANS Conference began with our participation in the Women in Engineering (WIE) Panel over breakfast, where discussions and networking focused on empowering women in the field of engineering. Then we attended the session where one of our student members, Deeksha Varsney presented her research work named **"Performance evaluation of new modulation technique, OTSM, in underwater acoustic channel."** In the afternoon, Shweta and I embarked on a technical tour of the NEWater Facilities in Changi, gaining valuable insights into water recycling and management technologies. Some of us also had the opportunity to explore cutting-edge research facilities and initiatives at the St. John Island National Marine Lab.

As for myself, I am grateful for the opportunity to present at the OCEANS 2024 Singapore conference. I presented a paper on **"Overview and Performance Assessment of Different Multicarrier Waveforms for Wideband Underwater Acoustic Communication"** in the domain of Advances in Underwater Acoustic Telemetry and Communication. During my session, I had the chance to interact with esteemed professors such

GALA Dinner.

Discussion with OES Members.

Enjoying Breakfast at Venue.

Priya Pandey Presenting Her work.

Priya Pandey with Fellow Attendees.

as Prof. Roee Diamant and Prof. Jinhong Yuan, exchanging valuable insights and networking with exhibitors, speakers, and fellow attendees from various fields related to the ocean. The evening's main event was the Gala Dinner, a heartwarming culmination of the conference, where participants gathered for networking, camaraderie, and celebration. Cultural events added a touch of local flavour, offering a glimpse into Singapore's rich heritage and traditions. The day concluded with the SPC Prize Presentation Ceremony, honoring outstanding contributions and achievements in the field of marine science and engineering. As the night drew to a close, we left the gala dinner with cherished memories, grateful for the opportunity to forge new connections and reignite our passion for the boundless wonders of the ocean.

The final day of the IEEE OCEANS Conference was filled with insightful technical sessions. We attended Priya Pandey's session, where she presented her research "Evaluating the Performance of Direct and External Modulators for Underwater Visible Light Communication" on underwater optical communication. Fellow presenters shared valuable insights into the latest advancements in underwater technology. After the technical sessions, we embarked on a technical tour of TCOMS, exploring state-of-the-art facilities and learning about innovative technologies shaping the future of marine research and exploration. As the day ended, participants bid farewell to one another, reflecting on the knowledge gained and connections made throughout the conference. Engaging in discussions with experts, we exchanged ideas on conservation, sustainability, and the future of ocean exploration.

Leaving the conference inspired by the collective dedication to safeguarding our oceans, I am empowered to contribute to their preservation in my own capacity. Overall, the OCEANS 2024 conference at Marina Bay Sands, Singapore, was a great experience.

"Amidst the whispers of scholarly minds,
In the conference halls, wisdom binds.
Where ideas surge and innovation shines,
The ocean of knowledge, an endless find."

IEEE OES Indian Institute of Technology-Delhi Student Branch Chapter: 2024 Event Overview

Puja Dube, Research Scholars, Indian Institute of Technology Delhi-OES Student Branch Chapter

The IEEE OES Indian Institute of Technology-Delhi Student Branch Chapter organized a series of engaging and educational events throughout 2024, aimed at both school students and research scholars. The events covered a wide range of topics, from hands-on technology workshops to distinguished lectures by renowned experts in cutting-edge fields. Here's an overview of the key events held this year.

We kicked off our year with a series of **IoT Workshops** designed specifically for K-12 students. These workshops, held on **18 March, 2024**, **30 May, 2024**, and **21 June, 2024**, introduced young students to programming using Python and the exciting world of the **Internet of Things (IoT)**. Through these workshops, students learned how IoT can be applied in everyday life, and they completed hands-on projects that brought their ideas to life. The workshops were a resounding success, with a good number of school students participating across the three events. Each session ended with certificates of participation, refreshments, and an atmosphere filled with curiosity and excitement. These workshops provided an invaluable introduction to technology for young minds, fostering their problem-solving skills and encouraging creative exploration.

Following the workshops, on **21 March, 2024**, we had the honor of hosting **Dr. Arvind Rao**, Associate Professor at the University of Michigan's Department of Computational Medicine and Bioinformatics. Dr. Rao delivered an insightful lecture on **Machine Learning Approaches to the Interpretation of Spatial Imaging & Transcriptomics for Personalized Medicine**. This talk explored the intersection of machine learning, spatial imaging, and bioinformatics. Dr. Rao delved into spatial profiling technologies like hyper-plex immunostaining and discussed their applications in understanding tissue microenvironments, especially for cancer treatment. Dr. Rao's talk was well-received, with an active Q&A session that allowed students to delve deeper into the subject. His insights into AI-driven personalized medicine provided a forward-looking perspective on the future of healthcare, leaving the audience deeply engaged and inspired.

On **10 April, 2024**, we organized a hybrid event featuring **Dr. Vijay Kumar Mishra, National Academies Harry Diamond Distinguished Fellow at the U. S. Army Research Laboratory**, who gave a distinguished lecture on **Phase Retrieval for Radar Waveform Design**. This highly technical talk focused on the mathematical intricacies of radar waveform design and the ambiguity function that characterizes a radar's ability to discriminate in both range and Doppler velocity. Dr. Mishra discussed optimization techniques to design radar waveforms and provided numerical experiments to demonstrate real-world applications. This event attracted many students interested in signal processing and optimization, offering them a fresh perspective on radar technology.

Project Assistants and Participants at the IoT Workshop.

Distinguished Lecture by Dr. Arvind Rao.

Introducing Students to the World of IoT.

IIT Delhi Students Attending a Talk by Dr. Vijay Kumar Mishra.

Later in the year, on **18 July, 2024**, we hosted **Dr. Varshney**, an IBM Fellow at the Thomas J. Watson Research Center, for a distinguished talk on **The AI Alignment Problem, Limits, and Solutions**. In this session, Dr. Varshney discussed the growing challenges presented by large language models (LLMs) and generative AI, including risks like hallucination, prompt injection, and copyright issues. He also introduced different formulations of the AI alignment problem and information-theoretic limits to achieving alignment. This thought-provoking talk led to a highly interactive Q&A session, where students engaged in discussions about the ethical implications of AI in society. Dr. Varshney's visit to our labs further strengthened connections between academia and industry.

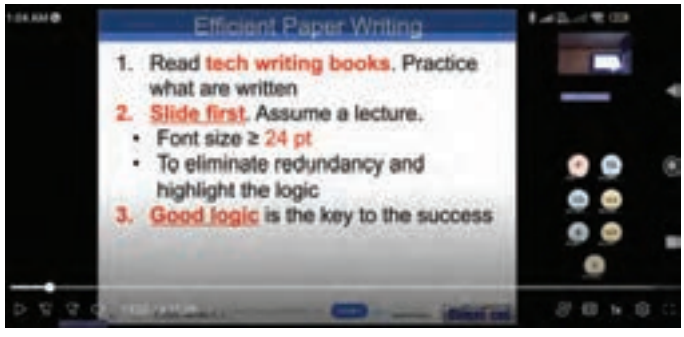
Prof. Monika Aggarwal Presenting a Gift to Invited Speaker Prof. Preetam Kumar.

IIT Delhi Students Posing with Dr. Varshney.

On **15 May, 2024**, **Professor Preetam Kumar** from IIT Patna delivered a comprehensive lecture on **5G: Challenges and Enabling Technologies**. With over 20 years of experience in wireless communications, Professor Kumar explored the transformative potential of 5G technology, touching on key innovations such as millimeter waves, small cells, and massive MIMO. However, he also discussed the significant challenges associated with 5G deployment, including infrastructure costs, spectrum availability, and security concerns. This balanced view of 5G's potential and challenges was both informative and enlightening for the audience, particularly those studying wireless communications and networking.

In **August, 2024**, the chapter hosted **Dr. Akihiko Sugiyama**, a renowned speaker from Tokyo, Japan, for a workshop on **Mastering Authorship: Techniques and Practice**. Held on **27 August, 2024**, this event was well attended and focused on improving writing and analytical skills for young researchers. The workshop included a morning lecture followed by an afternoon hands-on session, where participants were able to apply what they had learned and receive real-time feedback. Dr. Sugiyama's unique teaching approach and personalized feedback were greatly appreciated, and the event concluded with students feeling more confident about their research writing skills.

Event Volunteer with Guest Speaker Dr. Akihiko Sugiyama.



*Workshop on **Mastering Authorship: Techniques and Practice.***

The year 2024 has been an incredible journey for the IEEE OES Indian Institute of Technology-Delhi Student Branch Chapter, with a diverse array of events catering to students and scholars alike. From fostering technological creativity in young students through the IoT workshops to offering deep insights into AI, radar waveform design, and 5G, these events have had a profound impact on the student community. We are proud of the participation and enthusiasm shown by students and look forward to organizing more such enriching events in the future.

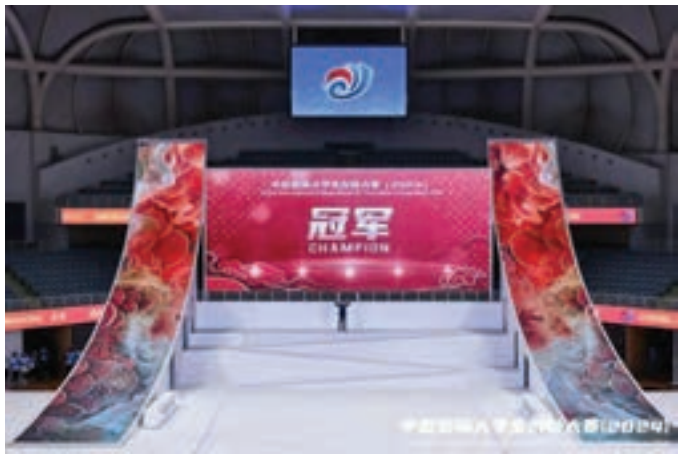
"Nezha" Won the Championship of China International Student Innovation Competition (2024); Over Half of the Team are OES Members of Shanghai Jiao Tong University Student Branch Chapter

Zheng Zeng, Shanghai Jiao Tong University Student Branch Chapter Advisor and Lian Lian, Shanghai Chapter Chair

In the just concluded **China International Student Innovation Competition (2024)** Championship Competition, **Shanghai Jiao Tong University "Nezha - the world's first hybrid aerial underwater vehicle in real ocean"** was selected from 5,140,000 projects from 5,406 schools in 153 countries and regions around the world, and won the championship. Over half of the team are OES members of Shanghai Jiao Tong University Student Branch Chapter (SJTU SBC).

Lv Chenxin, the co-chair of Shanghai Jiao Tong University SBC presenting "Nezha" in the competition.

"Nezha" the champion team celebrates with the leaders of Shanghai Jiao Tong University.



"Nezha" won the championship of China International Student Innovation Competition (2024).

Winning Project Introduction

Project Name: Nezha - the world's first hybrid aerial underwater vehicle in real ocean

Director: Lv Chenxin, Co-Chair of SJTU SBC

Advisor: Zeng Zheng, Lian Lian

Team members: Jin Yufei, Bi Yuanbo, Song Suwang, Yuan Xinyi, Shi Yixin, Xu Zhuxiu, Shen Yishu, Muxierepu Aili, Hu Haojie, Zhu Hanyu, Zhang Sen.

Project description: The "Nezha" series of the hybrid aerial underwater vehicle (HAUV) is an original exploratory multi-area unmanned system capable of continuously transiting the air, ocean surface and underwater mediums. It is capable of in-flight

"Nezha" field test in the sea.

"Nezha" surfing in the waves.

"Nezha" diving with buddy.

deployment and retrieval, and is equipped with functions such as aerial flight control, localization, underwater submerged navigation and flight return. "Nezha's novel and unique ability to "fly and dive in the sky and into the sea" and cross-media continuous observation has great market prospects in the fields of ocean exploration, marine engineering construction, and marine resources development. It is a revolutionary platform for joint observation of environmental elements in sea and air, detection and identification of underwater targets, cross-media communication relay and maritime emergency search and rescue.

Federal Fluminense University Student Branch Chapter Report - Aulão ao (M)ar Livre, an Ocean Decade Initiative Event

Silvana Paz, IEEE OES UFF SBC Chair; Virna Barbosa, IEEE OES UFF SBC Vice-Chair and Michel Mendes, IEEE UFF Student Branch Chair

On October 14, 2024, the Aulão ao (M)ar Livre (of the portuguese Outdoor Sea Lesson) took place as part of the Engineering Academic Week (SEMENDE) at Fluminense University. This initiative aimed to extend knowledge beyond the traditional classroom setting, providing an outdoor lecture focused on sustainable ocean use in a local context.

The event was hosted at the Dora Hees de Negreiros Natural Park on Morro do Morcego in Niterói, Rio de Janeiro, where participants were transported by boat to facilitate immediate contact with the marine environment at the start of the session. The initiative aimed to integrate the objectives of the Decade of the Ocean within the context of Guanabara Bay, a region of significant historical, ecological, and economic importance.

The morning featured a series of activities comprising interconnected projects, each addressing the challenges of the Decade of the Ocean through four primary focus areas: biodiversity conservation, effluent treatment, socio-environmental initiatives, management of floating waste, and observation of marine life.

Participating Projects and Activities

The Aruanã Project, named after the green sea turtle commonly found in the region, seeks to inform and engage the public about environmental concerns related to marine turtles and their ecosystems.

Águas de Niterói, part of the Águas do Brasil Group, is responsible for wastewater treatment in the city of Niterói and is recognized as a benchmark in sewage management.

The Grael Project, a non-governmental organization (NGO), aims to democratize access for young people to sailing sports, nautical workshops, and environmental education, contributing to the social transformation of its beneficiaries.

Exhibition table of the Aruanã Project.

Volunteers of the Aruanã Project gathered at the exhibition stand.

Professor André Belém (Chapter Counselor) and Michel Mendes (IEEE UFF Student Branch Chair) talking about the Guanabara Bay biodiversity.

Participants of the event, volunteers of OES SBC and the group project gathered.

Professor André Belém and students at the beginning of the snorkel activity.

Participants of the class gathered at the Dora Hees de Negreiros Natural Park during the opening of the event.

Professor André Belém activity observing the marine sea life.

The Orla Sem Lixo (of the Portuguese Litter-Free Shoreline) Project is an innovative initiative focused on intercepting, collecting, transporting, and recycling floating waste in the waters of Guanabara Bay, providing a sustainable solution to local pollution challenges

The snorkeling workshop, taught by professor and oceanographer André Belém, offered an opportunity to directly explore marine ecosystems, raising participants' awareness of the importance of preserving these environments and fostering a deeper connection with the ocean.

IEEE OES University of Zagreb SBC Report

Vladimir Slošić, Luka Mandić, Juraj Obradović, Matko Batoš, Igor Kvasić, Matej Fabijanić

Over the course of 2024 the **IEEE OES University of Zagreb Student Branch Chapter (SBC)** has, as always, been active in organizing and taking part in a variety of events for deepening the understanding and appreciation for marine robotics, with a particular focus on engaging our students. Through workshops, lectures, competitions, and hands-on demonstrations, these events have aimed to bridge the gap between theoretical knowledge and practical experience. From participating and presenting in most of the marine robotics related conferences such as OCEANS and IROS, inviting distinguished professors and lecturers to present new hot topics, organizing various competitions, the yearly activities culminated with hosting the flagship SBC event of the year, Breaking the Surface 2024 workshop. More on that and other exciting recent events in the next few pages!

Breaking the Surface 2024 group photo in Biograd na Moru, Croatia.

Breaking the Surface Workshop 2024

Breaking the Surface 2024 main lecture stage.

IEEE OES University of Zagreb SBC team.

After 15 successful workshops, and the first edition held outside Croatia in 2023, the "Breaking the Surface" (BtS) international workshop on marine robotics and its applications returned to Croatia in 2024. The workshop was held on the stunning Dalmatian coast and saw another successful gathering of nearly 200 international experts and enthusiasts coming from a variety of marine disciplines. Focused on the latest in maritime robotics and marine technology, BtS attracted professionals in fields like maritime robotics, marine biology, maritime archaeology and marine geology from 25 countries worldwide. Across seven days, attendees engaged in a comprehensive program featuring 14 plenary lectures, 10 demonstrations, 11 interactive hands-on tutorials and 3 company presentations.

Each morning, participants enjoyed engaging plenary talks led by distinguished speakers presenting their work and most recent research results, interspersed with coffee breaks that encouraged networking and conversation. Afternoons were packed with three parallel tracks of hands-on tutorials, demos and presentations from leading marine industry companies. Maintaining the BtS tradition of its famous social events, evenings featured the signature IEEE OES party, an International Night, Pub Quiz, Karaoke Night, and a closing ceremony that honored outstanding contributions and celebrated another memorable edition of BtS with a gala dinner. The traditional Saturday field trip provided a scenic bus tour along the Dalmatian coast towards the historical city of Šibenik, offering opportunities to soak in the region's cultural and natural beauty. Closing of yet another successful workshop was rounded off by the exciting announcement of Breaking the Surface 2025, which for the next edition is moving to the coast of Cyprus.

Challenges and Competitions at BtS 2024

For the third year in a row, participants of the BtS workshop had the opportunity to take part in the *Localization challenge*, organized by Newcastle University, University of Haifa, INESC-TEC, and LABUST. The task was to locate a hidden acoustic modem within a 700 by 1200-meter search area, using acoustic data, signal processing, and other engineering skills.

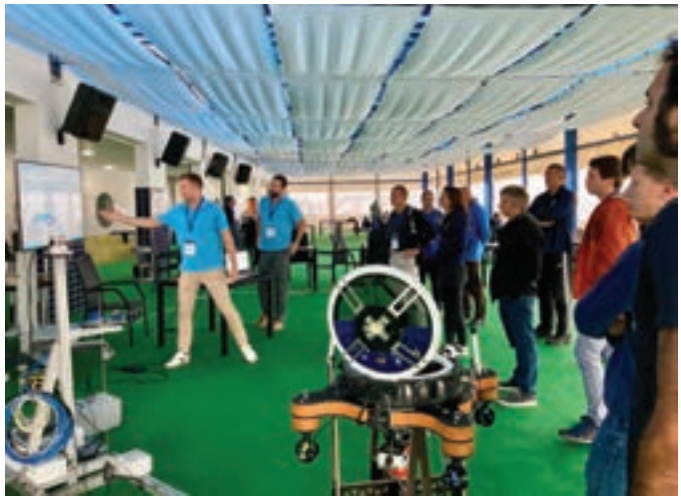
Search area with position estimates of the teams.

After an initial day of introductory presentations and familiarization with the equipment and software, each team was given 45 minutes of boat time to record data for post-processing. Teams had complete freedom in selecting their localization strategies and determining both the number and location of their boat recordings. Ultimately, Team THM from Technische Hochschule Mittelhessen emerged as the winner, based on criteria evaluating the hidden modem's most innovative and accurate position estimate.

BtS 2024 Localisation challenge winners: Team from Technische Hochschule Mittelhessen.

Following their victory at MBZIRC 2023 competition, the University of Zagreb's Laboratory for Underwater Systems and Technologies shared a detailed demonstration at the 2024 BtS workshop. Workshop attendees explored the strategies, innovations, and behind-the-scenes work that helped UNIZG-FER secure top honors in this challenging robotics competition.

Demonstration highlights included a breakdown of the catamaran's search and detection techniques, a look into visual servoing processes, and an overview of their docking system, which uses suction cups and hooks to stabilize the vessel. The presentation concluded with insights into the team's drone operations, giving participants a clear view of the coordinated effort behind their successful run. This presentation gave BtS attendees an inside view of the innovation and teamwork that led to UNIZG-FER's success at MBZIRC 2023.



MBZIRC demonstration during BtS 2024.

OES SBC Presentations at Conferences in 2024

During April 2024, several OES members actively participated at the OCEANS 2024 conference in Singapore organized by the IEEE Oceanic Engineering Society (OES) and the Marine Technology Society. Namely, Luka Mandić presented the tutorial "Data meets Model Predictive Control: From classical MPC to an online adaptive direct data-driven navigation and control of autonomous vessels." In addition, Assist. Prof. Fausto Ferreira presented three articles: one related to the uBlueTec project, one related to an ROV simulator and one dealing with boat detection and classification using machine learning.

In September 2024, two OES PhD students, Juraj Obradović and Luka Mandić, presented their work at the CAMS conference, which was held in Blacksburg, Virginia (USA). Luka Mandić presented his work entitled "Adaptive and Robust Direct Data-Driven Controller for Surface Vessel Navigation," where he introduced and applied an extension of the DeePC algorithm as the vessel controller. This approach aligns with the increasing trend of data-driven reference tracking in control system theory. Juraj Obradović presented his work titled "Analysis of LiDAR-Camera Fusion for Marine Situational Awareness with Emphasis on Cluster Selection in Camera Frustum," where he introduced a method that integrates LiDAR and camera data for precise 3D object detection and tracking.

During the week of September 23–26, 2024, the work and MBZIRC competition demonstrations were presented at the 40th Anniversary of the IEEE Conference on Robotics and Automation (ICRA@40) in Rotterdam, Netherlands, with the extended abstracts titled "Autonomous Surface Vehicle for Search and Intervention in GNSS-Denied Operations" by Luka

Mandić, Matko Batoš, Juraj Obradović, Natko Kraševac, Fausto Ferreira, Barbara Arbanas Ferreira, Nikola Mišković, and "Heterogeneous Multi-Robot Team for Maritime Inspection and Intervention in GNSS-Denied Scenarios" by the same group of authors together with LARICS lab members.

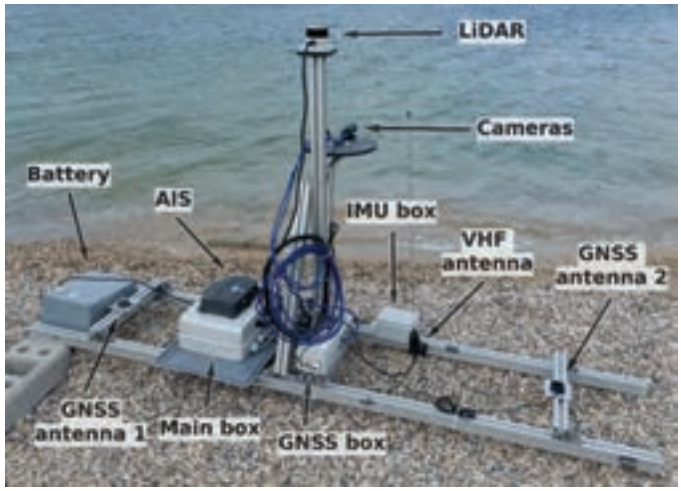
Barbara Arbanas Pascoal Ferreira, Matej Fabijanić, and Nadir Kapetanović attended the IROS 2024 conference held in Abu Dhabi on 14–18 October2024. Barbara presented our MBZIRC competition experiences at the *Maritime Heterogeneous Unmanned Robotic Systems* workshop. Matej presented his work on biofouling estimation in a poster session at the *Autonomous Robotic Systems in Aquaculture: Research Challenges and Industry Needs* workshop, while Nadir presented the overview of the results of the HEKTOR project at the same workshop. In addition to presenting fruitful results of their recent work, conferences in 2024 were a great opportunity for OES members to socialize and gather ideas for future research.

Expert Visits and Invited Lectures at University of Zagreb

The University of Zagreb fosters an engaging academic atmosphere by hosting expert visits and invited lectures, enriching both students and faculty with cutting-edge knowledge from global thought leaders. As part of the SEATECHHUB project, the university welcomed Dr. George Rossides from the Cyprus Marine & Maritime Institute (CMMI) for a two-day workshop on January 9th and 10th, 2024. Dr. Rossides presented innovations in autonomous underwater and surface marine robotics, focusing on their application in environmental monitoring, maritime surveillance, and digitalizing the Cypriot maritime industry. He also conducted a hands-on training session on integrating robotic platforms with IoT and computer vision technologies, emphasizing skill development and mutual learning.

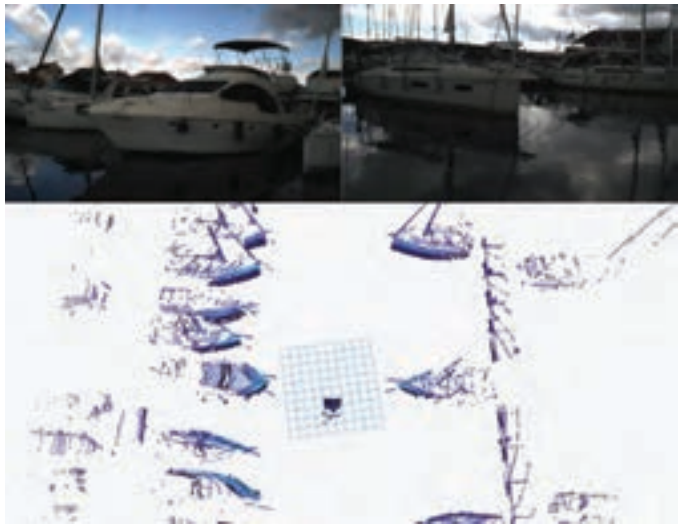
In March, IEEE OES University of Zagreb SBC, hosted Asst. Prof. Alberto Testolin from the University of Padova. Prof. Testolin delivered a lecture titled "The Recent Excitement Around Generative Artificial Intelligence," exploring the latest advancements in AI. Following this, in April, OES welcomed Prof. Emeritus Craig Smith from the University of Hawaii, who presented "Mining the Deep-Sea Floor: Treasure versus Destruction in the Oceans' Most Pristine Ecosystems," offering a nuanced view of deep-sea resource extraction. In May, 2024, Liisa Janssens from the Netherlands Organisation

Expert lectures and knowledge exchange at the University of Zagreb (top and bottom).



Closeup picture of the developed sensor rack during testing, and the same rack mounted on a motorboat during data collection.

Recorded GPS data overlaid over the map of the Zadar archipelago showing where data collection took place.



Excerpt from the data showing 2 images from the cameras and the 3D LIDAR scan of the area.

for Applied Scientific Research, shared her expertise on "Responsible AI and Rule of Law." Her lecture delved into scenario-based methods for integrating AI in civil-military contexts, shedding light on NATO's recent AI design report. These engagements highlight the university's commitment to advancing interdisciplinary learning and fostering global academic collaboration.

Field Experiments and Data Collection

Researchers from OES UniZg SBC have been steadily working toward advancements in situational awareness technology for autonomous boating. Recently, the team conducted a focused data collection effort as part of this ongoing project, which aims to refine and test a sensor system for improved navigation. The team, working towards a June 2025 completion, has developed a sensor rack for motorboats equipped with two cameras, LIDAR, dual GPS antennas, multiple IMUs, and AIS receiver. Over two days in early October, the team visited several marinas around Croatia's Zadar archipelago, collecting data that will be instrumental in refining navigation algorithms. "The whole Smart Blue Tourism team prepared intensely for several weeks leading up to the planned data collection date to give us the best possible chance of actually going out to the sea and getting useful data, and it paid off!" says Matej Fabijanić, one of the researchers working on the project.

In the months ahead, this data will be analyzed to support the development of an algorithm designed to enhance situational awareness, an essential element for safe autonomous boating. This research seeks to advance both maritime technology and sustainable navigation, potentially contributing to safer and more efficient boating practices for the tourism industry and beyond.

MakiComet, the AUV participated in Underwater Robot Convention in JAMSTEC 2024!

Kento Takemoto, Yang Teni, Motoki Sakai, Yew Qi Ming, The University of Tokyo

Introduction

On August 24 and 25, students and enthusiasts gathered at JAMSTEC headquarters in Yokosuka, Japan, for the Underwater Robot Convention in JAMSTEC 2024. The event, organized by NPO Japan Underwater Robot Network, provided a platform for participants to exchange technical ideas and network through the competition and presentations of self-build underwater robots. For more details on the convention, visit the official website [1] (in Japanese), and additional reports from past conventions can be found in [2], [3], [4], [5], [6], and [7].

We, the authors, are master's students from Prof. Maki's laboratory at the University of Tokyo, and we participated in the AI-challenge division as team "MakiCommanders" [Figure 1]. Our primary goal was to gain essential knowledge and skills in underwater robotics to support our future research. Additionally, we gained valuable experience in teamwork, which is crucial for the development and operation of underwater robots.

Competition Rules

The AI-challenge division was created to promote the use of Artificial Intelligence (AI) in underwater robotics. In this challenge, robots were required to autonomously break balloons placed in a water tank. There were three types of balloons: red,

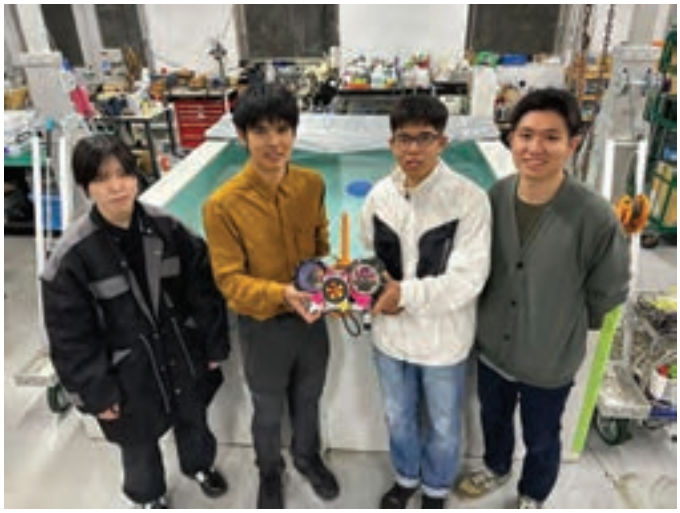


Figure 1. The group photo of "MakiCommanders" Team and the AUV, MakiComet.

Table 1. Height and score of balloons.

Color	Height [m]	Score
Red	0.5	30
Yellow	1.5	10
Blue	0.7	–10

yellow, and blue, each with different point values depending on their height in the tank [Table 1]. The arrangement of the balloons was random. Figure 2 shows a diagram of the water tank setup. The only tool allowed to break the balloons was a thumbtack. Teams had 4 minutes to complete the task, and the higher the score, the better the team's rank. In addition to the performance score, judges also evaluated the robots' autonomy and the poster presentations, with the final ranking based on the total score.

Strategy

MakiComet is designed based on last year's competition vehicle Sebastian, and can control surge, heave, and yaw. This year's competition rules are the same as last year's, requiring participants to pop as many red and yellow balloons as possible while avoiding blue balloons within the time limit to earn higher scores. Therefore, last year's algorithms [2] are used for the balloon search and approach methods. In summary, at the start of the competition, the AUV moves to the center of the pool and uses the heave thruster to land on the bottom of the pool. The point where it hits the bottom is used as the vertical reference, and it rises to an altitude of 50 cm where the red balloon is placed, and then begins its search. When it finds the target balloon, it moves toward its center coordinates.

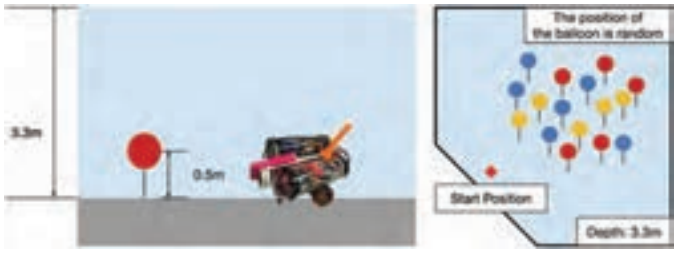


Figure 2. Overview of water tank setup.

Our main goal this year was to solve last year's problems by utilizing this search and approach method. We thought that there were two major problems last year. The first problem was that when popping a balloon with a pin, the AUV's speed was insufficient, or when the speed was increased, it became difficult to control, and the balloon could not be hit properly and escaped. To address this problem, we added a new mechanism that allows the pin to be pressed firmly against the balloon. Specifically, a new shaftless thruster was installed and a pin was placed on its intake port. This shaftless thruster finds the target balloon and starts rotating when the approach begins. This allows the balloon to be reliably approached, and the suction force of the thruster presses the balloon against the pin, making it possible to pop it reliably. The second challenge is that the color identification of balloons, which worked in the AUV's development environment, does not work well in the competition environment. This is thought to be a phenomenon caused by differences in the lighting and natural light intensity between the development environment and the competition environment. To address this issue, we ensured that the parameters could be adjusted based on the local environment. Specifically, when identifying a color as red, instead of using the RGB value of red as the standard, the RGB value actually captured by the camera is checked and set. This approach allows the standard appropriate to the environment to be set for each target color, improving the accuracy of balloon color identification.

AUV

This mission used the original cruising autonomous underwater vehicle "MakiComet" [Figure 3], [Table 2], based on the Sebastian AUV that participated in last year's competition.

MakiComet can move in surge, heave, pitch, and yaw by four thrusters. Its acrylic hull, which serves as a buoyant body, is located on both sides. At the same time, the center of gravity is set lower in the middle to maintain stability in the roll direction. As sensors, we used a depth sensor for estimating depth and a camera module for recognizing balloons in the water. The AUV was also equipped with leg parts for landing on the pool floor. Additionally, it featured another thruster without a shaft, as mentioned in the previous section, at the top front of the AUV, and a pushpin was attached at the center of the thruster. Thanks to the suction power of the new thruster, MakiComet was able to suction a balloon [Figure 4], and burst the balloon reliably. It's also worth noting that the power didn't disturb MakiComet's movement or posture maintenance.

As a control tool, MakiComet used a common open-source tool for robotics control called Robot Operating System (ROS) on the Raspberry Pi. The Teensy driver is used to send PWM commands to the motor drivers. In this mission, circle detection was planned to be performed using the ellipse fitting algorithm initially. This was because the Hough transform was not robust against objects like ladders inside the tank. However, we were

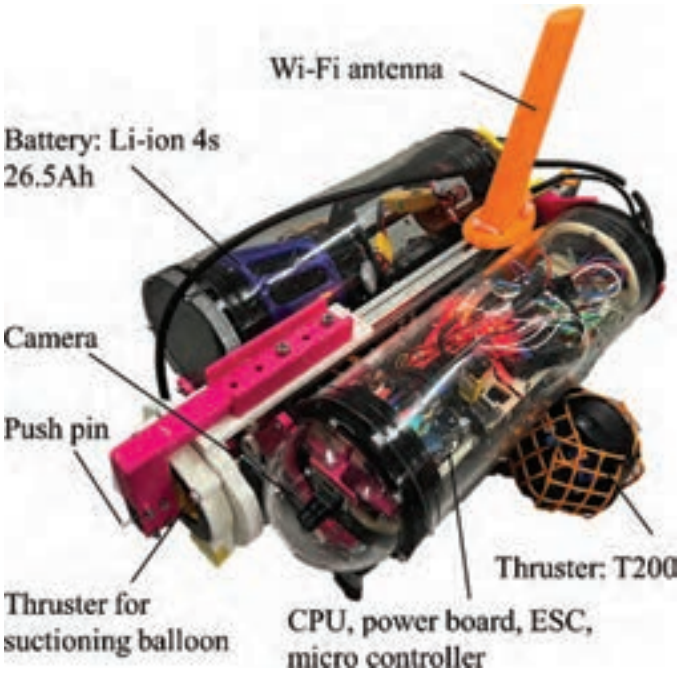


Figure 3. General arrangement of the AUV MakiComet.

Table 2. Spec and the number of thrusters of MakiComet.

Spec	
Length[mm]	560
Width[mm]	410
Height[mm]	350
Weight[kg]	9
Thrusters	
Surge	2
Heave	2
Suction	1

unable to implement the alternative method effectively, so we ultimately reverted to using the Hough transform in OpenCV on images captured by a USB camera [Figure 5]. For details on the algorithm, please refer to last year's article [2].

The competition rules were released in June 2024, and our development project was started. The development was divided into three areas: new thruster implementation, balloon recognition algorithm, and state transition algorithm. By the end of July, we abandoned the implementation of the ellipse fitting algorithm due to difficulties in making it work effectively and focused instead on thruster development and the state transition algorithm. By mid-August, the entire system was completed, and we confirmed that balloon detection and destruction could be performed reliably [Figure 6].

Result

At the first day of the competition, each team is required to make a presentation with their own A0-sized poster. Judges

Figure 4. A view of the balloon suction experiment.

Figure 5. An example of balloon recognition using Hough transform. The recognition result was almost perfect but not robust against other objects.

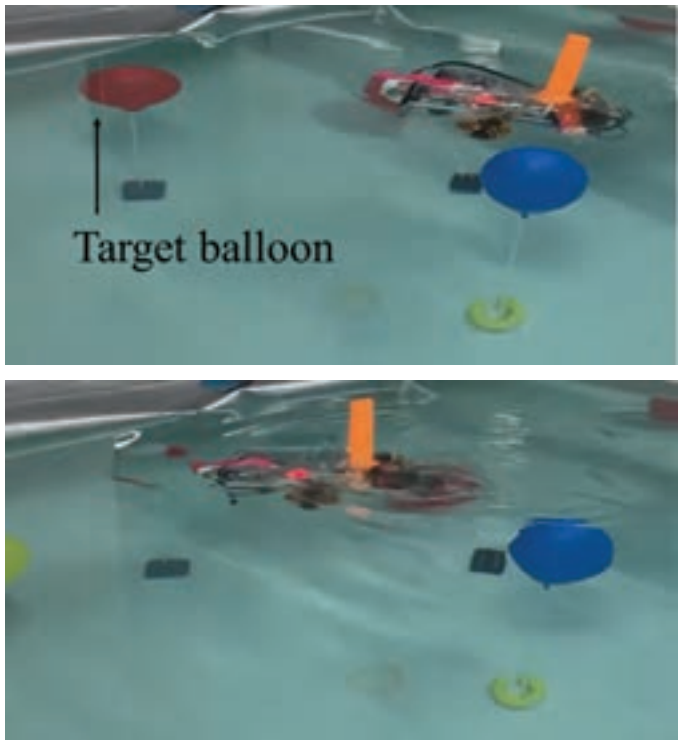


Figure 6. MakiComet breaking a balloon. Top: before, Bottom: after.

then ask questions based on the presentation and category of participation. After the presentation, there is a time slot for every team to test and fine tune their AUV. We tested our AUV with a tether cable so that we could see the status and the environment parameters experienced by the AUV. Our AUV could not detect the balloons as the color of balloons detected is different in that environment compared to what we have practiced.

On the second day of the competition, each team is given some time to test and fine tune again. By using relevant RGB values, we managed to tune our AUV for detecting the balloons together with better maneuvering performance to carry out the mission. However at our last practice, the AUV could not float and could not switch into the search mode after diving. During the competition, it is also unfortunate for our AUV to perform the same as our last practice. After the competition, we tested the AUV and it works fine again as usual. Thus, we suspect the depth sensor or Teensy controller board might be old which cause the unexpected performance during the competition.

Throughout this competition, we realize that unexpected situation will arise easily in underwater robot development, not only limited to us. Therefore it is important to stay alert even if everything seems to be going smoothly at first. We believe that the lesson we learned from this competition will inspire us and allow us to contribute better in our research and future careers.

Acknowledgement

The Underwater Robot Convention in JAMSTEC in 2024 was supported by The Japan Society of Naval Architects and Ocean Engineers, Techno-Ocean Network, IEEE/OES Japan Chapter, MTS Japan Section, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Oki Electric Industry Co., Ltd., Oki Com-Echoes Co., Ltd., IDEA Consultants, Inc., Nortek Japan LLC, Sea challenge Co., Ltd., Misago Co., Ltd., MinebeaMitsumi Inc., Japan Underwater Drone Association, Matsuyama Industry Co., Ltd., IWAKITEC Co., Ltd., Robotis Co., Ltd., FullDepth Co., Ltd., KOWA Corporation, Aqua Modelers Meeting, National Ocean Policy Secretariat, Cabinet Office, Government of JAPAN, Kanagawa Prefecture, Yokosuka City, Tokyo University of Marine Science and Technology, and Center for Integrated Underwater Observation Technology at Institute of Industrial Science, the University of Tokyo. We would like to express our sincere appreciation to the sponsors for their strong support and cooperation in realizing this convention.

Comments

Takemoto: It is really disappointing that I could not perform well in the actual competition, since we were able to confirm my balloon-breaking action in the practice right before the competition. However, through this result, I found out what I was lacking, and I will take this as a big lesson for the next challenge.

Yang: I realized the significance of preparation and the need to anticipate potential issues and plan solutions in advance. This experience will be invaluable throughout my master's studies.

Sakai: I am disappointed that we were unable to achieve good results. The failure of surfacing is a critical issue that could lead to the loss of the AUV in an actual mission. I am determined to apply this lesson to my future project.

Yew: This competition makes me realize my flaws in underwater development. We will be more alert in the future.

References

[1] Underwater Robot Convention in JAMSTEC 2024 (Japanese). https://www.jam24.underwaterrobonet.org/

[2] H. Kasuga, L. Hakataya, H. Yokohata, Sebastian, the AUV Won First Place in Underwater Robot Convention in JAMSTEC 2023! IEEE OES Beacon Newsletter, 12(4), 76-79 (2023.12) https://ieeeoes.org/oes-beacon/december-2023/sebastian-the-auv-won-first-place-in-underwater-robot-convention-in-jamstec-2023/

[3] A. Toriyama, M. Ohashi, H. Yokohata, wARIEL, the AUV Won First Place in Underwater Robot Convention in JAMSTEC 2022! IEEE OES Beacon Newsletter, 11(4), 83-86 (2022.12)

[4] K. Yamamoto, S. Chun, Y. Sekimori, C. Kawamura, ARIEL, the AUV Won First Place in Underwater Robot Convention in JAMSTEC 2021! IEEE OES Beacon Newsletter, 10(4), 70-73 (2021.12) https://ieeeoes.org/oes-beacon/december-2021-beacon/ariel-the-auv-won-first-place-in-underwater-robot-convention-in-jamstec-2021/

[5] Y. Sekimori, T. Maki, Underwater Robot Convention in JAMSTEC 2020 – All Hands on Deck! Online!!, IEEE OES Beacon Newsletter, 10(1), 39-42 (2021.3)

[6] K. Fujita, Y. Hamamatsu, H. Yatagai, Reflection for Singapore Autonomous Underwater Vehicle Challenge – the Comparison Between SAUVC and a Competition Held in Japan, IEEE OES Beacon Newsletter, 8(2), 64-67 (2019.6)

[7] H. Yamagata, T. Maki, Underwater Robot Convention in JAMSTEC 2018 – from an Educational Perspective, IEEE OES Beacon Newsletter, 7(4), 68-72 (2018.12)

Workshop Recap: STEM Remotely Operated Vehicle 2024

Zainah Md. Zain, IEEE OES Malaysia Chapter Secretary and Zool Hilmi Ismail, IEEE OES Malaysia Chapter Chair

The Science, Technology, Engineering, and Mathematics (STEM) Underwater Robotics Workshop began at Fakulti Teknologi Kejuruteraan Elektrik & Elektronik (FTKEE) during the 2022 Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA) STEM Carnival in Pahang, leading to the popular Underwater Robot Challenge (URC) series. The success of URC 2022 and URC 2023, supported by the IEEE STEM Try-Engineering grant, encouraged further development of the program. In 2024, FTKEE, in collaboration with the IEEE OES Malaysia Chapter, secured a UNESCO Malaysia grant to fund the workshop, covering the costs of Remotely Operated Vehicle (ROV) kits provided to students.

The STEM Remotely Operated Underwater Vehicle Workshop, held on the 2nd and 3rd of September, 2024, at Akademi Adab UMPSA Pekan Campus, aimed to foster students' interest in topics related to Science, Engineering, and Mathematics, with a specific focus on underwater robotics through ROV project-based learning. The workshop successfully achieved the following:

- Sparked students' awareness in underwater robotics through hands-on experience in designing and assembling underwater robots, while also building critical thinking, teamwork, and creativity.
- Empowered students with technical skills and practical knowledge in operating and programming Remotely Operated Vehicles, with exposure to the latest advancements in marine engineering.

The STEM ROV Workshop kicked off with an "Introduction to ROVs" and an "ROV Design Theory" session on Day 1, where participants focused on key concepts and began assembling the thruster at FTKEE. The afternoon was dedicated to hands-on design and development of the ROV's vehicle frame and control box.

Day 2 featured ROV testing and troubleshooting at the dedicated pool, allowing participants to apply their skills in a real-world setting. The workshop concluded with a certificate presentation and closing ceremony, celebrating the participants'

Figure 1. Students engaging in hands-on assembly of underwater robots at the STEM ROV Workshop, guided by instructors at FTKEE.

Figure 2. Assoc. Prof. Dr. Shahrieel, an instructor, addresses the participants, providing insights and instructions for the next phase of the ROV assembly.

Figure 3. A packed room of students, teachers, and participants attentively listening during the STEM ROV Workshop.

Figure 4. Students working collaboratively on assembling an ROV during a hands-on workshop, focusing on wiring and structural assembly to enhance their practical engineering skills.

Figure 5. Primary school students proudly testing their assembled ROV in the pool under the guidance of their teacher.

Figure 6. An instructor provides guidance to participants as they prepare to test their ROVs in a pool, aiming to complete a series of underwater tasks.

achievements and hands-on learning experience in underwater robotics.

A total of 85 participants attended the workshop, including 45 secondary school students and 40 primary school students, accompanied by 13 secondary school teachers and 14 primary school teachers. Participants came from various states, with Pahang contributing 7 secondary schools and 8 primary schools, Terengganu contributing 3 secondary schools, and Melaka with 1 secondary school.

In conclusion, the STEM Underwater Robotics Workshop provided an invaluable opportunity for young students to explore the fields of engineering and marine technology through hands-on experience. By engaging students in real-world applications of STEM concepts, the workshop fostered critical thinking, creativity, and teamwork while empowering them with practical skills in underwater robotics. The enthusiastic participation from schools across multiple states underscores the growing interest in STEM education in Malaysia. The workshop's success, supported by collaboration between FTKEE UMPSA, IEEE OES Malaysia Chapter, and UNESCO Malaysia, highlights the importance of industry-academic partnerships in nurturing future talent and inspiring the next generation of engineers and innovators.

Figure 7. Students prepare to launch their developed Remotely Operated Vehicle (ROV) into the pool as they get ready to start the challenge.

Figure 8. All participants gather with the organizers for a group photo, capturing a memorable moment from the event.

Deadline Extension for the IEEE OES Ocean Challenge!!! Submit Your Proposal by 31/12/2024!!

Are you a student or young professional passionate about ocean conservation and innovation?
Join us in shaping the future of our planet by participating in the IEEE OES Ocean Challenge. Let's work together to develop groundbreaking solutions to address the UN Decade of Ocean Science goals.

Visit https://oceanchallenge.xyz/ to learn more and submit your ideas!

This is a challenge dedicated to teams of students and young professionals to take on new innovative ideas and technical solutions to address at least one of the ten Ocean Decade (OD) challenges (oceandecade.org).
The "Ocean Challenge" will be modelled as a two-stage global competition.

1) In the first phase, teams will present their ideas in a written report and a video. A panel of experts from Academia and Industry, including the OES Technical Committees, will evaluate the proposals and select 5 teams for the second phase.
2) The seed funding will be used to implement the proposed solution.

Representatives of the winning team will then be invited to present their solution at the IEEE OES OCEANS 2025 Brest conference!

Timeline:
- First Phase: written proposals and videos outlining the proposed innovative solutions. 2024/12/31
- A panel of industry and academic experts will select the top five teams to advance to the second phase. 2025/01/31
- The 5 finalists will receive seed funding to implement a portion of their proposed solution and move to the second phase
- Second Phase: implementation / building of the project, with a video and a presentation. 2025/05/31
- The winners will present their work at the prestigious IEEE OES OCEANS 2025 Brest conference! 2025/06/16-19

For contact info:
f.maurelli@ieee.org
giulia.demasi@ieee.org

IEEE OCEANIC ENGINEERING SOCIETY EX-OFFICIO ADMINISTRATIVE COMMITTEE

Co-Editors-in-Chief, OES BEACON
HARUMI SUGIMATSU
University of Tokyo
ROBERT WERNLI
First Centurion Enterprises

Earthzine Editor-in Chief
HARI VISHNU

Social Media
VACANT

Webmaster
BHARATH KALYAN

Student Activities
ELIZABETH CREED

Membership Development
ELIZABETH CREED

Fellow Evaluating Committee
ROSA ZHENG

Women in Engineering
FARHEEN FAUZIYA

Young Professional
ROBERTO PETROCCIA

Technology Committee Coordinator
M. A. ATMANAND

OCEANS Central Coordination Committee (OCCC)
VENUGOPALAN (VENU) PALLAYIL

Awards, Nominations
JERRY C. CARROLL

Chapter Coordinator
MAURIZIO MIGLIACCIO

CHAPTER CHAIRS

REGION 1-6, USA
PROVIDENCE
Gopu Potty

HOUSTON
In Chul Jang

SAN DIEGO
Gregory Laugle

SEATTLE
Vacant

HAWAII
Mark Rognstad

REGION 7, CANADA
CANADIAN ATLANTIC
Mae L. Seto

NEWFOUNDLAND & LABRADOR
Weimin Huang

OTTAWA
Zied Bouida

QUEBEC
Saeid Homayouni

TORONTO
AliReza Sadeghian

VANCOUVER
Jacqueline Nichols

VICTORIA
Del Dakin

REGION 8, EUROPE, MIDDLE EAST & AFRICA
FRANCE
Philippe Courmontagne

ITALY
Maurizio Migliaccio

NORWAY
John Potter

PORTUGAL
Nuno Cruz

SPAIN
Joaquin del Rio Fernandez

RUSSIA
Igor Shirokov

TUNISIA
Habib Kammoun

UKRI (REGION 8)
Radhakrishna Prabhu

REGION 9, SOUTH AMERICA
ARGENTINA
Gerardo Acosta

REGION 10, ASIA & PACIFIC
AUSTRALIA
Melanie Olsen

DELHI
Arun Kumar

HONG KONG
Paul Hodgson

INDONESIA
Marina Frederik

JAPAN
Masanao Shinohara

KOREA
Son-Cheol Yu

MADRAS
V Sriram

MALAYSIA
Zool H Ismail

NEW SOUTH WALES
Ollencio D'Souza

SHANGHAI
Lian Lian

SHANDONG
Haiyong Zheng

SINGAPORE
Bharath Kalyan

TAIWAN
Forng C. Chiu

TECHNOLOGY COMMITTEE CHAIRS

AUTONOMOUS MARITIME SYSTEMS (AMS)
BHARATH KALYAN
BILL KIRKWOOD

CURRENT, WAVE AND TURBULENCE MEASUREMENT AND APPLICATIONS
WEIMIN HUANG

DATA ANALYTICS, INTEGRATION AND MODELING
GOPU POTTY
ANANYA SEN GUPTA

OCEAN OBSERVATION AND ENVIRONMENTAL SUSTAINABILITY
RENÉ GARELLO
R. VENKATESAN

OCEAN REMOTE SENSING
FERDINANDO NUNZIATA
PAOLO DE MATTHAEIS

OCEAN SUSTAINABLE ENERGY SYSTEMS
BILL WILSON

POLAR OCEANS
ANDREAS MAROUCHOS
XIONG (BILL) YU

SUBSEA OPTICS AND VISION
HAIYONG ZHENG
JOHN WATSON

UNDERWATER ACOUSTICS
SULEMAN MAZHAR
MEHDI RAHMATI
XUEBO ZHANG

UNDERWATER COMMUNICATION, NAVIGATION, AND POSITIONING
MILICA STOJANAVIC
MANDAR CHITRE

JOURNAL ASSOCIATE EDITORS

Saeed Anwar
Filippo Arrichiello
M.A. Atmanand
David Barclay
Edmund F. Brekke
Li Chongyi
Nicholas Chotiros
Brandon Cochenour
Runmin Cong
Riccardo Costanzi
Nuno Cruz
Roee Diamant
Brendan Englot
Fausto Ferreira
Kenneth Foote
Eric Gill
Joao Gomes
Chunle Guo
Merrick Haller
Michael Hayes
Wei He
Alan Hunter
David William Illig
Guoyuan Li
Hua Li
Nina Mahmoudian
Toshihiro Maki
Giulia De Masi
Eliza Michaloupoulou
Andrey Morozov
Andrea Munafò
Tracianne Neilsen
Barbara Nicolas
Miao Pan
Costas Pelekanakis
Vincenzo Piscopo
Silvio Del Pizzo
John Potter
Gopu Potty
Loannis Rekleitis
Peng Ren
Alessandro Ridolfi
Torstein Sæbø
Yan Song
Joao de Sousa
Milica Stojanovic
Ken Takagi
Yufei Tang
Jun Tao
Blair Thornton
Harris Tsimenidis
Andrea Trucco
Karl von Ellenrieder
Yu Wang
Huang Weimin
Wen Xu
Fumin Zhang
Peng Zhang
Haiyong Zheng
Rosa Zheng
Yifan Zhou

STUDENT BRANCH CHAPTER ADVISORS AND CHAIRS

University of Southern Mississippi
Advisor: Vacant
Chair: Azadeh Razavi Arab

Western Washington University
Advisor: John Lund
Chair: James Kintzele

University of Zagreb
Advisor: Nilola Miskovic
Chair: Igor Kvasic

University of Limerick
Advisor: Gerard Dooly
Chair: Matheus Santos

University of Haifa
Advisor: Itzik Klein
Chair: Nadav Cohen

University of Florence
Advisor: Alessandro Ridolfi
Chair: Alessandro Bucci

National Agronomic Institute of Tunisia
Advisor: Vacant
Chair: Chatti Nour

National Engineering School of Sfax (ENIS)
Advisor: Habib Kammoun
Chair: Abir Abid

Strathclyde University
Advisor: Andrea Coraddu
Chair: Katarzyna Patryniak

Federal Fluminense University
Advisor: Andre L. Belem
Chair: Silvana Cristina Paz do Couto

Pontificia Universidad Catolica de Chile
Advisor: Giancarlo Troni
Chair: Javiera Fuentes

Escuela Tecnologica Inst Tecnico Central
Advisor: Jose Lugo
Chair: David Alejandro Bermudez Rojas

Escuela Superior Politecnica Del Litoral
Advisor: Vacant
Chair: Vacant

Universidad Peruana de Ciencias Aplicadas
Advisor: Nikolai Vinces
Chair: Dana Alessa Rojas Vasquez

Shanghai Jiao Tong University
Advisor: Zheng Zeng
Chair: Yufei Jin

Southwest Petroleum University
Advisor: Suleman Mazhar
Chair: Qingyuan Pu

Zhejiang Ocean University
Advisor: Lu Cao
Chair: Ying Xiong

Chinmaya Vishwa Vidyappth
Advisor: Anupama Jims
Chair: Mohith M

Indian Institute of Technology-Delhi
Advisor: Monika Aggarwal
Chair: Puja Dube

Indian Institute of Technology -Chennai
Advisor: M. A. Atmanand
Chair: Sridhar Krishnamoorthy

KIMEA Engineering College-Aluva
Advisor: Sunil Paul
Chair: Anfal Hisham Thangal P

Panimalar Institute of Technology -Chennai
Advisor: Arun M
Chair: Vacant

Zakir Hussain College of Engineering & Technology
Advisor:Saleem Anwar Khan
Chair: Mohammad Haadi Akhter

Sri Sai Ram Engineering College
Advisor: Sivaramakrishnan S
Chair: Vijay Agritha

https://brest25.oceansconference.org

Call for Abstracts Now Open!

We are thrilled to announce that the Call for Abstracts for OCEANS 2025 Brest is officially open! This prestigious event, taking place from June 16-19, 2025, in Brest, France, invites marine professionals, researchers, and innovators worldwide to submit their abstracts and share insights on the protection and sustainable use of our oceans.

OCEANS 2025 Brest will bring together over 800 attendees and feature 400+ technical papers, interactive sessions, and countless networking opportunities. Don't miss the chance to contribute your expertise and join the global dialogue on maritime innovation.

Submit Your Abstract

Key Deadlines:

Abstract Submission: December 20, 2024
Notification of Acceptance: February 15, 2025

For submission guidelines and further details, please visit our official website.

Join us in shaping the future of ocean sciences and technology. We look forward to your innovative contributions!

OCEANS CONFERENCE & EXPOSITION

IEEE Oceanic Engineering Society

MTS marine technology society

To stay connected and catch the latest updates, follow OCEANS Conference on our social channels linked below.