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From the OES BEACON Editors

Harumi Sugimatsu and Robert Wernli

Welcome to the September 2026 issue of the Beacon. As you'll see in this issue, OES continues to be very active. And this activity is at various levels, from those of us who have been active members for many decades to our YP, WIE and younger members who are carrying our technology into the future. Accordingly, refer to the Table of Contents for a listing of the many activities that OES has been involved in this year and next and the many new names of those helping run OES.

The increased technical activity in OES is shown in the large number of Early Access Papers on IEEE Xplore in the report from our Journal Editor-in-Chief. Other reports from our Executive Committee highlight recent and upcoming activities of the society and what we can expect this year and next. Our Executive VP gives us the latest on the upcoming changes to our constitution. Our VP for Workshops and Symposia provides the OES Conference Calendar that will keep the society active around the world this upcoming year. This issue includes reports on the Western Indian Ocean (WIO) Futures conference, SAUVC 2026 and the inaugural Canadian Atlantic Ocean Symposium (CAOS).

Our VP for OCEANS provides the latest on the OCEANS conferences. This year's events include OCEANS 2026 Sanya, China, and OCEANS 2026 Monterey, California. The Sanya conference was just concluded and this issue's reports on the event (including Special Session on the Ocean Decade, IEEE OES Summer School, OES Awards, Student Poster Competition (SPC) and comments from the SPC winner and WIE ambassador) verify its tremendous success. Monterey will be held in September and will be reported in the next issue. Upcoming year's approved OCEANS conferences will be held in Aberdeen and Anchorage in 2027, followed by Adelaid, Australia, and San Diego in 2028. In addition, a call for OCEANS expression and interest for 2029 is included.

The VP for Technical Activities gives an update on the 2027-2029 DL Program. It also mentions the OES activities on IEEE OES Summer School and WIO. This issue also includes an article on the World Meteorological Organization (WMO)'s approach towards ensuring measurement quality.

Our VP for Professional Activities reports that it has been encouraging to see so many members contributing to activities including YP and WIE workshops at OCEANS 2026 Sanya, and a Student Marine Autonomous Systems Workshop in Edinburg, the CAOS, and IGARSS 2026 to name a few. In this issue, we have a chapter news from Japan. OES is also excited to welcome the Pontificia Universidad Catolica del Peru as the newest OES Student Branch Chapter (SBC).

The VPPA also indicated that the IEEE OES is currently seeking YP and WIE Ambassadors for a two year term starting in 2027. Individuals selected will help connect members within their communities, along with hosting workshops and support activities.

And don't miss this issue's report on one of our outstanding members in this issue's Who's Who in IEEE OES.

Have you done something exciting lately? Received an award or professional recognition? Be sure to contact your editors about submitting an article.

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. This issue covers many elected or appointed positions that begin in 2027. It's your society and it is here to help you reach your professional goals. Enjoy.



Harumi with Tamaki and our student in front of 10,000 m-class HOV"Fendouzhe"at Sanya.



It was Bob's pleasure as Conference Chair to Welcome everyone to OCEANS 2021 San Diego. Looking forward to welcoming everyone when cutting the ribbon at OCEANS 2028 San Diego.

Executive VP Report—Re-revision of Bylaws and Constitution

Mal Heron, Executive VP



In line with the increasingly fast communications and short time scales, any changes to the Constitution or Bylaws may be short-lived. And we have been caught up in this whirlwind.

Changes to our Bylaws were adopted by AdCom 0n 21 April 2026. One of the (many) changes was to grant Graduate Student Members (GSM) the same rights and privileges as Members, as requested by IEEE. Unfortunately, the IEEE Board found some unexpected consequences in this, and we were advised in July that there had to be some changes. It all centred on a technical meaning of the word 'election,' but I won't go into that here – you have to read the Bylaws. Just note that Lewis Carroll [1] in a rather prescient comment had Mr. Dumpty giving advice about the definition of words. "When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean—neither more nor less." The newly revised Bylaws with the correct wordings are on AdCom's agenda for their September meeting.

The situation for the Constitution has become even more entangled because the Constitution has a built-in inertia that (quite correctly) makes it harder to change. The amendments to the Constitution were endorsed by AdCom in April and off they went through the IEEE validation and on to a ballot of all Members (i.e., you). It was still in process in July when we got the notice to change some wording. You will see elsewhere in this issue an article that outlines these new changes. These go on top of the changes that were published in the March Beacon (Page 11, Revision of the Constitution) but the approvals process now has to start all over again from the beginning. To be fair I must say that some corrections and clarifications were also made to improve the document as the basis of the Society.

To end on a more cheery note, I am pleased to report that the revision of committees is now complete with a suite of charters to guide the Policies and Procedures.

References

[1] Lewis Carroll, Through the looking glass, Ch VI, 1871.

VPTA Column

Shyam Madhusudhana, VP for Technical Activities



As we move into the second half of 2026, our technical and regional portfolios are entering a busy transition period. With several key volunteer terms concluding at the end of the year, we have important calls for leadership nominations, alongside updates on recent events and upcoming coordination meetings.

First, I would like to share that our Technology Committee (TC) Coordinator, M. A. Atmanand, has decided to step down from his role. On behalf of the Society, I want to express my gratitude to Atmanand for his service and guidance. We are seeking a new TC Coordinator to step in. If you are interested in shaping the trajectory of our TCs, please reach out directly to me with your application.

Additionally, as noted in my previous report, the term for our Chapters Coordinator—currently held by Maurizio Migliaccio—concludes at the end of December. We are inviting nominations for the 2027–2029 term. Self-nominations are very welcome.

The two-year terms for all TC Chairs and Co-Chairs across all of our Technology Committees also conclude at the end of this year. To ensure a smooth transition, the slate of new executives must be formally appointed during the December AdCom meeting. As such, nominations must be received by 15 October. I encourage members to nominate qualified colleagues or self-nominate to lead their respective technical communities. Please send nominations directly to the VPTA (vp-technical-activities@ieeeoes.org).

I am pleased to report that the IEEE-OES Summer School held alongside Sanya OCEANS was a resounding success. It provided a fantastic platform for students and early-career professionals to engage with ocean engineering experts. Likewise, the WIO Futures 2026 conference in

Mauritius wrapped up successfully, fostering fruitful dialogue around sustainable ocean management and regional policy in the Western Indian Ocean (WIO). Readers can find detailed coverage on both events in dedicated articles featured elsewhere in this issue of Beacon.

To maintain strong alignment across our operational bodies, we are scheduling dedicated virtual alignment meetings:

- A meeting of all TC Chairs is being planned for late August.
- A meeting of all Chapter Chairs will follow in mid-September.

Our global footprint continues to expand. Following the approval of the Hunan-Fujian-Guangdong Chapter earlier this year, I am happy to announce that a new OES Chapter under the IEEE Wuhan Section was recently approved. Welcome to our new colleagues in Wuhan; we look forward to your contributions to the Society.

Finally, regarding the Distinguished Lecturer (DL) program, we have received 6 nominations for the 2027–2029 term. The newly established DL Committee will begin evaluations in September, and we look forward to announcing the selected cohort in the next edition of Beacon.

As always, thank you to all our chairs, coordinators, and volunteers for your continued commitment to OES. Please consider stepping forward for one of our open leadership positions as we plan for 2027 and beyond.

From the VP for Professional Activities (Sept 2026)

Jacqueline Nichols, Vice President for Professional Activities



The OES community continues to be active globally. It has been encouraging to see so many members contributing to activities including YP and WIE workshops at OCEANS 2026 Sanya, a Student Marine Autonomous Systems Workshop in Edinburgh, the inaugural Canadian Atlantic Ocean Symposium (CAOS), and IGARSS 2026 to name a few. These activities are only possible through the efforts of our fantastic volunteers - thank you!

The IEEE OES is currently seeking YP and WIE Ambassadors for a two year term starting in 2027. Individuals selected will help connect members within their communities, along with hosting workshops and support activities. These positions are an opportunity to contribute to OES while developing leadership experience and expanding your professional network.

I am also excited to welcome the Pontificia Universidad Catolica del Peru as the newest OES Student Branch Chapter (SBC). SBCs are an excellent way for students to connect with the Society, participate in and organize local activities, and build relationships with other ocean engineering students and professionals. If your institution does not have an OES SBC, consider starting one!

If you are interested in getting involved with any of these activities, have an idea for a new initiative, are interested in joining one of our committees, or would simply like to learn more about professional activities and opportunities within OES, please contact me at vp-professional-activities@ieeeoes.org.

VP OCEANS Report

Venugopalan Pallayil, Vice President for OCEANS (VPO)

Dear OES Members,

OCEANS 2026 Sanya has been a successful conference, thanks to the good work put in by both the Local Organising Committee (LOC) and the Professional Conference Organiser (PCO). We received a warm welcome while arriving at the conference venue. A detailed report on the conference organization and associated side events has been covered elsewhere in this edition of Beacon. Nevertheless, I would like to touch up on some



of the highlights of the conference. The conference received over 700 abstracts of which 460 papers have finally made it into the IEEE Xplore database. A Summer School was organized prior to the conference, which was well attended. There were multiple plenaries and keynotes, and many tutorials in addition to the usual events like Young Professional and Women in Engineering panel discussions over lunch. The Student Poster Competition had 20 participants showcasing their research work.

It is a very welcome sign that we are seeing an increase in the number of abstract submissions in the recent OCEANS conferences. Brest contributed 417 papers to IEEE Xplore. Monterey OCEANS has received over 600 abstracts, and we have over 400 papers accepted. But this also comes with the challenge of finding enough reviewers. It is concerning that only 15 to 20% of the reviewers accept our request to review the abstracts. The LOCs often struggle to get enough reviews and had to send repeated reminders to get the reviews completed. This is not sustainable in the long run and needs help from our members. I would like to request more of our members to sign up as reviewers, highlighting their topics of interest, and help with the reviews. The OES Technology Committees can also help in this regard by organizing special sessions at OCEANS conferences.



Figure 1. Received a warm welcome on arriving at Sanya.



Figure 2. A relaxing afternoon with colleagues on the beaches of Sanya.

OCEANS 2026 Monterey is just a few weeks away with an outstanding technical programme planned. I look forward to meeting many of you there. A few changes to our technical programme are worth noting. Papers to be considered for publication in the IEEE database required an extended abstract to assess its quality and relevance. In addition to the regular poster presentations with full papers, a poster only program without the need for a full paper was introduced. This is to provide an opportunity for authors to showcase some preliminary results or ideas from their research, which may have a potential to expand into a full journal publication later. We also offered a reduced fee for students who wanted to register for 'poster only' presentations. The tutorials are also being offered at a reduced rate for those who have registered for the full conference. These measures we hope will help to mitigate to some extent the rising costs of registration fees associated with the conference organization. The usual Student Poster Competition will run separately as in the past and all the papers under this session will go into IEEE Xplore.

Another notable change is to, once again, open up our exhibition to the public under free registration with a view to bring more value to our exhibitors. We have been experimenting from OCEANS 2024 Singapore onwards with this approach and based on the feedback from exhibitors, it has been paying off. It is important that we ensure our exhibitors are getting enough exposure and footfall during the conference. In the past the exhibitors had no or limited, visitors when the technical sessions are on.

For the year 2027, OCEANS will be held in Aberdeen in June followed by Anchorage in September. The 2028 OCEANS editions will be held in Adeliade and San Diego respectively during April and September. An OCEANS Central Coordination Operational Committee has been formed for a better planning of future OCEANS. This committee will be responsible for reviewing proposals for hosting future OCEANS and recommending the venues for AdCom approval. Proposals for 2029 editions of OCEANS are still awaited while for 2030, Japan and Abu Dhabi have expressed interest. Hawaii has expressed interest to host the OCEANS 2030 North America edition and Chennai, India is bidding for the 2032 Asia edition.

OCEANS 2026 Monterey will be my last conference as VP OCEANS as my term comes to an end on 31 Dec 2026. A new VP OCEANS will be appointed during our forthcoming AdCom meeting in Monterey and will take charge from 01 Jan 2027 onwards for the next two years. I would like to take this opportunity to thank you all for supporting me over the last four years in my role as VP OCEANS. I would also like to thank IEEE OES for providing the great opportunity to serve our community, which has been very challenging. I wish all the best for our future VP OCEANS.

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:

- Rim Eltobgui, Saverio Iacoponi, Federico Renda, Giulia De Masi, Jorge Dias. Underwater Robotic Swarms: Lightweight Visual Tracking and Relative Localization Approach. https://www.doi.org/10.1109/JOE.2026.3678798
- Cong Wei, Alison B. Laferriere, Wei-Kuo Yen, Aaron Thode, Dieter Bevans, Lauren Freeman, Krishnanand Kaipa. Inter-Platform Coordination for Estimating Oceanic Velocity Gradients Using Lagrangian Floats. https://www.doi.org/10.1109/JOE.2026.3682017
- Milind Fernandes, Soumya Ranjan Sahoo. Modeling and Nonlinear Control Design for a Small Hydrobatic Autonomous Underwater Vehicle. https://www.doi.org/10.1109/JOE.2026.3695741
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More Revisions of the OES Constitution

Mal Heron, Executive VP

In the March issue of Beacon there is an article ("Revision of the OES Constitution," page 11) that outlines proposed changes to the Constitution. These changes were duly approved by AdCom and went through the IEEE-TAB compliance process and in July were ready to go to a ballot of all Members for approval. At that point the proposed amendments were withdrawn because IEEE had mandated some extra changes, mainly about consistent wording. This second-layer of amendments is now going through the required approvals and it is anticipated that the full suite of amendments to the current 2022 Constitution will go out to ballot of all Members later in the year. This article satisfies one of the constitutional requirements for amending itself.

1) Definition of "election"
IEEE has defined the word "election" to apply only to a ballot of all Members of the Society – like the election of members of AdCom. When a committee votes for a chair, or when Ad Com votes for the OES Officers, it is an "appointment." Appropriate changes to effect this are scattered throughout the revised Constitution.
2) Corrections without changing meaning
A structural error in the document is fixed in clauses V-3.2 and V-3.3.
Corrections are made in clauses V-1.1, V3.1, VII-1, and IX-2.
3) Constitution Amendment Procedure
Clause X-1 is amended to reduce the timeline for most amendments to the Constitution without compromising the high standard required to make changes.

Call for Expressions of Interest—Committees

From the OES Administrative Committee

OES 12 Technology Committees, along with several Standing Committees and Operational Committees, will undergo their biennial membership renewal process this October/November, with new terms beginning on 1 January 2027. These committees play a vital role in supporting and advancing the Society, and we are eager to welcome new members and fresh perspectives. A list of the committees open for renewal is provided below. If any align with your interests or professional expertise, we encourage you to reach out - we would be delighted to have you involved. Additional information can be found on the OES website (will be updated soon), and as explained in the Executive VP report in this issue.

All appointments are subject to approval by the Administrative Committee.

1) All of the Technology Committees are up for renewal:
   - Autonomous Maritime Systems
   - Data Analytics and AI
   - Energy
   - Living Resources
   - Moorings and Structures
   - Optics and Imaging
   - Oceanography and Meteorology
   - Remote Sensing
   - Metrology and Instrumentation
   - Underwater Acoustics
   - Underwater Communication and Positioning
   - Emerging Technologies & Other Oceanic Engineering Topics
2) Operational Committees up for renewal:
   - OCEANS Central Coordination Committee
   - Awards committee
3) Some of the Standing Committees are being renewed:
   - Governance Committee
   - Strategic Planning Committee
   - Standards Committee
   - Nominations and Appointments Committee

In addition to the above committees, there are occasional volunteer vacancies throughout the year. If you are interested in volunteering in the above committees starting in 2027, or filling current vacancies, please refer to the volunteer interest form: https://tinyurl.com/VolunteerOES.

2025 OES Distinguished Service Award Presented to Professor Emeritus Tamaki Ura at OCEANS 2026 Sanya

IEEE OES Awards Committee

The 2025 IEEE Oceanic Engineering Society Distinguished Service Award was formally presented to Professor Emeritus Tamaki Ura of the University of Tokyo during the Gala Dinner at OCEANS 2026 Sanya on Wednesday, May 27, 2026.

Professor Ura was unable to attend OCEANS 2025 Great Lakes, where the 2025 OES award recipients were originally recognized. The award presentation was therefore held in Sanya, together with the presentations of other OES awards, and OES President Elizabeth Creed presented Professor Ura with the Distinguished Service Award plaque.

Professor Ura received the award for decades of inspired and enduring leadership, including his service as the founding Chair of the OES Japan Chapter, his central role in establishing and organizing the OES International Symposium on Underwater Technology (UT), and his contributions to bringing the OCEANS conference to Japan.

The ceremony provided a memorable opportunity for the international OES community to celebrate Professor Ura's longstanding and distinguished service to the Society.



OES President Elizabeth Creed presented the award plaque to Professor Emeritus Tamaki Ura.

Behind Every Research Project Is a Story Worth Telling – A Week at OCEANS 2026 Sanya

Vijaya Lakshmi Thiagarajan, PhD scholar (PMRF), IIT Madras, IEEE OES Women in Engineering (WIE) Ambassador (2026–27)

On 27 May, I stood in a room in Sanya, China, watching a journalist teach a group of ocean engineers how to tell the story of their own research. It was the WIE Luncheon our team had organised at OCEANS 2026 Sanya, and its theme was simple: behind every research project is a story worth telling.

I spent that afternoon helping others find the stories inside their work. It was only on the flight home that I realised the week itself had quietly become one. So let me tell it the way it deserves to be told.

Before the Conference Began

My OCEANS 2026 Sanya actually started two days early, at the IEEE OES Summer School on 23–24 May. There is a particular feeling to a room of early-career ocean professionals at the start of such a programme—a mix of ambition and quiet uncertainty, everyone wondering whether they truly belong in a field this vast. By the end of the second day, that uncertainty had dissolved into something warmer. We were no longer strangers; we were a cohort. I am grateful to Shyam Kumar Madhusudhana, Vice President for Technical Activities, for shaping a programme that does the unglamorous, essential work of making the next generation feel at home in this society.

The Podium

Then it was my turn to step up. I presented my paper, "Bayesian Hyperparameter Optimization of Physics-Informed Neural Networks for Marine Current Turbine Wake Prediction" — work that asks how Bayesian optimisation can tune physics-informed neural networks to better predict the wakes of marine current turbines. It is the spine of my doctoral research at IIT Madras, and standing before an international audience to defend it was both daunting and deeply satisfying. None of it would exist without the patient guidance of my supervisor, Prof. Abdus Samad, and Dr. Suresh Rajendran. The slides carried my name; the thinking behind them carries theirs too.

The Heart of the Week: The WIE Luncheon

If I had to choose one afternoon to relive, it would be the luncheon itself. Alongside my fellow organisers, Luyuan Peng and Olaya Alvarez-Tuñón, I helped bring to life a session on the theme of Scientific Storytelling. Our speaker was Geng Tingting, a reporter with the Qingdao Daily, and she did something I will not forget: she stood before a room full of engineers and gently dismantled the wall we so often build between our research and the people we hope it will reach. Through a hands-on, interactive workshop, she showed us how to turn dense technical work into narratives that hold their scientific depth while finding a human voice. She came to us as an invited speaker. She is now my friend—proof, perhaps, that storytelling really does connect people.

We were honoured that OES President Elizabeth L. Creed joined the session. When she told us afterward how much the event had resonated with her, the entire organising team felt the quiet pride of work that has reached exactly the audience it was meant for.

Sharing the Research



Presenting at OCEANS 2026 Sanya



At the IEEE OES Summer School (23–24 May)

The WIE Luncheon on Scientific Storytelling



The WIE Luncheon on Scientific Storytelling — "From the Deep, To the World"



Organisers and speaker with OES President Elizabeth L. Creed



Event flyer — speaker Geng Tingting, Qingdao Daily

Conversations at the Booth

Some of the most memorable moments of any conference happen away from the main stage. For me, that was the OES booth. I had the privilege of staffing it through the conference, and the conversations there became a kind of portrait of the society itself: students encountering IEEE OES for the very first time, their eyes widening at the breadth of the field; senior members who have shaped this community for decades, generous with both their time and their stories. The same curiosity, the same love of the ocean, across every generation in the room.

The People Who Made It Possible

A conference is, in the end, the people who gather for it. I would like to honour a few of them.

To President Elizabeth L. Creed, whose warmth and presence at our luncheon set a tone of inclusion that carried through the week — thank you. To Executive Vice President Mal Heron, whose steady leadership holds this community together in ways most of us never see — thank you. To Vice President for OCEANS Venugopalan Pallayil, whose tireless work behind the scenes made a conference of this scale feel effortless — thank you.

To Prof. M. A. Atmanand, I owe a different kind of gratitude altogether. He has been my mentor and my guiding lamp throughout this journey — the figure whose counsel I carry with me long after each conversation ends, and whose belief in me has shaped the researcher I am becoming.

To Treasurer Weimin Huang, for a conversation I genuinely treasured and hope to continue. To Francesco Maurelli, Giulia De Masi, and Prof. Sulaiman, for exchanges that sharpened my thinking and widened my view of the field.

And to Harumi Sugimatsu — for years our acquaintance lived entirely in email, and meeting her in person at last was a small, real joy. The ocean has a way of eventually bringing the right people to the same shore.



Leaving Sanya

Sanya gave us a setting equal to the occasion — the sweep of Phoenix Island, the wonder of the Atlantis Aquarium, the South China Sea a steady blue companion throughout. But what I packed for home was not the scenery. It was a paper delivered, a luncheon brought to life, a notebook full of new ideas, and a contact list full of new friends.

The theme of our luncheon was that every research project hides a story worth telling. OCEANS 2026 Sanya reminded me that the same is true of a community — and that the privilege of belonging to one as warm as IEEE OES is, itself, a story I will keep telling for a long time to come.



Chapter News

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

Japan Chapter

IEEE OES Japan Chapter Special Lecture

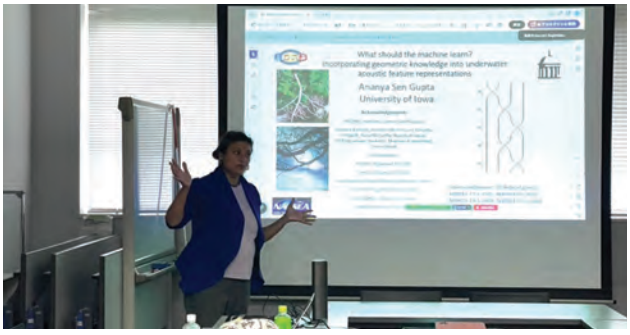
What should the machine learn? Incorporating geometric knowledge into underwater acoustic feature representations

Speaker: Ananya Sen Gupta, University of Iowa, IEEE OES AdCom member

Reported by Harumi Sugimatsu

On 6 August, 2026, the IEEE Oceanic Engineering Society (OES) Japan Chapter organized a special lecture by Dr. Ananya Sen Gupta, Associate Professor in the Department of Electrical and Computer Engineering at the University of Iowa and a member of the IEEE OES Administrative Committee (AdCom). The lecture was held at the Institute of Industrial Science (IIS), The University of Tokyo, in conjunction with the Foreign Researcher Lecture Program of the Foundation for the Promotion of Industrial Science.

In her lecture, entitled "What Should the Machine Learn? Incorporating Geometric Knowledge into Underwater Acoustic Feature Representations," Dr. Sen Gupta addressed the challenges of applying machine learning to underwater acoustic data. Such data are often affected by complex, dynamic, and unpredictable environmental conditions, as well as nonlinear and time-varying overlap among multidimensional features.



Dr. Ananya Sen Gupta delivering her special lecture at the IIS, The University of Tokyo.

Drawing on case studies from field experiments and physics-based simulations, she explained how classical signal theory, geometric feature engineering, and modern artificial intelligence can be combined to extract scientifically meaningful information from noisy and highly structured sensor data. She also introduced the use of topology and geometric braid theory to assess what makes a machine-discovered feature informative. The lecture stimulated an engaging discussion on machine learning, underwater acoustics, and knowledge discovery in complex marine environments.



Group photo after the lecture.



Discussions following the lecture.



Lunch at the campus cafeteria.

Before the lecture, members of the Japan Chapter joined Dr. Sen Gupta for lunch at the campus cafeteria. Following the lecture, she toured the institute's marine robotics facilities, including several autonomous underwater vehicles and the experimental water tank.

The lecture and laboratory tour provided a valuable and enjoyable opportunity to exchange ideas and discuss possibilities for future collaboration. We hope that this visit will help foster closer connections and further collaboration among OES AdCom members.

Malaysia Chapter

IEEE OES Malaysia Chapter Showcases Oceanic Engineering and Underwater Robotics at the Terengganu Innovation & Invention Expo 2026

Reported by Zainah Md. Zain & Zool Hilmi Ismail

The IEEE Oceanic Engineering Society (OES) Malaysia Chapter participated as an exhibitor at the Terengganu Innovation & Invention Expo 2026 (Ekspo Rekacipta & Inovasi Terengganu 2026), held from 9–11 August, 2026, at the Terengganu Trade Centre (TTC), Kuala Terengganu, Malaysia. The three-day event brought together students, educators, researchers, innovators, industry representatives, and technology enthusiasts through exhibitions and activities focusing on STEM, robotics, programming, innovation, and emerging technologies. The OES Malaysia Chapter used the exhibition as a platform to introduce oceanic engineering, underwater robotics, marine sensing, and autonomous systems to the wider Science, Technology, Engineering, and Mathematics (STEM) community. A key focus was underwater robotics, highlighting how ROVs and AUVs integrate mechanical systems, electronics, sensors, embedded computing, control, communications, and software to operate in challenging underwater environments.



Figure 1. Highlights of the IEEE OES Malaysia Chapter exhibition at Terengganu Innovation & Invention Expo 2026.

Through the exhibition, visitors were introduced to the role of underwater sensors and intelligent systems in applications such as environmental monitoring, marine research, underwater inspection, and autonomous operations. The demonstrations also illustrated how sensors, microcontrollers, motors, communication systems, and software can be integrated into complete engineering solutions. Interaction with students and educators was an important part of the three-day event. The exhibition encouraged young visitors to ask questions, explore how underwater robots operate, and discover how familiar STEM concepts such as programming, electronics, sensing, control, and artificial intelligence can be applied beneath the water surface. For many visitors, the booth provided an engaging first introduction to oceanic engineering and its potential career opportunities. The expo also created valuable opportunities for the OES Malaysia Chapter to connect with educators, researchers, industry representatives, and other STEM stakeholders. These interactions strengthened awareness of IEEE OES and highlighted the importance of interdisciplinary collaboration in advancing marine and underwater technologies.

A significant achievement during the expo was the IEEE OES Malaysia Chapter receiving Second Place in the Terengganu Innovation & Invention Award 2026 (Industry Category). This recognition reflects the Chapter's efforts



Figure 2. IEEE OES Malaysia Chapter receiving Second Place Award in the Terengganu Innovation & Invention Expo 2026, Industry Category.

in promoting innovation, oceanic engineering, and technology engagement through its exhibition and activities. It also highlights the potential of oceanic engineering and underwater robotics as platforms for innovation and STEM outreach. The achievement further reaffirms the OES Malaysia Chapter's commitment to engaging the wider STEM community and inspiring the next generation of ocean engineers. Through exhibitions, technical activities, demonstrations, and collaborative programmes, the Chapter aims to encourage young innovators to explore the opportunities and challenges of the underwater world.

IEEE OES Malaysia Chapter Members Recognized at Terengganu Research, Innovation and Invention Colloquium 2026

Reported by Zainah Md. Zain & Mohd Shahrieel Mohd Aras

Two members of the IEEE Oceanic Engineering Society (OES) Malaysia Chapter received awards at the Terengganu Research, Innovation and Invention Colloquium 2026, held on 10 August, 2026, at the Terengganu Trade Centre (TTC), Kuala Terengganu, Malaysia. The recognition highlights the Chapter's contribution to research, innovation, and technology development in oceanic engineering and STEM education.



Figure 3. Dr. Zainah Md. Zain receiving the Best Research Award for "Underwater Sensor for Aquatic Environment Monitoring."



Figure 4. Assoc. Prof. Dr. Mohd Shahrieel Mohd Aras receiving the Best Commercialization Potential Award for "Underwater Robotics: Empowering STEM Through Hands-on Innovation."

Dr. Zainah Binti Md Zain received the Best Research Award for her project, *"Underwater Sensor for Aquatic Environment Monitoring."* The project focuses on the development and application of underwater sensing technology for monitoring aquatic environments, demonstrating the role of oceanic engineering and sensing systems in supporting environmental observation and data-driven monitoring. In parallel, Associate Prof. Dr. Mohd Shahrieel Mohd Aras received the Best Commercialization Potential Award for *"Underwater Robotics: Empowering STEM Through Hands-on Innovation."* The project highlights the potential of underwater robotics as an engaging STEM education platform, combining robotics, electronics, programming, sensing, and hands-on learning to introduce students to real-world engineering challenges.

The two awards demonstrate the breadth of activities within the IEEE OES Malaysia Chapter, spanning underwater sensing, aquatic environmental monitoring, underwater robotics, and STEM innovation. They also reflect the Chapter's continuing efforts to promote research excellence, technology innovation, and practical engagement with the wider community. The recognition at the colloquium further strengthens the visibility of IEEE OES Malaysia Chapter and highlights the potential of oceanic engineering research and innovation to contribute to environmental monitoring, education, and the development of future marine technologies.

IEEE OES Malaysia Chapter Explores Terengganu's Traditional Maritime Heritage Through RC Boat Craftsmanship 2026

Reported by Zainah Md. Zain

On 11 August 2026, four members of the IEEE Oceanic Engineering Society (OES) Malaysia Chapter visited a local workshop in Kampung Surau Panjang, Kuala Terengganu, to explore the craftsmanship and technology behind traditional Terengganu fishing boats recreated as radio-controlled (RC) models. The visit provided an opportunity for OES members to learn how the distinctive forms and details of traditional Terengganu boats are carefully translated into miniature RC vessels. The designs draw inspiration from traditional fishing boats, including their hull shapes, cabin structures, masts, rigging, colours, and finishing, preserving important elements of Terengganu's maritime heritage in a modern form.

Beyond craftsmanship, the RC boats demonstrate an interesting integration of traditional maritime knowledge with modern technology, including electric motors, electronic components, and radio-control systems. This combination provides a unique example of how cultural heritage can inspire contemporary engineering and technological innovation. For the OES Malaysia Chapter, the visit also highlighted the connection between maritime heritage and oceanic engineering. Traditional boats represent generations of knowledge in understanding the marine environment, while modern RC technology provides new opportunities to explore, recreate, and introduce these concepts to younger generations.

The visit reinforced the Chapter's commitment to promoting oceanic engineering not only through advanced









Figure 5. Photos during the visit.

marine technologies and underwater robotics, but also by recognising and connecting with the rich maritime heritage and knowledge of coastal communities.

IEEE OES Malaysia Chapter River Cruise in Terengganu

Reported by Zainah Md. Zain & Zool Hilmi Ismail

As part of the activities held in conjunction with the Terengganu Innovation & Invention Expo 2026, members of the IEEE Oceanic Engineering Society (OES) Malaysia Chapter took the opportunity to explore the Terengganu River through a river cruise on 10 August 2026. The cruise provided a relaxed and meaningful opportunity for OES members and academic colleagues to experience the river environment while enjoying views of some of Kuala Terengganu's prominent landmarks, including the iconic Terengganu Drawbridge and the Crystal Mosque. Beyond sightseeing, the activity provided an opportunity for members to strengthen professional and personal connections in a more informal setting. The experience also offered a closer appreciation of the river as an important part of Terengganu's maritime landscape and its connection to the local community, culture, and economy.

The river cruise complemented the Chapter's participation in the innovation expo by providing members with an opportunity to connect their professional interests in oceanic engineering with the real marine and riverine environment. Such activities contribute to building stronger relationships among OES members and supporting a vibrant and collaborative professional community.





Figure 6. IEEE OES Malaysia Chapter Terengganu River Cruise.

Specially Organized Technical Session at OCEANS 2026 Sanya

Status of the UN Decade of Ocean Science for Sustainable Development (2021–2030): The Engineering Challenges

M. A. Atmanand, SM, Former Chair, ODI Committee and Sridhar Krishnamoorthy, IEEE OES ODI Committee

The specially organized technical session on **"Status of the UN Decade of Ocean Science for Sustainable Development (2021–2030): The Engineering Challenges"** was successfully held during **OCEANS 2026 Sanya** on **28 May 2026**. This was initiated by the **Ocean Decade Initiative (ODI)** group of IEEE OES. Chaired by Prof. M. A. Atmanand, Indian Institute of Technology, the session brought together researchers, engineers, and technology developers working at the forefront of ocean engineering to discuss how innovative technologies are helping translate the ambitions of the **UN Decade of Ocean Science (2021–2030)** into practical solutions.

Organized under the **IEEE Oceanic Engineering Society (OES) ODI**, the session provided an opportunity to review ongoing engineering contributions towards achieving *"the science we need for the ocean we want."* The presentations demonstrated how advances in ocean observing systems, autonomous technologies, renewable energy, digital engineering, and ecosystem restoration are becoming key enablers of sustainable ocean development.



Figure 1. Prof. M. A. Atmanand opening the Specially Organized Technical Session at OCEANS 2026 Sanya.

The technical session opened with a brief talk by Prof. Atmanand, which was followed by a presentation by **Dr. Francesco Maurelli**, titled **"Engineering the Ocean Decade Innovation Pipeline: The IEEE OES Ocean Challenge as a Scalable Mechanism for Ocean Technology Prototyping and Capacity Development."** The presentation highlighted the growing role of the IEEE Oceanic Engineering Society in supporting the UN Decade of Ocean Science through international collaboration, innovation challenges, and capacity-building initiatives. Particular emphasis was placed on developing scalable engineering solutions and nurturing the next generation of ocean engineers capable of transforming innovative concepts into operational technologies. The presentation demonstrated how professional societies can play a significant role in accelerating technology readiness while strengthening global engineering capacity, particularly in developing nations.



Figure 2. Dr. Francesco Maurelli presenting IEEE OES contributions to the UN Ocean Decade.

The session continued with **Mr. Sridhar Krishnamoorthy**, who presented **"Multipurpose Offshore Floating Platforms: A Solution towards Sustainable Ocean Economy by Mitigating Ocean–Climate Impacts."** The presentation introduced integrated offshore platforms capable of combining renewable energy generation, environmental monitoring, aquaculture, and other blue economy applications within a single infrastructure. Such multifunctional systems offer significant opportunities to enhance resource efficiency, reduce operational costs, and support climate adaptation while contributing directly to several Ocean Decade Challenges related to sustainable ocean economies and climate resilience.

Mr. Sridhar also presented a second contribution entitled **"Engineering Insights into Coral Reef Habitat Distribution Using Hydrodynamic Modelling and Seabed Morphology: A Gulf of Mannar Case Study."** This work demonstrated how advanced numerical modelling and seabed characterization can improve understanding of



Figure 3. Mr. Sridhar Krishnamoorthy presenting multipurpose offshore floating platforms.

coral reef habitat distribution, providing valuable scientific information for ecosystem conservation and restoration. By integrating engineering tools with marine ecology, the study illustrated how ocean engineering can directly support biodiversity conservation, habitat management, and evidence-based marine spatial planning—important priorities under UN Decade of Ocean Science.

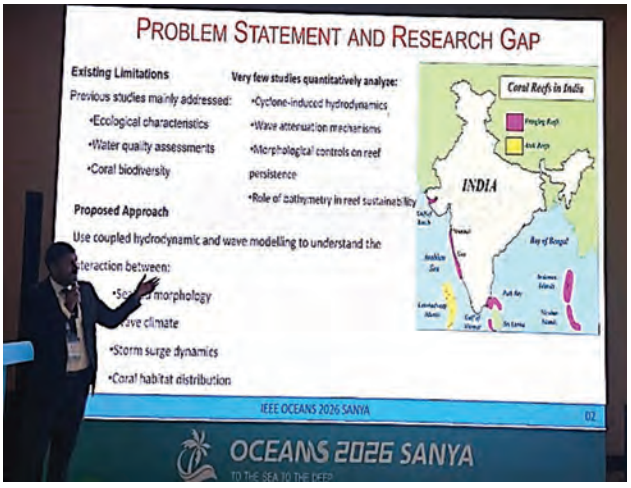


Figure 4. Mr. Sridhar Krishnamoorthy presenting engineering insights into coral reef habitat distribution.

Advancing the discussion on intelligent autonomous systems, **Dr. Giulia De Masi** presented **"Biomimetic Intelligent Robotic Swarm for Marine Ecosystem Monitoring, Conservation and Restoration."** The presentation showcased how biologically inspired robotic swarms can provide adaptive, distributed, and efficient monitoring of fragile marine ecosystems. Such autonomous systems have the potential to transform long-term environmental observation, coral reef monitoring, and restoration activities by improving spatial coverage while reducing operational costs and human intervention. The work aligns closely with the UN Decade of Ocean Science vision of developing innovative observing technologies capable of supporting healthy and resilient marine ecosystems.



Figure 5. Dr. Giulia De Masi presenting biomimetic robotic swarms for marine ecosystem monitoring.

The final technical presentation by **Mr. Suman Kumar**, titled **"Influence of Ocean Currents on Mooring Dynamics and Power Performance of a Point Absorber,"** addressed one of the important engineering challenges associated with marine renewable energy systems. Through detailed analysis of mooring behaviour under varying ocean current conditions, the study provided valuable insights into improving the reliability, survivability, and energy conversion efficiency of wave energy devices. These findings contribute directly to the development of sustainable low-carbon ocean energy technologies that support the transition towards climate-neutral maritime operations.

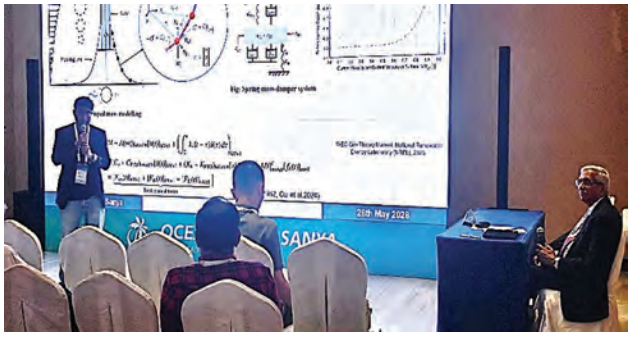


Figure 6. Mr. Suman Kumar presenting wave energy point absorber dynamics under ocean currents.

Together, the five presentations illustrated the breadth of engineering innovation currently supporting the implementation of the UN Decade of Ocean Science. They addressed several of the Ocean Decade Challenges, including advancing ocean observing systems, protecting marine ecosystems, developing sustainable blue economy solutions, strengthening climate resilience, promoting renewable ocean energy, and building engineering capacity through international collaboration and technology development.

The session generated lively discussions among participants from academia, industry, government agencies, and research organizations. Audience interactions focused on challenges related to technology scalability, affordability,



Figure 7. Group photograph of the Specially Organized Technical Session at OCEANS 2026 Sanya.

interoperability, long-term sustainability, and deployment in under-observed regions. Several participants highlighted the importance of translating laboratory-scale innovations into operational ocean technologies while ensuring accessibility for developing countries, Small Island Developing States (SIDS), and data-poor regions. The discussions also emphasized the growing importance of interdisciplinary collaboration between ocean scientists, engineers, policymakers, and industry partners to accelerate implementation of UN Decade of Ocean Science Actions.

One of the key outcomes of the session was the recognition that engineering innovation is fundamental to achieving the societal outcomes envisioned under the UN Decade of Ocean Science for Sustainable Development. The exchange of ideas during the session fostered new opportunities for collaboration, encouraged future joint research activities, and reinforced the importance of international partnerships in delivering scalable technologies for sustainable ocean management. The Specially Organized Technical Session, initiated by the **IEEE OES Ocean Decade Initiative (ODI)** Group, marks an important step in this continuing effort. Building on this foundation, the IEEE OES **Ocean Decade Operational Committee (ODOC)** is carrying this work forward by coordinating ongoing activities, strengthening collaborations, and advancing engineering contributions in support of the UN Decade of Ocean Science. The success of this Specially Organized Technical Session reflects the growing commitment of the global ocean engineering community to contribute practical solutions to the world's most pressing ocean challenges while further strengthening the role of the IEEE Oceanic Engineering Society as a platform for engineering excellence in support of the UN Decade of Ocean Science.

The organizers gratefully acknowledge the **IEEE Oceanic Engineering Society (IEEE OES)** for supporting the Ocean Decade Initiative and providing an international platform to showcase engineering innovations that contribute to sustainable ocean development. Special thanks are also extended to the **OCEANS 2026 Sanya Local Organizing Committee** for their excellent support, coordination, and hospitality, which ensured the successful organization and smooth conduct of this Specially Organized Technical Session. Their dedicated efforts created an engaging environment for technical exchange, collaboration, and international networking, making the session a valuable contribution to the OCEANS 2026 conference programme.

The session concluded with optimism that the ideas, collaborations, and technical advances presented in Sanya will continue to contribute to the remaining years of the **UN Decade of Ocean Science (2021–2030)** and inspire future engineering innovations that will help realize *"the ocean we want."*

What Ocean Science and Technology can Learn from WMO's Approach Towards Ensuring Measurement Quality

Christoph Waldmann, IEEE Life Senior Member

The World Meteorological Organization (*WMO, www.wmo.int) Guide to Instruments and Methods of Observation* was first published in 1954 and has since evolved into a multi-volume reference covering measurement methods for a wide range of operational meteorological, climatological, and oceanographic variables, including many of the Essential Climate Variables (ECVs).



The establishment of the Guide in 1954 can be understood as the result of four converging pressures. First, the newly created treaty-based organization required a practical "how-to" layer beneath its binding Technical Regulations. Second, the rapid expansion of aviation had turned inconsistencies in meteorological measurements into issues of safety and operational responsibility. Third, the growing upper-air observing network and the emergence of numerical weather prediction made systematic instrumental biases scientifically unacceptable. Fourth, the long-established synoptic principle—that international data exchange is only meaningful if observations are comparable—finally acquired an institutional framework with the authority to codify and maintain common measurement practices.

Importantly, none of these drivers were concerned with "measurement quality" as an end in itself. The underlying objectives were safer operations, better forecasts, and internationally exchangeable data. Historically, this is the argument that has justified investment in measurement infrastructure, and it remains a highly relevant framing for the ocean-observing community today.

Two structural features of the Guide are particularly important. First, it is a living document supported by formal governance. Updates are prepared by expert teams in cooperation with the Editorial Board of WMO INFCOM's Standing Committee on Measurements, Instrumentation and Traceability, circulated to WMO Members for review, and revised through a documented process in which comments are formally addressed and tracked. Second, and this is much less widely recognized within the ocean community, Volume II of the Guide is entitled *Measurement of Oceanographic Variables*. What is largely missing is sustained ownership and active development by the ocean-observing community itself. WMO-No. 8 is arguably one of the most successful instruments for promoting measurement consistency across environmental observations; less well known is the fact that it already provides an institutional foothold for ocean measurements.

Possible Transferable Mechanisms

1. Move from documentation toward convergence

The ocean community's principal mechanism for documenting measurement practice, the Ocean Best Practices System (OBPS), is fundamentally a repository. This is highly valuable, but it is deliberately pluralistic: multiple documented methods can coexist for the same variable, and there is no requirement to converge on a single endorsed approach.

WMO-No. 8 embodies a different philosophy. It provides a consolidated, version-controlled and internationally maintained reference for each class of measurement, supported by a defined amendment process and clear editorial responsibility. The deeper lesson is that **convergence is itself a scientific product**. Interoperable global datasets do not emerge solely because every group documents its own procedures; they depend on sufficient agreement about how observations are made, processed and reported.

A realistic step for the ocean community would therefore be to designate, for each Essential Ocean Variable (EOV), one OBPS-hosted document as the endorsed reference method. This document could be maintained through

a versioned, CIMO-style governance process, while alternative approaches would remain documented as justified deviations or complementary methods.

2. Make uncertainty a specification rather than a retrospective statement

A further strength of the WMO framework is the explicit connection between user requirements and measurement capability. Annex 1 of the Guide provides, for individual variables, information on required measurement uncertainty, achievable performance and reporting resolution. In parallel, WMO's Rolling Review of Requirements expresses observational needs in terms of threshold, breakthrough and goal values.

Together, these mechanisms create a direct link between what users require and what observing systems are expected to deliver. Measurement uncertainty therefore becomes a design and performance specification, rather than something assessed only retrospectively after data have been collected.

Global Ocean Observing System (GOOS, www.goos-ocean.org) Essential Ocean Variable (EOV, https://goos-ocean.org/what-we-do/framework/essential-ocean-variables/) specification sheets already move in this direction, but uncertainty requirements are not yet consistently expressed in quantitative or application-specific terms. A transferable approach would be to assign each EOV explicit numerical uncertainty requirements for different use cases—for example climate applications, operational forecasting and coastal management—and to review these requirements on a regular cycle.

OES Conference Calendar

Contact BEACON Editors, OES VPWS and VPTA

OCEANS

OCEANS 2026 Monterey
September 21–24, 2026
Monterey, USA
https://monterey26.oceansconference.org

OTC

OTC 2027
May 3–5, 2027
Houston, USA
https://2027.otcnet.org

OTC Brasil 2027
October 26–28, 2027
Rio de Janeiro, Brasil
https://otcbrasil.org

OES Sponsored (financial or technical)

AQ²UASIM-V2 - Simulators for Marine Applications
October 1, 2026
Pittsburgh, USA
https://sites.google.com/view/aquasim-v2/home

MetroSea 2026
October 5–7, 2026
Sibenik, Croatia
https://metrosea.org

USYS 2026
December 18–20, 2026
Penang, Malaysia
https://www.usys26.com

SAUVC 2027
February 24–27, 2027
Singapore
https://sauvc.org

UT27
February 28–March 3, 2027
Tokyo, Japan
http://ut27.org

OES Patronaged

BtS2026
October 18–25, 2026
Vodice, Croatia
https://bts.fer.hr

Underwater Robot Challenge 2026
October 9–11, 2026
Pahang, Malaysia

Non-OES but OES members are involved in

None

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

WIO Futures 2026: Anchoring Science, Technology, and Policy for a Resilient Ocean Economy

Shyam Madhusudhana, VP for Technical Activities



The *WIO Futures* conference, first such event to be organized under the OES' banner in the Western Indian Ocean (WIO) region, had marked a key milestone in 2024 at its pilot edition, connecting scientists, policymakers, and industry leaders in the region towards forging new partnerships for marine research and sustainable ocean governance. The event, envisaged to integrate scientific innovation with practical policy strategies, had 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 had succeeded in highlighting the importance of cross-sectoral and cross-border collaboration.

Building on the success of the inaugural 2024 event, the WIO Futures 2026 International Conference returned for its second edition on 18–19 May at the Caudan Arts Centre in Port Louis. Centered around the theme "Building a Resilient Ocean Economy through Science, Policy, and Community," the summit brought together over 150 researchers, policymakers, diplomats, and industry leaders from 13 countries, with the aim to draft actionable strategies and pave the way for a regional blue economy roadmap.



Conference attendees were well-engaged during the break-out group discussions.

The 2026 conference signaled a significant expansion in high-level diplomatic and institutional backing. The opening proceedings featured a distinguished lineup of dignitaries, emphasizing the strategic geopolitical weight of the Western Indian Ocean:

- Dr. the Hon. Arvin Boolell, Minister of Agro-Industry, Food Security, Blue Economy and Fisheries (Mauritius), who outlined government visions for transforming Mauritius into a "Big Ocean Sustainable State" and announced drafting new ocean governance legislation.



Dignitaries who graced the conference opening with their presence. Left-to-Right: ***Caroline Rault****, Eclosia Group;* ***Dr. Shyam Madhusudhana****, FER, University of Zagreb, Croatia;* ***Dr. Myriam Blin****, Charles Telfair Centre;* ***Dr. the Hon. Arvind Boolell****, Government of Mauritius;* ***H.E. Anurag Srivastava****, Indian High Commission;* ***Dr. Jeremy Charoux****, Charles Telfair Education;* ***H.E. Lisa Simrique Singh****, UN Mauritius & Seychelles;* ***H.E. Kate Chamley****, Australian High Commission;* ***Prof. Lina Pelliccione****, Curtin Mauritius;* ***Bernardo Nascimento****, Odysseo Foundation;* ***Marius Schneider****, German Consulate.*

- H.E. Anurag Srivastava, High Commissioner of India to Mauritius.
- H.E. Kate Chamley, High Commissioner of Australia to Mauritius.
- H.E. Lisa Simrique Singh, UN Resident Coordinator for Mauritius and Seychelles.



Shyam Madhusudhana presented a token of appreciation to H. E. Anurag Srivastava for gracing the event with his presence and for his insightful opening speech.

As the primary sponsor, the IEEE Oceanic Engineering Society (OES) continued its key role in connecting cutting-edge scientific innovation directly with high-level ocean governance and regional policy. Alongside the co-founding and organizing collaborators—the Charles Telfair Centre (CTE) and the Centre of Ocean and Earth Science & Technology (COEST)—this year's event garnered additional financial support from the Indian Ocean Rim Association (IORA) and Australia's Department of Foreign Affairs and Trade (DFAT), and institutional support from the Odysseo Foundation.

A core highlight driven by OES was Expert Session 1. Titled *Ocean Science for Decision-Making*, the session was tailored to bridge the regional "data gap" by translating complex technological innovation into low-cost, scalable, "decision-ready" tools for governance:

- Dr. Nadir Kapetanović: Demonstrated advanced research infrastructure and data-driven engineering solutions geared toward sustainable fisheries management and regional food security.
- Prof. M. A. Atmanand: Highlighted clean, life-sustaining energy and water solutions through Low-Temperature Thermal Desalination (LTTD) and Ocean Thermal Energy Conversion (OTEC).
- Prof. Weimin Huang: Explored the deployment of high-frequency Ocean Radars to provide real-time surface wave and current monitoring for operational safety.
- Dr. Bharath Kalyan: Focused on autonomous marine systems and robotics, acting as force multipliers for deploying smart, independent ocean-monitoring platforms.

Beyond technology, the two-day event featured broad-ranging dialogues on marine spatial planning, blue finance, and inclusive governance:

- Community & indigenous knowledge: Prof. Rosabelle Boswell emphasized the need to integrate local and indigenous knowledge into technocratic frameworks for equitable ocean governance.
- Geopolitical dynamics: High-level panel sessions featuring Prof. Christian Bueger (University of Copenhagen), former UN Ambassador Jagdish Koonjul, and former Permanent Representative Usha Dwarka-Canabady examined evolving maritime security, Small Island Developing States (SIDS) sovereignty, and multilateral cooperation.



Bharath Kalyan, IEEE-OES VP for Professional Activities, posing a question to the panelists during the session on geopolitical dynamics.

By bringing technical precision directly to the table with high-level policymakers, OES has solidified its role in turning ocean science into actionable regional impact across the Western Indian Ocean.

IEEE CAOS 2026 report

Jason Gu, IEEE CAOS 2026 General Chair

The 1st IEEE Canadian Atlantic Ocean Symposium (CAOS 2026) was successfully held at Dalhousie University in Halifax, Nova Scotia, Canada, from 20-22 July, 2026. The theme of the symposium was "Ocean Frontiers: Intelligent Solutions for an Evolving World." The symposium was technically sponsored by the IEEE Oceanic Engineering Society (OES) and financially co-sponsored by the IEEE Canada Atlantic, New Brunswick, and Newfoundland & Labrador Sections.

We gratefully acknowledge the support of the IEEE Oceanic Engineering Society (OES) Chapter, IEEE Canadian Atlantic Section, which served as a Bronze Sponsor of IEEE CAOS 2026.

A total of 75 papers were initially submitted. Following a rigorous full-paper peer-review process, 34 papers representing 10 countries and regions were accepted for presentation, resulting in an acceptance rate of approximately 45%. The accepted papers reflect the growing interest in research, development, and applications across a broad range of dynamic and emerging areas, including hydroacoustics, signal processing, marine robotics and control, naval architecture, ocean engineering and marine technology, marine electronics and devices, ocean sensing and networks, renewable energy/wind/hydrogen, and underwater communications—all key areas within the scope of IEEE CAOS.

The technical program featured distinguished plenary speakers Henry Leung, Jian Lin, and Ying (Gina) Tang, as well as keynote speakers Len Zedel, Mae Seto, David Barclay, and Weiming Huang. Their presentations covered a wide range of topics, including AI-enabled ocean exploration, autonomous and intelligent systems, and maritime surveillance.

The organizing committee brought together strong representation from Dalhousie University, Memorial University, the University of New Brunswick, the University of Prince Edward Island, and other Canadian institutions, along with international participation.

In addition to the plenary and keynote presentations and technical sessions, IEEE CAOS 2026 featured highly successful IEEE affinity group activities sponsored by the IEEE Canadian Atlantic Section, including sessions organized by IEEE Young Professionals (YP) and IEEE Women in Engineering (WIE). These activities provided valuable opportunities for networking, professional development, and community engagement.

Overall, IEEE CAOS 2026 was a highly successful inaugural symposium, both technically and organizationally. The symposium also achieved a strong financial performance and is expected to generate a surplus, providing a solid foundation for the continued growth and sustainability of the IEEE CAOS conference series.



Group photo of some of the participants of IEEE CAOS 2026.



Conference paper awards winners of IEEE CAOS 2026.



Three plenary talks.

OTC

Explore the world's offshore developments.
Share a lifetime of learning with your peers.

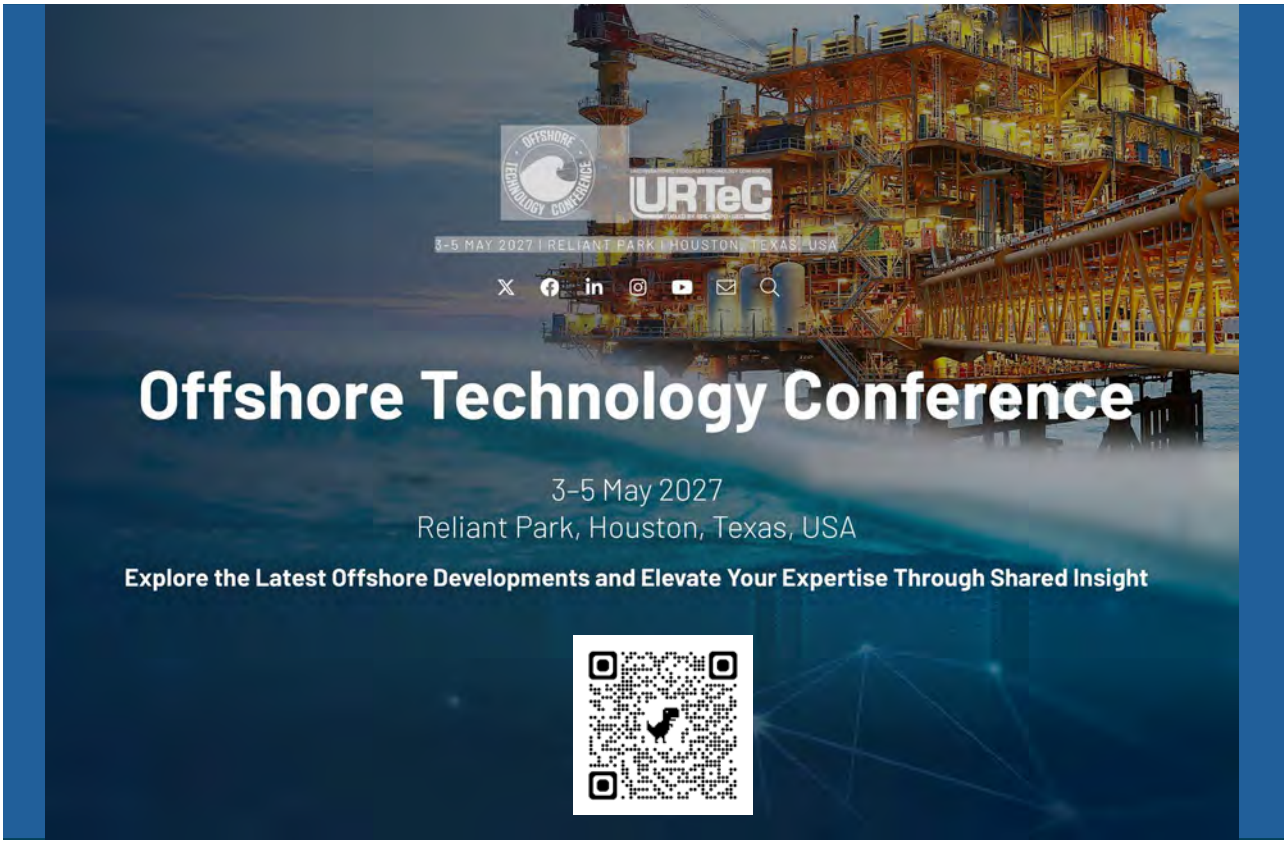


Offshore Technology Conference 2027
3-5 May, 2027
Reliant Park, Houston, Texas, USA

OTC Brasil 2027
26-28 October, 2027
Rio de Janeiro, Brasil

OTC Asia 2028
21-23 March, 2028
Kuala Lumpur, Malaysia

Website
Coming soon



IEEE Advancing Technology for Humanity

IEEE Oceanic Engineering Society

SORBONNE UNIVERSITY ABU DHABI

Call for Papers



Sorbonne University Abu Dhabi, 20-21 January 2027

Sponsored by IEEE Oceanic Engineering Society

We are pleased to announce the MARIS-AI 2027, the 2nd edition of the Symposium dedicated to advancing research and innovation in Marine Intelligence, Robotics, and Biodiversity Conservation.

At the interface between SCAI (Sorbonne Cluster for Artificial Intelligence) and Institut de l'Océan, this two-day event will gather distinguished speakers, researchers, industry experts, innovators, working at the intersection of AI, ocean science, robotic autonomy, and marine ecosystems.

Call for Papers for oral and poster presentation

Proceedings will be published on IEEExplore

Topics of Interest

We welcome research contributions in areas including (but not limited to):

- AI for marine sensing, perception, and decision-making
- Computer vision, deep learning, and biodiversity assessment
- Data-driven oceanography, digital twins, predictive modeling
- BioInspired and Soft Robotics
- Autonomous surface and underwater vehicles, multi-robot and swarm systems

Selected papers will be invited for oral presentations or posters.

BEST poster Award!

If you are a student of BSc, MSc, or PhD, indicate your status in the abstract submission. The best student contribution will be selected for award

Paper Submission

15 November 2026: Paper Submission
10 December 2026: Paper Acceptance
31 December 2026: Camera Ready Paper submission25

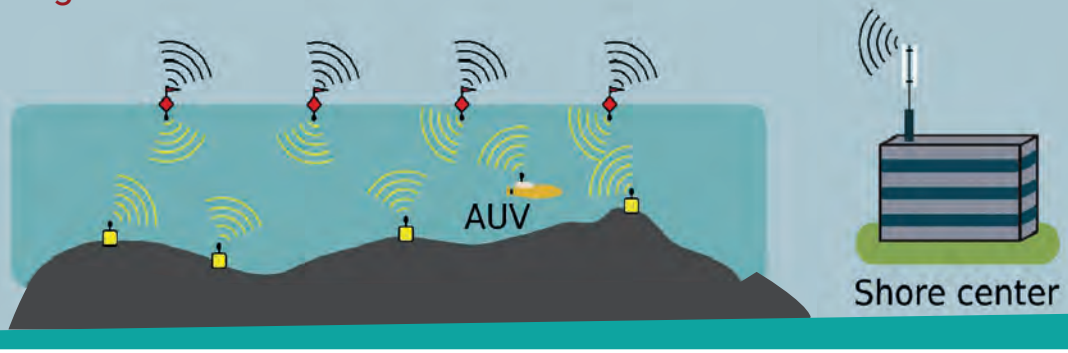
Instructions:
https://sites.google.com/view/maris-ai2027
INFO: giulia.demasi@sorbonne.ae

UNWiS

Winter School on Underwater Network Simulation

PADOVA / ITALY | 1st of February – 5th of February 2027

Registration deadline: 31st December 2026



Focused on the **DESERT Underwater network simulation and experimentation framework**, the fith 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: 31st December 2026






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IEEE OES Oceanic Engineering Society

2021 2030 United Nations Decade of Ocean Science for Sustainable Development



The University of Tokyo is delighted to welcome international experts for the International Symposium on Underwater Technology (UT27). UT27 will provide you with a thematic umbrella under which attendees will discuss the problems and potential long-term solutions that concern not only the Pacific Rim countries, but the world in general.

Important Dates

Abstracts submission page opens: June 1, 2026
Deadline for Abstract Submission: September 18, 2026
Notification of Acceptance: October 23, 2026
Deadline for Full Paper Submission: December 28, 2026
Deadline for Early Registration: January 31, 2027
Symposium Dates: February 28 - March 3, 2027

Call for Abstracts and Exhibitors open now!
Please contact us.

Organizers

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IEEE OES Japan Chapter
Institute of Industrial Science (IIS), the University of Tokyo

Technical Co-Sponsors
Earthquake Research Institute, the University of Tokyo

JAMSTEC

For more information about UT27
please contact: UT27 Secretariat: ut27@conferences.jp

A Blast From the Past! . . . It's Not Just the Attendees

Bob Wernli – Beacon Co-Editor-in-Chief and Photographer Stan Chamberlain

Well, most of the prior Blast's from the Past have focused on the people and activities related to the OCEANS conferences. However, the key word having to do with the OCEANS conferences is "OCEANS." Thus, the conference needs venues that are on the ocean. Following are photos from six of our past OCEANS cities.



OCEANS 2010 Sydney.



OCEANS 2011 Santander.



OCEANS 2013 San Diego.



OCEANS 2014 St. Johns.



OCEANS 2018 Charleston.



OCEANS 2018 Kobe.

IEEE OES OCEANS 2026 Sanya

Wen Xu (Technical Program Chair, China Academy of Science),
Yijun Shen(General Chair, Hainan University),
Lian Lian (General Co-Chair, Shanghai Jiao Tong University),
Harumi Sugimatsu (General Co-Chair, The University of Tokyo)

This year, OCEANS came to Sanya, China, for the first time. Located at the southern tip of Hainan Island, Sanya is China's premier tropical tourist destination and an important hub for marine-related scientific exchange. The conference was held at the Sanya Bay Mangrove Tree Convention Center from 25 to 28 May. Under the theme "To the Sea, to the Deep," it promoted research and fostered collaboration in deep-sea exploration and resource exploitation, topics of strong local relevance given Sanya's proximity to the South China Sea, through keynote talks and special sessions.



Sanya Bay Mangrove Tree Convention Center.

The conference was also the first in many years to be sponsored solely by IEEE, without MTS involvement. Thanks to the coordination of OES, particularly Venugopalan Pallayil, OES Vice President for Conferences, and the relevant East Asia chapters, as well as the hard work of the Local Organizing Committee led by Prof. Yijun Shen of Hainan University, the transition was smooth. The conference recorded 573 registrations, with attendees from 30 countries and regions worldwide. Selected from nearly 700 abstract submissions, the program included about 460 presentations, including regular-session papers, general posters, and student posters. Special thanks also go to Yazhou Bay Science and Technology City, which supported the conference in various ways from the very beginning; to Mr. Siqi Guan and his local arrangements team from Sanya Kecheng Cultural Development Co.; and, of course, to all the volunteers.



The Local Organizing Committee. From left to right: Fumin Zhang (SPC Chair), Jenhwa Guo (Technical Program & Tutorial Chair), Yijun Shen (General Chair), Lian Lian (General Co-Chair), Harumi Sugimatsu (General Co-Chair), Wen Xu (Technical Program Chair), Toshihiro Maki (SPC Chair).

Plenaries

The opening ceremony, featuring welcome remarks from local government officials and OES President Elizabeth Creed, was held on the morning of 26 May, followed by the plenary session. Echoing the conference theme, the plenary session highlighted three dimensions of "deep": deep diving, deep drilling, and deep learning. Dr. Xiaotong Peng of the Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences, introduced the audience to the deepest realm of the ocean, the hadal zone, drawing on numerous deep-diving field expeditions using the 10,000 m-class HOV "Fendouzhe," including joint expeditions with researchers from New Zealand, Indonesia, Russia, and Chile. Dr. Eiichiro Araki of JAMSTEC presented a deep subsea borehole monitoring program in the Nankai Trough



Keynotes: Dr. Hongmei Xin of Ocean Consultation Center, MNR, China (top left), Dr. Xiaotong Peng of Institute of Deep-sea Science & Engineering, Chinese Academy of Sciences (top right), Dr. Eiichiro Araki of JAMSTEC (bottom left), and Dr. Peter Gerstoft of Technical University of Denmark & UCSD (bottom right).



Photos from the plenary session.

Megathrust Seismogenic Zone, which successfully detected slow slip events. Dr. Peter Gerstoft of the Technical University of Denmark and the University of California, San Diego, discussed physics-informed machine learning for dense ocean observations, with a focus on reconstructing sound fields from limited observations. In addition, Dr. Hongmei Xin of the Ocean Consultation Center, MNR, China, reviewed the current status of marine scientific and technological development in China and analyzed the challenges and opportunities ahead.

Workshops

Four dedicated half-day workshops attracted strong interest from conference participants. The first, held on the afternoon of 26 May, was chaired by Mr. Rendong Xu of the Hainan Provincial Society for Oceanography and Yijun Shen of Hainan University, and addressed global marine intelligence, polar exploration, and sustainable governance. The second, held on the morning of 27 May, was chaired by Fangjiong Chen of South China University of Technology, Yan Wei of Zhejiang University, and Xiaoxiao Zhuo of the Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, and focused on AI-empowered underwater acoustic communication, localization, and sensing. The third, held on the afternoon of 27 May, was chaired by Hui Zhou of the Institute of Oceanology, Chinese Academy of Sciences, and Subrata Sarker of Shahjalal University of Science and Technology, and focused on enhancing coastal resilience with affordable marine technologies and AI-driven networks. The fourth, held on the morning of 28 May, was the IEEE Alternative Energy Generation and Storage (AEGS) Second Workshop, chaired by Ye Li of SUSTech and Hong Chen of PJM Interconnection LLC.



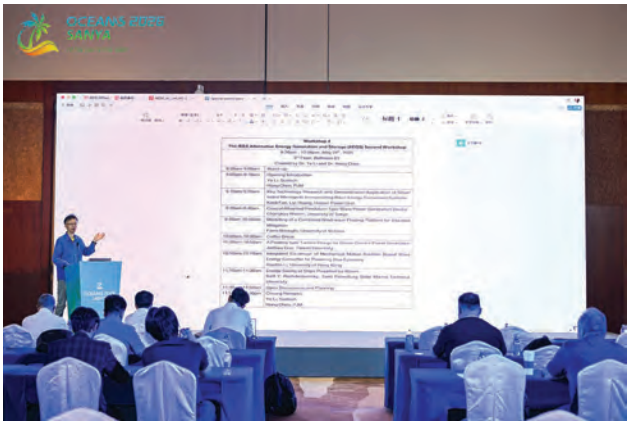
Workshop panel on global marine intelligence, polar exploration and sustainable governance.



Workshop panel on AI-Empowered Underwater Acoustic Communication, Localization, and Sensing.



Workshop panel on Enhancing Coastal Resilience with Affordable Marine Tech and AI-Driven Networks.



The IEEE Alternative Energy Generation and Storage (AEGS) Second Workshop.

Technical Program

OCEANS Sanya featured a total of 80 oral sessions, with eight parallel sessions running across two and a half days. In addition, two General Poster sessions, each with 18 papers, were scheduled over lunchtime on the final day. Among the technical topics, the Special Topic "Artificial Intelligence in Ocean Science and Technology" ran for 10 consecutive sessions from the beginning to the end of the

conference, indicating that AI has entered nearly every area of ocean-related research, including optics, acoustics, remote sensing, robotics, modeling, and data processing. Traditional OCEANS topics, such as sonar signal processing, acoustic telemetry and communication, and autonomous underwater vehicles, also remained strong. The average attendance per session was 21 on the first day, 18 on the second day, and 12 on the third day. It should be noted that two separate technical tours drew some participants away on the second and third days. The Special Topic "Mobile Underwater Sensor Networks: Coordinated Communication, Localization, and Observation" had the highest average attendance, with 32 participants per session.



Photos from various technical sessions.

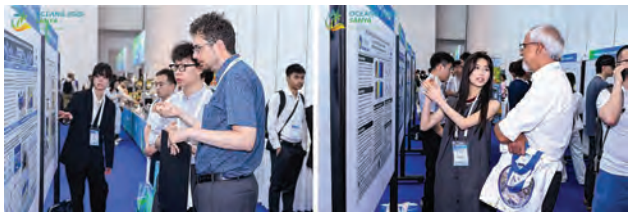
There were four specially organized sessions:

1) Status of the UN Decade of Ocean Science for Sustainable Development (2021-2030): The Engineering Challenges, chaired by M. A. Atmanand of Indian Institute of Technology
2) Deployment, Control, and Communication in Cross-Domain Networks, chaired by Fei Ji, Yan Wang of South China University of Technology, and Hao Zhao of Guangzhou Maritime University
3) Advanced Power Take-Off and Control Technologies for Wave Energy Conversion, chaired by Xiaofan Li of the University of Hong Kong, and Zechuan Lin of Maynooth University
4) Cross-domain Intelligent Marine Robots, chaired by Zheng Zeng of Shanghai Jiao Tong University

These sessions brought some of the latest advances in the field to the OCEANS audience. We thank all special-session chairs for these excellent additions, as well as the regular-session chairs for helping the program run smoothly.

Student Poster Competition

This year, the Student Poster Competition (SPC) received 90 abstract submissions, and 20 of them from 10 countries or special administrative regions were selected as SPC participants. The award was sponsored by SmartSea Tech, Wuxi, China. Details of the SPC will be introduced in a separate report in this issue.



Photos from the Student Poster Competition.

Tutorial

On 25 May, four tutorials were delivered by four well-qualified scholars:

1) Differentiable and data-driven ocean acoustic propagation modeling, by Mandar Chitre, Associate Professor, National University of Singapore, IEEE Fellow
2) Ocean Remote Sensing Using Global Navigation Satellite System Reflectometry, by Weimin Huang, Professor, Memorial University of Newfoundland, IEEE-OES Distinguished Lecturer
3) Open-Source Underwater Robotics: Build Your Own Underwater Robots, by Fumin Zhang, Professor, Hong Kong University of Science and Technology, IEEE Fellow
4) Deep Learning-Based Architectures for End-to-End Underwater Acoustic, by Suleman Mazhar, Professor, Harbin Engineering University, IEEE-OES Distinguished Lecturer

The tutorials were engaging and well received by attendees. We thank Mandar, Weimin, Fumin, and Suleman for their generous contributions and excellent lectures.



Photos from tutorials.

Exhibition

OCEANS Sanya hosted 48 exhibitors. Under the current international political and economic circumstances, many major overseas commercial vendors were absent, and the exhibition was therefore primarily domestic. Even so, it was impressive to see such a wide range of domestic marine technologies and products, including cables, batteries, sensors, sonars, optical systems, platforms, vehicles, software, and highly complex system solutions, in a market that has traditionally been dominated by imported products. The exhibition also included booths from universities, research institutes, professional journals, and, of course, the next OCEANS conference, OCEANS 2027 Aberdeen. As usual, an exhibitor reception was held on the opening day of the exhibition.



Photos from the exhibition.

Social Events

Welcome Reception

As usual, the welcome reception was held on the evening of the first day of the conference. This year's reception combined indoor and outdoor settings. Attendees met new friends and reconnected with colleagues and longtime friends over drinks and excellent food.



Welcome reception.

Member Events

The Student Mixer and IEEE OES Member Night were jointly held on 26 May at a local restaurant, "Glu Glu Bar." In addition, the IEEE OES Young Professional Luncheon was scheduled on the same day, and the IEEE Women in Engineering Luncheon was scheduled on 27 May.



The Student Mixer & IEEE OES Member Night.

Gala Dinner

The Gala Dinner featured local artistic performances and Chinese cuisine with regional flavors. During the dinner, the SPC winners were announced and presented with their awards; Dr. Tamaki Ura was recognized with the 2025 Distinguished Service Award; and OCEANS 2027 Aberdeen was promoted to encourage future participation.



Photos from the Gala Dinner.

Technical Tours

On 27 May, a technical tour was organized to Yazhou Bay Science and Technology City. Built from the ground up about 10 years ago, the Science and Technology City has become an important platform for ocean science and technology research and field experiments. During the



Technical tours to Yazhou Bay Science and Technology City and the Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences.

tour, participants visited the deep-sea science and technology innovation public platform. On 28 May, a tour to the Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences, was organized. Participants boarded a research vessel and had a close look at the 10,000 m-class manned submersible "Fendouzhe," which has frequently been used for hadal trench exploration in collaboration with international partners under the UN Decade Program.

Overall, OCEANS Sanya was a great success. It overcame the challenges faced by a new host city while maintaining the standards of the traditional OCEANS conference. Most participants were students and early-career professionals. They demonstrated strong research capabilities while also showing respect for the long-standing traditions of the OCEANS community. We would like to thank all participants, exhibitors, and volunteers, and we look forward to seeing you at future OCEANS conferences.

IEEE-OES Summer School 2026 … another resounding success!

Shyam Madhusudhana, VP for Technical Activities



Following the success of our inaugural event in Singapore, the IEEE Oceanic Engineering Society returned with the second edition of the IEEE-OES Summer School, held on 23–24 May, 2026. Set against the tropical coast of Sanya, Hainan, China, right alongside the OCEANS 2026 Sanya conference, this year's event centered on the timely theme of "OCEAN Observation and Interpretation."

The Summer School brought together 23 participants—comprising graduate students and early-career professionals—all sharing a drive to explore advancements in oceanic engineering, sensor technologies, and data interpretation. Designed as an intensive two-day precursor to the main conference, the program balanced technical lectures with career development, networking, and interactive discussions.

The event kicked off on the evening of Friday, 22 May, with a welcome reception dinner where attendees checked in, connected with peers, and met faculty in a relaxed setting. Day 1 opened with participant introductions, followed by four high-impact technical lectures covering radar remote sensing, AI underwater image analysis, bioacoustics, and autonomous underwater vehicle (AUV) autonomy. A key highlight of the afternoon was a presentation by the winners of the OCEAN Challenge.

Day 2 shifted focus toward professional growth and emerging technological frontiers. OES leaders kicked off the morning by introducing volunteering opportunities within IEEE-OES and facilitating an open discussion on navigating career paths in oceanic engineering. The technical sessions resumed with presentations on distributed AI, stretchable deep-ocean sensors, and Distributed Acoustic Sensing (DAS). The event concluded with feedback collection, closing remarks, and the distribution of completion certificates.

Lecture topics

Ocean observation using ground-based radars: HF and X-band
Prof. Weimin Huang
Memorial University, Canada

Machine learning based underwater image analysis
Prof. Peng Ren
China University of Petroleum, East China

Cetacean bioacoustics: fundamentals and applications
Dr. Suleman Mazhar
Harbin Engineering University, China

AUV autonomy as an enabler for ocean observation
Prof. Francesco Maurelli
Constructor University, Germany



Shyam Madhusudhana (right) with the faculty of the 2026 IEEE-OES Summer School.



Weimin Huang kicking-off with the first of the series of lectures.



Venugopalan Pallayil delivering the last of the lectures of the Summer School.

Distributed artificial intelligence for underwater exploration: from multi-robot coordination to autonomous swarms
Dr. Giulia De Masi
Sorbonne University Abu Dhabi, UAE

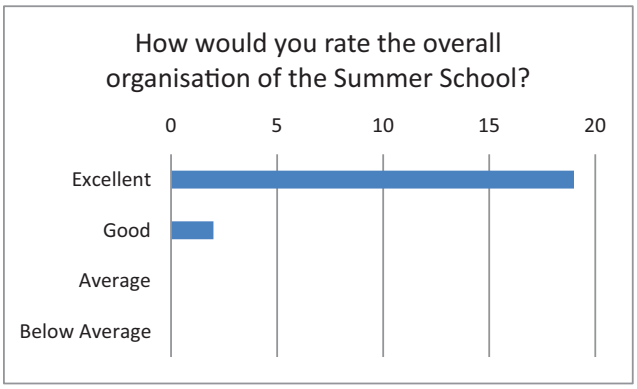
Emerging flexible and stretchable sensors for deep ocean monitoring
Dr. Yang Yang
Institute of Deep-Sea Science and Engineering, CAS, China

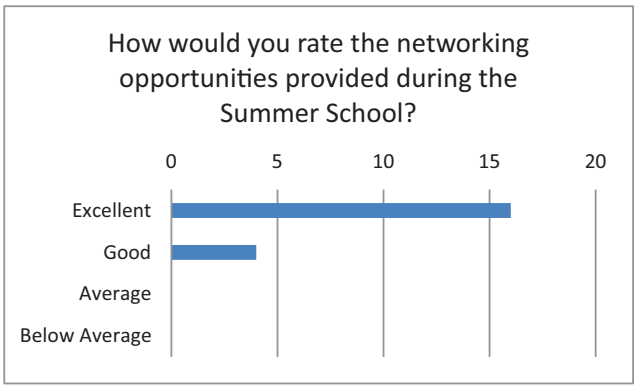
Distributed Acoustic Sensing—An emerging, game-changing technology for ocean observations
Dr. Venugopalan Pallayil
National University of Singapore, Singapore

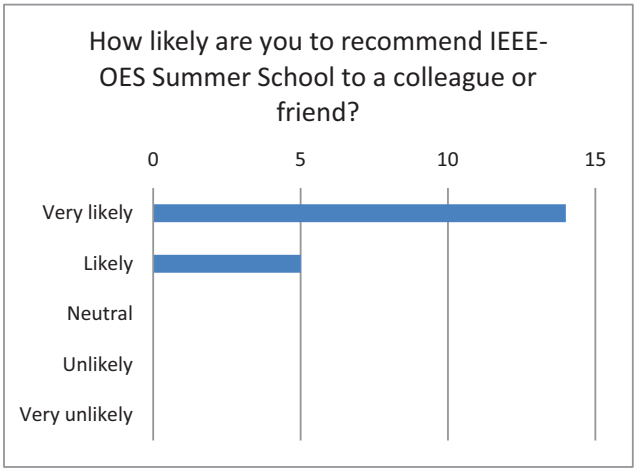
The positive feedback and engagement from attendees reinforced the value of providing a dedicated space for early-career researchers to build professional networks and learn directly from leaders in the field.



Participants enjoying local cuisine during one of the breaks.







Aggregated feedback from the Summer School students.

An undertaking of this scale is only possible through dedicated volunteers. Thanks especially to our VP for OCEANS, Venugopalan Pallayil, whose wisdom and connections with local entities ensured seamless logistics throughout the planning of the event. Sincere thanks also go out to our international faculty who generously contributed their time and expertise.

With two successful editions now complete, the IEEE-OES Summer School is firmly established as a core Society activity for nurturing the next generation of ocean engineers and scientists. Planning has already commenced for the Summer School alongside the OCEANS 2027 Aberdeen conference. With anticipation building and enthusiasm abound, we surely hope to deliver yet another exceptional event that promises to enrich and empower the wider oceanic engineering community.

The Student Poster Competition at OCEANS 2026 Sanya

Shyam Madhusudhana, OES Student Poster Competition Chair



The Student Poster Competition (SPC) has been a cherished tradition at OCEANS conferences ever since its introduction by Col. Norman Miller at the 1989 Seattle meeting. Over the decades, it has evolved into a highly anticipated feature of IEEE-OES OCEANS events, drawing talented undergraduate and graduate students from universities and research institutions worldwide. The SPC offers these emerging scientists a unique platform to share their research, network with peers and professionals, and gain visibility within the global ocean science and engineering community.

For each conference, prospective participants submit abstracts that undergo a rigorous two-stage review process. From this pool, around top 20 highly-competitive submissions are shortlisted, and the candidates invited to take part in the final program. These finalists benefit from waived registration fees and receive financial assistance to help cover travel and lodging expenses. Until recent times, this assistance was made possible through the generosity of the Office of Naval Research (ONR) for the North American editions and the Office of Naval Research Global (ONR-G) for the rest-of-the-world editions. Prize money funding for the Sanya edition was provided by Smartsea Tech (https://www.smartseatech.com/), whose representative, Tony Yao, handed over cash awards to the winners.

The SPC at OCEANS 2026 Sanya was handled by local organizing committee (LOC) SPC Chair Fumin Zhang. This edition drew over a hundred abstract submissions, out of which 19 were shortlisted for presentation during the



Well-attended sessions on all days of the conference.



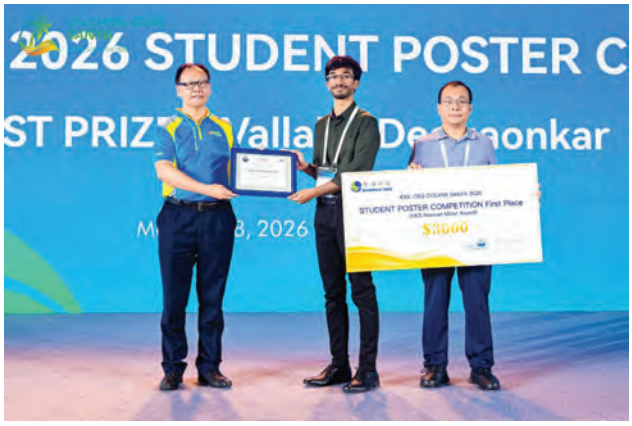
Student participants and judges, along with OES representatives Shyam Madhusudhana and Venugopalan Pallayil.

conference. The poster sessions attracted steady interest throughout the event, with judges engaging the finalists in detailed discussions about their work. The panel of judges—all volunteering their time—played an essential role in providing feedback and selecting the winners.

The competition concluded with the awards ceremony during the gala evening. Certificates of participation were presented by Fumin Zhang and the OES SPC Chair, Shyam Madhusudhana. Top three awards were presented by the respective sponsors, closing another successful chapter in the SPC's long-running history.

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)
Vallabh Deogaonkar, Indian Institute of Technology Madras, Tamil Nadu, India
3D Reconstruction of Underwater Structures using Forward-Scan Sonar and Gaussian Splatting on AUVs



Abstract—Inspection and 3D reconstruction of underwater infrastructure such as pipelines, piers, offshore platforms, and harbor structures are critical for maintenance, safety assessment, and damage detection. Many existing inspection workflows rely on optical sensing using cameras mounted on remotely operated vehicles or diver-assisted surveys. However, visual methods are limited in turbid, low-light, and biofouled underwater environments, making acoustic sensing the primary modality for reliable perception in poor-visibility conditions. While multi-beam imaging sonars enable dense acoustic imaging, they incur significant hardware cost and system complexity. Forward-scan sonars offer a compact and cost-effective alternative but acquire data sequentially through mechanical rotation, producing temporally sparse range–bearing measurements that pose challenges for coherent 3D reconstruction.

Second Prize (Certificate and $2,000)
Huibo Zhang, The Hong Kong University of Science and Technology, Hong Kong, China
LLM-Guided Bi-Objective Planning for Energy-Constrained AUV Fleets



Abstract—Autonomous underwater vehicles (AUVs) are increasingly employed for underwater infrastructure inspection and environmental monitoring, where multiple spatially distributed tasks must be completed under strict energy limits and mandatory return-to-depot constraints. Unlike aerial or ground robots, AUVs operate with limited communication and complete missions on a single battery cycle, making energy feasibility central to multi-AUV planning. Our small-scale experimental platforms such as MASEP provide an important means to validate algorithms under controlled but realistic aquatic conditions, enabling research on coordination, localization, and energy-aware control. Traditional multi-robot task allocation (MRTA) methods and classical optimization techniques such as the Hungarian algorithm and Mixed-Integer Linear Programming (MILP)-based formulations offer structured allocation mechanisms but scale poorly and typically rely on simplified energy models unsuited for endurance-critical AUV missions. Decentralized frameworks such as Consensus-Based Bundle Algorithm (CBBA) and bio-inspired optimizers like Speeding-Up and Slowing-Down (SUSD) improve scalability and robustness but do not incorporate experimentally grounded battery constraints.

Third Prize (Certificate and $1,000)
Zhiyan Ren, The University of Tokyo, Japan
Exploring Multispectral Information for the Detection of Marine Plastic Litter: Controlled Tank and Field Experiments

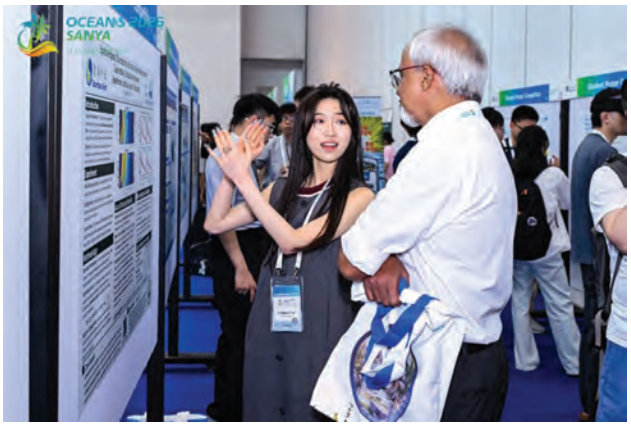


Abstract—Marine litter, widespread in coastal and nearshore environments, poses persistent threats to marine ecosystems, with plastics constituting over 70% of the total litter. Detecting litter from UAV imagery remains challenging because targets are often small and sparsely distributed, while complex coastal backgrounds and reflective nearshore conditions degrade visual separability. Most existing UAV-based detection pipelines rely on RGB imagery, which provides only visible-spectrum information and often fails under wet or reflective conditions or when litter exhibits strong color similarity to background materials. Multispectral imaging offers additional reflectance cues beyond human vision and has the potential to improve litter–background separability, particularly through IR-related bands. However, the relative contribution of individual bands and practical band-combination strategies for marine litter detection remain insufficiently quantified, especially under realistic UAV transfer scenarios. In this study, we investigate a cost-effective multispectral UAV detection framework that systematically analyzes band effectiveness under controlled conditions and evaluates transferable band combinations in real coastal scenes.

Aatmaj Bhayani, Indian Institute of Technology Madras, Tamil Nadu, India
NeRF-Driven Virtual Tethering for Change-Aware Coral Reef Monitoring with AUVs

Abstract—Reef ecosystems are rapidly declining due to warming seas, pollution, and storm damage, making continuous underwater monitoring essential, yet operationally expensive. Coral reefs support nearly 25% of marine biodiversity, and their degradation has severe ecological and economic consequences, creating an urgent demand for scalable long-term observation systems. Remotely Operated Vehicles (ROVs) can survey large coral areas without diver intervention, but real-time supervision over tethers remains constrained due to problems such as tether drag, entanglement, and limited maneuverability. For Autonomous Underwater Vehicles (AUVs), existing studies on underwater acoustic and optical communication links show that acoustic links provide only a few tens of kilobytes per second with intermittent connectivity, while optical links are confined to short transmission distances. This work proposes a NeRF (Neural Radiance Field) -driven inspection pipeline for coral reefs that turns an acoustic link into a change-aware "virtual tether": instead of sending full images, the AUV transmits only how the current view differs from the view predicted by a learned 3D model of the reef. A key challenge remains modeling underwater or highly turbid scenes, where the medium strongly influences the appearance of objects, combined with the complex structure of coral reefs.

Yingxuan Chen, Sun Yat-Sen University, Zhuhai, China
Spatio-temporal Characteristics of Indian Ocean Reverberation: Quantitative Comparison between Experiment and Ray-Facet Simulation



Abstract—Benchmarking a three-dimensional ray-facet model against field-measured reverberation data from the Indian Ocean, this study identifies the primary physical mechanisms governing modeling discrepancies through a multi-metric error-tracing chain. Despite the successful replication of characteristic hyperbolic striations in Time-Depth-Intensity plots via numerical simulation, detailed comparative analysis reveals fundamental morphological differences driven by non-specular scattering and environmental microstructure. Furthermore, the reverberation decay following the first bottom reflection is numerically overestimated under large grazing angles, thereby highlighting the inadequacy of a constant-coefficient Lambertian kernel in representing scattering characteristics across the full angular spectrum. Such findings emphasize the necessity of refining large-angle scattering and near-surface gradient perturbations for high-precision modeling.

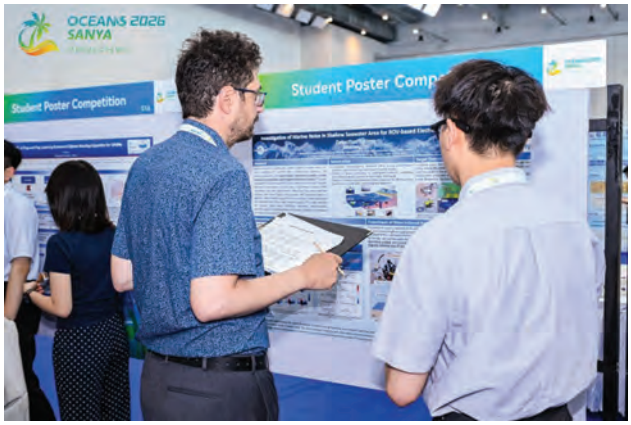
Jingmo Guo, Zhejiang University, Hangzhou, China
An Underwater Network Data Fusion Method Based on Statistical Detection Theory

Abstract—Underwater network technology serves as the foundation of the Internet of Underwater Things (IoUT). However, the complexity of the underwater environment and the dynamic nature of underwater networks introduce significant uncertainty and conflict into data collected by distributed nodes, posing challenges for traditional data fusion techniques. To address these challenges, this paper proposes a data fusion method based on an improved Dempster-Shafer (D-S) evidence theory. Firstly, to handle the characteristics of underwater signals, a Basic Probability Assignment (BPA) generation method based on statistical detection theory is developed. Secondly, a compatibility coefficient is introduced to pre-process the evidence, thereby mitigating the influence of unreliable data. Finally, an improved combination rule utilizing Pignistic probability distance is constructed to adaptively fuse the evidence. Simulation results demonstrate that the proposed algorithm outperforms existing methods in handling conflicting evidence, achieving the highest support for the correct proposition and proving its effectiveness for underwater network data fusion.

Taichi Isobe, The University of Osaka, Osaka, Japan
A Simulator for Collaborative UUV Inspection of Offshore Wind Turbines under Dynamic Conditions

Abstract—The global shift toward sustainable energy has made offshore wind a critical resource, with floating offshore installations enabling operations in deeper waters. However, as wind farms move further offshore into deeper and harsher environments, the maintenance of subsea structures presents significant costs and safety risks. While automating inspections with Unmanned Underwater Vehicles (UUVs) is a necessary solution, conventional control technologies often lack the adaptability required for dynamic environments and fail to execute coordinated behaviors among multiple UUVs. Although Artificial Intelligence (AI) offers promising solutions for adaptive decision-making, high risks and costs hinder physical experimentation. To address this, we developed a high-fidelity simulator for training and validating AI-driven control systems.

Zekun Jiang, Harbin Engineering University, China
Analysis of Wave-induced Noise in Marine Electromagnetic Detection System for Shallow Seawater Area

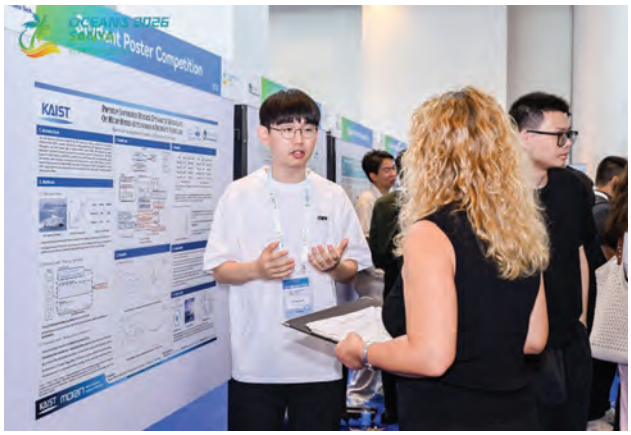


Abstract—With the continuous advancement of marine exploration, electromagnetic detection system mounted on the unmanned platforms has attracted considerable attention across multiple fields, including marine archaeology, underwater unexploded ordnance clearance, and inspection of submarine buried cables and pipelines. Compared with sonar and optical detection methods, underwater electromagnetic detection has superior cross-medium detection capabilities, making it particularly effective for identifying and locating buried targets under the seabed. In practical detection, when the submersible electromagnetic detection system operates in shallow seawater areas, the dynamic sea surface scatters the primary field Bp radiated by the transmitting coil. This leads to a surface-scattering secondary field B^{s}_{s}, which is dependent on the time-varying nature of ocean waves.

Pranav Kedia, University of Konstanz, Germany
BIND-USBL: Bounding IMU Navigation Drift using USBL in Heterogeneous ASV–AUV Teams

Abstract—Heterogeneous swarms of Autonomous Surface Vessels (ASVs) and Autonomous Underwater Vehicles (AUVs) are emerging as a practical solution for scalable marine operations requiring wide-area coordination and high-resolution underwater inspection. ASVs can provide GNSS-referenced localization, high-bandwidth surface communications, and persistent mobility, making them natural coordination agents for AUVs operating in drift-prone, GPS-denied environments. In this context, Ultra-Short Baseline (USBL) acoustic positioning enables an ASV to act as a surface anchor and generate absolute AUV position fixes by combining its GNSS state with acoustic range/bearing measurements for drift correction. Prior work has investigated single-ASV support for multi-AUV teams using acoustic positioning and LOS relays to maintain navigation accuracy and communication links. Other studies propose centralized or event-triggered ASV–AUV coordination strategies for tasks such as search and rescue or seafloor mapping. However, it remains unclear how performance scales when transitioning from a single-anchor model to multi-ASV systems that cooperatively provide USBL-based localization resets and acoustic servicing to underwater swarms.

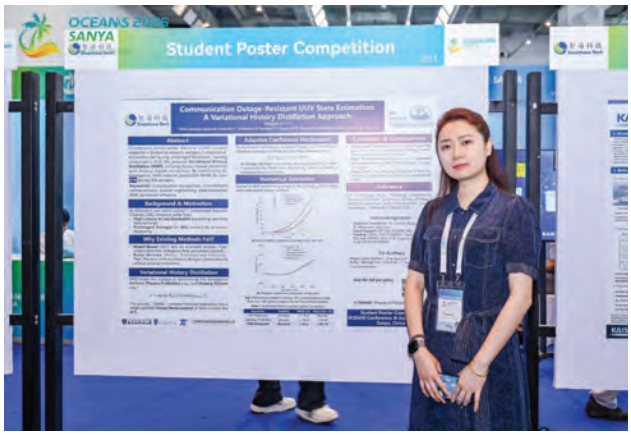
Taewoo Lee, KAIST, Republic of Korea
Physics-Informed Hybrid Dynamics Modeling of High-Speed Autonomous Surface Vehicles



Abstract—We propose a hybrid dynamics modeling framework for high-speed autonomous surface vehicles (ASVs) that achieves both condition-invariant residual learning and fast online adaptation to changing operating regimes. The key idea is to separate invariant dynamics from condition-dependent effects, enabling robust modeling across vessel speeds and environmental disturbances. The model is built on a physics-informed nominal baseline that embeds the vessel's three-degree-of-freedom rigid-body equations of motion. To compensate for planning-regime mismatch and unmodeled disturbances, we train a feature network with adversarial objectives that suppress speed- and domain-discriminative cues. Condition-dependent variations are then represented by a low-dimensional coefficient matrix updated online, allowing rapid adaptation without retraining

the feature network. The resulting hybrid model preserves physical structure while improving generalization across operating regimes and environmental conditions.

Shuyue Li, Xi'an Jiaotong-Liverpool University, Suzhou, China
Communication Outage-Resistant UUV State Estimation: A Variational History Distillation Approach



Abstract—The operational reliability of Unmanned Underwater Vehicle (UUV) clusters is fundamentally constrained by intermittent acoustic communication. Conventional estimators, like the Unscented Kalman Filter (UKF), fail during prolonged outages due to unmodeled dynamics, leading to catastrophic position error growth. To address this challenge, we propose the Variational History Distillation (VHD) framework, which unifies physics-based prediction with history-based correction. The core mechanism is to distill high-dimensional historical data into a low-dimensional virtual measurement which is fused with a physics-based prior via Kullback-Leibler (KL) divergence minimization. A key innovation is an adaptive confidence mechanism that dynamically adjusts the confidence level based on outage duration. Numerical simulations demonstrate that VHD reduces prediction RMSE by over 91% compared to a strong UKF baseline during the extreme case of a 40-second outage.

Xiaogang Li, University of New South Wales, ACT, Australia
Novel Longitudinal Dynamic Modelling and Adaptive Control for the Turtle-like Bionic Robot

Abstract—The development of turtle-inspired bionic robots represents a key research direction in remotely operated and autonomous underwater vehicles. Accurate modelling and robust control are critical for their practical deployment. This work first analyses and establishes the control-oriented longitudinal dynamics of the robot based on observed turtle locomotion. Building on this model, a novel adaptive learning–based control scheme is proposed to compensate for hydrodynamic nonlinearities, environmental disturbances, and time-delay effects, ensuring precise trajectory tracking and enhanced operational reliability in complex underwater environments.

Marián López, Universitat Politècnica de Catalunya, Spain
Development and evaluation of an ex situ system for monitoring survival and floral induction in Posidonia oceanica

Abstract—Posidonia oceanica, a seagrass species endemic to the Mediterranean Sea, provides multiple essential ecosystem services, including the maintenance of high biodiversity, shoreline stabilization, and carbon sequestration. However, since the early 2000s its meadows have undergone a marked decline driven by anthropogenic pressures such as eutrophication, anchoring, and coastal infrastructure development. This hermaphroditic species reproduces both sexually—through flowering and seed production—and asexually via clonal extension of its rhizomes. Both strategies show limited effectiveness due to the species slow growth and low natural recruitment rates, which constrain its capacity for recovery. Moreover, its physiology is tightly regulated by environmental conditions: *P. oceanica* exhibits an optimal temperature range of 10–28 °C and a salinity of 33–38 ‰, thresholds beyond which prolonged exposure can adversely affect photosynthetic performance and overall survival. This situation underscores the need to develop ex situ conservation strategies, still at an early stage and with experimental results currently under consolidation.

Jiale Qian, Southern University of Science and Technology, Shenzhen, China
Physics-Informed Spatiotemporal Deep Learning for High-Precision Laboratory Wave Reconstruction and Prediction

Abstract—Accurate acquisition and prediction of spatiotemporal wave data are fundamental to ocean engineering. While binocular stereo vision offers a powerful non-contact measurement solution, it traditionally relies on a high density of tracer particles to reconstruct dense wave fields. This dependency poses significant experimental challenges. Furthermore, conventional data-driven prediction models, such as Convolutional LSTM (ConvLSTM), struggle to generalize when observational data is sparse, often leading to physically inconsistent results. To address these limitations, this paper proposes a novel framework integrating stereo vision with a Physics-Informed ConvLSTM (PI-ConvLSTM) network. By embedding wave governing equations into the network training, our method leverages physical laws to compensate for sparse visual data. We utilize a robust Gray-Weighted Centroid algorithm for precise feature extraction. Experimental results demonstrate that the proposed system achieves millimeter-level accuracy and maintains hydrodynamic consistency even with reduced tracer density, outperforming baseline models in reconstruction robustness.

Shixin Sun, Constructor University, Germany
Spatially Varying Curve Estimation with Brightness-Aware Reinforcement Learning for Low-Light Underwater Enhancement

Abstract—Low-light underwater imaging is a challenging problem for marine robotic perception due to severe illumination deficiency, spatially non-uniform lighting, and noise amplification. Most existing underwater image enhancement methods are designed for relatively well-lit conditions or rely on one-shot global transformations, which limits their effectiveness in low-light underwater environments. In this paper, we propose a reinforcement learning–based low-light underwater image enhancement framework based on spatially varying curve estimation. The enhancement process is formulated as a sequential decision-making problem, where pixel-wise intensity transformation curves are progressively estimated. To better handle illumination degradation, a brightness-aware state representation is introduced, and a full-reference reward is designed to encourage step-wise quality improvement toward reference images. The proposed framework enables location-dependent enhancement and progressive refinement while remaining lightweight and suitable for marine robotic applications.

Kaixin Tao, Shanghai Jiao Tong University, China
Flexible Acoustic Tactile Sensing for Hybrid Aerial Underwater Vehicles

Abstract—Hybrid aerial-underwater vehicles (HAUVs) play an increasingly pivotal role in diverse marine missions, ranging from environmental monitoring to emergency rescue. However, their environmental perception capabilities are significantly constrained by the substantial discrepancies in physical properties (e.g., density, viscosity, and acoustic propagation) between air and water. Seal whiskers, evolved through long-term natural selection, possess exceptional perception capabilities characterized by high signal-to-noise ratios and robust anti-interference performance, thereby providing an ideal biomimetic template for developing high-performance tactile sensors to address the aforementioned bottleneck. Nevertheless, translating the unique structural and perceptual advantages of natural seal vibrissae into engineered sensing systems compatible with HAUVs remains a critical challenge, particularly in balancing sensing sensitivity, low power consumption, and cross-medium operational adaptability. To address this challenge, a fiber-waveguide-based tactile sensing mechanism is developed in this work for HAUVs operating both underwater and in air. Lead zirconate titanate (PZT) piezoelectric ceramic sheets are mounted at both ends of a glass microfiber to transmit and receive guided acoustic waves, following an identical signal excitation and reception scheme in both environments. The microfiber is bent into a U-shaped geometry, with the protruding segment serving as the tactile interaction region. When this U-shaped section comes into physical contact with an underwater or aerial target, the mechanical coupling introduces additional acoustic attenuation and energy dissipation within the fiber waveguide. As a result, the received signal exhibits a measurable amplitude reduction, which is used as an indicator of external contact, enabling real-time tactile perception. Polyurethane, featuring excellent acoustic transparency and sealing performance, is employed as both the interfacial bonding layer and the encapsulation material between the glass fiber and the PZT.

Menglong Wu, Harbin Engineering University, China
PIPSO: A Physics-Informed Particle Swarm Optimization for Offshore Wind Farm Layout to Maximise Energy Output

Abstract—With the abundant wind resources, high-capacity potential, and reduced land-use constraints, offshore wind energy has emerged as a critical pillar of large-scale renewable power systems. As offshore wind farms continue to expand in scale and turbine density, the spatial layout of wind turbines has become a decisive factor influencing the overall energy yield of a wind farm. Improper turbine placement may amplify aerodynamic wake interactions, leading to substantial wind-speed deficits and cumulative power losses across downstream turbines. Wind farm layout optimization (WFLO) has been extensively studied by using analytical wake models combined with heuristic optimization algorithms such as particle swarm optimization (PSO), genetic algorithms and so on. While these approaches provide computational efficiency, their reliance on simplified wake formulations often limits physical fidelity, especially under complex offshore wind conditions. On the other hand, high-fidelity computational fluid dynamics (CFD) methods offer accurate wake modeling but are computationally prohibitive for iterative layout optimization. Recently, data-driven and machine learning-based methods have been introduced. However, purely data-driven models may violate fundamental physical principles and suffer from poor generalization when extrapolated to unseen layouts. These limitations highlight a critical gap in offshore WFLO, which is the lack of an optimization framework that simultaneously ensures physical consistency, computational efficiency and scalability. Motivated by this challenge, this article proposes a physics-informed optimization framework that integrates Physics-Informed Neural Networks (PINNs) with PSO to maximize offshore wind farm energy yield while explicitly accounting for aerodynamic wake interactions.

Hao Yin, Xiamen University, China
Deep Sparse Autoencoder with ℓ^1-Dominated Regularization for Time-Domain Underwater Acoustic Signal Denoising

Abstract—Underwater acoustic signals are severely degraded by multipath and non-stationary noise, especially at low SNR. Classical sparse coding (e.g., K-SVD) suffers from instability and bias under high dictionary coherence. We propose a deep sparse autoencoder (DSAE) with ℓ^1-dominated regularization that combines model-based sparsity and deep

learning. Its overcomplete encoder enforces amplitude-preserving sparsity, while the decoder acts as a trainable synthesis dictionary. Evaluated on quadratic chirps at −6.68 dB input SNR, DSAE achieves 10.16 dB output SNR—a 16.84 dB gain—outperforming traditional methods. Results show that overcomplete deep sparse modeling provides a robust, interpretable front-end for underwater denoising.

Yu Yuan, Zhejiang University, China
P²LEDR: A Plug-and-Play Learning-Enhanced Dijkstra Routing Algorithm for UASNs



Abstract—Underwater acoustic sensor networks (UASNs) are fundamental to marine monitoring and seabed exploration, yet reliable low-latency routing remains challenging due to severe attenuation, long propagation delay, and time-varying links. Classical Dijkstra routing is lightweight and deterministic, but it typically relies on fixed link costs and cannot leverage historical experience to improve future decisions. This paper proposes P²LEDR, a plug-and-play learning-enhanced Dijkstra routing framework. It learns edge-level Q-priors offline via Q-learning and then shapes the online link-cost matrix accordingly before invoking a standard Dijkstra solver through a lightweight wrapper, thereby retaining Dijkstra's determinism and polynomial-time complexity while enabling experience-guided route selection. Extensive simulations show that P²LEDR improves packet delivery ratio (PDR) by 13.9%, 11.7%, and 17.9%, increases throughput by 23.4%, 23.4%, and 30.4%, and reduces end-to-end delay by 11.2%, 7.9%, and 19.2% compared with classical Dijkstra, a greedy algorithm-based routing method, and an ant-colony-optimization (ACO)–based routing method, respectively. These results indicate that P²LEDR achieves a more favorable delay–reliability–throughput trade-off while retaining the deterministic and low-complexity deployment of Dijkstra routing.

From Coastal Monitoring to the SPC Stage: OCEANS 2026 Sanya

Zhiyan Ren, The University of Tokyo – OCEANS 2026 Sanya SPC Third Prize Winner

When I received the news that my paper had been selected for the Student Poster Competition (SPC) at OCEANS 2026 Sanya, I was both excited and honored. It was my first international conference and my first time presenting a poster to such a broad audience, so I was also a little nervous.

My research began with a practical environmental question: how can we survey coastal plastic litter more efficiently and understand its spatial distribution over large areas? I use multispectral UAV imagery and deep-learning-based object detection, exploring how visible and near-infrared information and different flight altitudes can support both detailed inspection and broader-area screening.

Before the conference, I spent a surprising amount of time thinking about how to make the whole workflow understandable on a single poster. The study connects several steps, from multispectral image processing and band selection to object detection, high-altitude observation, and whole-area mapping. What felt clear after working on the project for a long time was not always easy to explain to someone seeing it for the

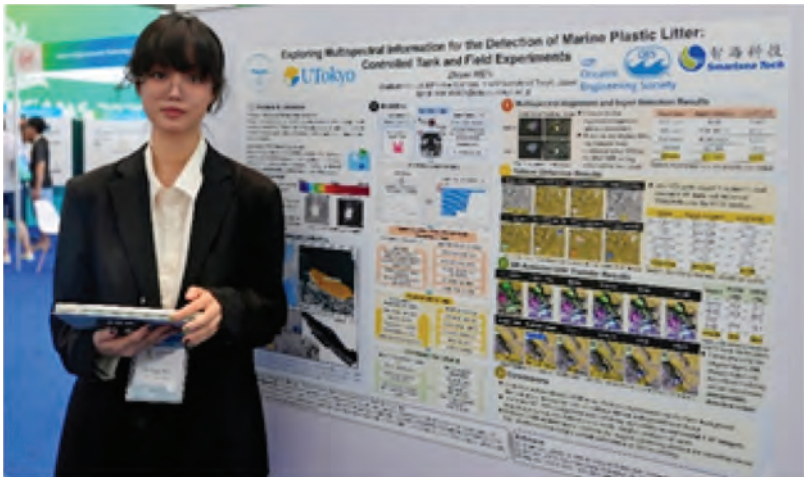


Figure 1. Presenting my work during the SPC poster session.

first time. I simplified figures, moved arrows, shortened labels, and thought carefully about what people should understand first. That preparation turned out to be very useful.

The SPC poster session became one of my favorite parts of the conference. People approached the work from very different perspectives, including marine environmental monitoring, UAV sensing, multispectral information, AI, and practical deployment. Questions from judges, researchers, and other students made me look at the work from new angles. Explaining the same project to people with different backgrounds also helped me see more clearly how its technical pieces connect to one practical problem.



Figure 2. Receiving the Third Prize from the OCEANS 2026 Sanya organizing committee.

The conference theme, "To the Sea, To the Deep," stayed with me. I saw work on underwater robotics, marine sensing, autonomous systems, ocean observation, and environmental monitoring. Everyone seemed to approach the ocean from a different direction, but with the same curiosity about what is still unknown and what technology can help us understand. Seeing so many people focusing their research "to the sea, to the deep" was genuinely exciting and made my own small area of research feel part of something much larger.

Sanya made the experience even more memorable. The sea was beautiful, the sky was bright, and the weather was warm—sometimes very warm. But the atmosphere of the conference felt just as warm. I was impressed by how willing people were to exchange ideas, offer encouragement, and talk with students.

Receiving the Third Prize was a wonderful surprise and a great encouragement. The project had gone through many stages, including plenty of moments when things did not work as expected and had to be reconsidered. Seeing the work recognized at OCEANS made those efforts feel worthwhile. The chance to hear different opinions and meet people I would otherwise never have met was equally valuable.

I would like to express my sincere gratitude to my supervisor, Professor Katsunori Mizuno, for his continuous guidance and encouragement, and to Mizuno Laboratory and the Department of Environment Systems at the Graduate School of Frontier Sciences, The University of Tokyo, for supporting this research.

I was also grateful to meet and receive encouragement from Professor Toshihiro Maki, Professor Harumi Sugimatsu, and Professor Tamaki Ura. As a student in marine environmental monitoring, meeting researchers who have contributed so much to ocean engineering was especially inspiring. Their work, together with the long-standing contributions of the Institute of Industrial Science, The University of Tokyo, made me feel connected to a broader research community.

Finally, I would like to thank the IEEE Oceanic Engineering Society, the SPC organizers and judges, and everyone who made OCEANS 2026 Sanya possible. The conference reminded me how much there is still to observe, understand, and protect in the ocean, and I hope to contribute in my own way.

3D Reconstruction of Underwater Structures using Forward-Scan Sonar and Gaussian Splatting

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***Abstract*—3D reconstruction of underwater structures is important for inspection and maintenance but due to turbidity and low-visibility environments optical sensors fail to provide reliable data. Acoustic imaging with multi-beam sonars provides reliable data, but requires expensive hardware and produces dense measurements. In contrast, forward-scan sonars are low-cost and acquire data sequentially as sparse range–intensity measurements. But this sparseness in the data leads to strong elevation ambiguity and makes direct 3D reconstruction ill-posed. Existing Gaussian splatting methods are mainly designed for imaging sonars or multi-modal setups and do not handle single-beam data effectively. This study proposes a Gaussian splatting framework for forward-scan sonar. Each sonar ping is modeled as an elevation-ambiguous arc, and multiple views are combined to initialize and optimize 3D Gaussian primitives. An elevation-aware densification strategy helps resolve geometric ambiguity through multi-view consistency. The proposed method is validated on simulated data, showing accurate and physically consistent 3D reconstructions using low-cost forward-scan sonar systems.**

***Index Terms*—Gaussian Splatting, Forward-scan sonar, 3D Reconstruction, Sparse Acoustic Sensing, Sonar imaging**

I. Introduction

3D reconstruction of underwater structures is critical for inspection, maintenance, and monitoring of infrastructure such as pipelines, bridge piers, and offshore platforms. However, underwater environments often suffer from turbidity, low illumination, and light scattering, which significantly degrade the performance of optical sensing systems. As a result, acoustic sensing, particularly imaging sonar, has become the primary modality for perception in such conditions.

Imaging sonars provide dense range–azimuth measurements and have been widely used for underwater reconstruction and mapping tasks. However, these systems are often expensive and complex, limiting their deployment in cost-sensitive and small-scale platforms. In contrast, forward-scan sonars offer a compact and low-cost alternative. Unlike imaging sonars, forward-scan sonars acquire data sequentially as sparse range–intensity measurements, typically corresponding to a single beam at a time. This fundamental difference introduces significant challenges for 3D reconstruction. Each measurement provides only partial spatial information and suffers from severe elevation ambiguity, making the reconstruction problem inherently ill-posed.

Recent advances in neural rendering, including Neural Radiance Fields (NeRF) [1] and 3D Gaussian Splatting [2], have demonstrated strong capabilities for novel view synthesis and 3D reconstruction. These approaches have been extended to sonar imaging, enabling reconstruction from multi-beam sonar data [3], [4]. More recently, Gaussian splatting–based methods such as SonarSplat [5] have shown improved efficiency and realism in sonar image synthesis.

Despite these advances, existing methods are primarily designed for imaging sonars or multi-modal sensing setups [6], where dense observations are available. These assumptions do not hold for forward-scan sonar, where measurements are sparse, sequential, and ambiguous along the elevation dimension. As a result, directly applying existing frameworks leads to poor geometric consistency and unreliable reconstructions.

This study addresses these challenges by proposing a Gaussian splatting framework tailored for forward-scan sonar data. Instead of treating sonar returns as discrete points, each measurement is modeled as an elevation-ambiguous arc. These arcs are accumulated across multiple viewpoints to initialize a set of 3D Gaussian primitives. The scene is then optimized by rendering synthetic sonar observations and minimizing the discrepancy with measured data. To resolve elevation ambiguity, multi-view consistency is leveraged and the geometry is refined.

The proposed approach is validated on both simulated datasets. The results demonstrate that accurate and physically consistent 3D reconstruction can be achieved using low-cost forward-scan sonar systems, highlighting their potential for practical underwater inspection applications.

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The citable Proceedings of the Conference will be published in
IEEE Xplore shortly after the conclusion of the conference.

II. Related Work

A. Sonar-Based 3D Reconstruction

Underwater 3D reconstruction using sonar has been widely studied due to the limitations of optical sensing in turbid environments. Early approaches rely on geometric modeling and sensor fusion techniques, combining multiple sonar modalities to recover 3D structure [7]. Multi-beam and forward-looking imaging sonars provide dense range–azimuth measurements, enabling reconstruction through point cloud aggregation or probabilistic modeling. More recent work has explored forward-looking sonar systems for reconstruction by introducing mechanical scanning or additional sensing mechanisms to recover elevation information [8]. While these approaches improve reconstruction quality, they often require specialized hardware or additional motion constraints, limiting their applicability in practical deployments.

B. Neural Rendering for Sonar

Neural rendering methods such as NeRF [1] have revolutionized 3D reconstruction by modeling scenes as continuous volumetric functions. These methods have been extended to sonar imaging by incorporating acoustic image formation models. Neusis [3] introduces a NeRF-based framework for reconstructing objects from imaging sonar, while subsequent works improve efficiency and scalability using techniques such as differentiable space carving [4]. Other approaches extend NeRF to account for sonar-specific properties such as acoustic propagation and noise [9]. While these methods demonstrate promising results, they rely on computationally expensive volumetric rendering and assume relatively dense observations, which are not available in forward-scan sonar.

C. Gaussian Splatting for Underwater Reconstruction

3D Gaussian Splatting has emerged as an efficient alternative to NeRF, enabling real-time rendering and fast optimization [2]. This approach represents scenes as collections of 3D Gaussian primitives, which are rasterized to generate images. Recent work has adapted Gaussian splatting to underwater environments, incorporating physics-aware models for light attenuation and noise [10]. In the context of sonar, SonarSplat [5] introduces a Gaussian splatting framework for imaging sonar, modeling acoustic reflectivity and azimuth streaking. Similarly, fusion-based approaches such as Z-Splat [6] combine sonar and camera data to improve reconstruction quality. Recent extensions also address sonar noise modeling within Gaussian splatting frameworks [11].

However, these methods are primarily designed for imaging sonar or multi-modal setups and assume dense range–azimuth measurements. They do not explicitly address the challenges of forward-scan sonar, where data is acquired sequentially and lacks elevation information.

D. Limitations of Existing Methods

Despite significant progress, existing approaches rely on dense observations or additional sensing modalities to resolve ambiguity. Forward-scan sonar, by contrast, provides sparse and sequential measurements, where each observation corresponds to a set of possible 3D locations along an elevation arc. This makes reconstruction fundamentally under-constrained.

To the best of our knowledge, there is limited work that directly addresses 3D reconstruction from forward-scan sonar within a neural rendering or Gaussian splatting framework. This motivates the need for a method that explicitly models the ambiguity of forward-scan measurements and resolves it through multi-view consistency.

III. Problem Formulation

A forward-scan sonar measurement can be represented as an image defined in polar coordinates. Specifically, a sonar image is denoted as $I(r, \theta)$, where r represents the range from the sensor and θ represents the bearing (azimuth) angle. Each pixel in this image encodes the intensity of the acoustic return received from a particular range and bearing direction. Intuitively, the sonar image describes how strongly the emitted acoustic wave is reflected back to the sensor from different directions and distances in the environment.

Unlike conventional optical images, which are formed by perspective projection, sonar images are formed through a time-of-flight measurement process. As a result, the image lies in the (r, θ) domain rather than Cartesian coordinates, and each measurement corresponds to a set of possible 3D points in space rather than a unique location.

Forward-scan sonar (FSS) differs fundamentally from imaging sonar in the way measurements are acquired. Instead of producing dense range–azimuth images, FSS systems acquire sparse range-intensity measurements sequentially, typically corresponding to a single beam at a given time step. This measurement process introduces significant ambiguity in the underlying 3D geometry.

A. Forward Model

Let the 3D scene be represented by a function $G(\mathbf{x})$ that encodes the acoustic reflectivity of points $\mathbf{x} \in \mathbb{R}^3$. Given a sonar pose, a forward-scan sonar measurement corresponds to acoustic returns along a beam direction in which the sonar is facing. FSS operates by emitting an acoustic wavefront and measuring the intensity of the returned signal as a function of range and bearing. For a fixed bearing angle, the sonar transmits energy that propagates outward and interacts with the scene. The received signal at a particular range corresponds to the aggregated reflections from all points that lie at that range along the beam.

A key characteristic of this sensing process is that the forward scan sonar does not directly resolve elevation. As a result, all points that share the same range (r) and bearing (θ), but differ in elevation (ϕ), contribute to the measurement at the same point in the resulting image. This measurement process can be viewed abstractly as a forward operator that maps a 3D scene to a lower-dimensional set of sonar observations. Importantly, this mapping is many-to-one and multiple distinct 3D configurations can produce identical sonar measurements.

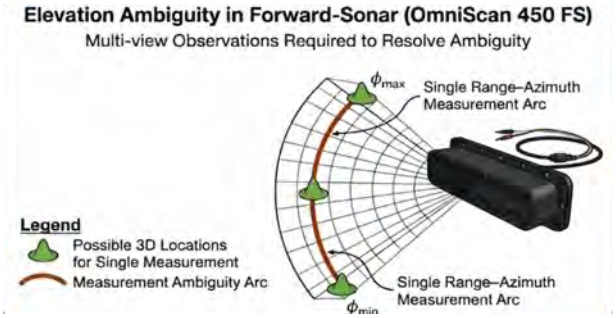


Fig. 1: Illustration of elevation ambiguity in forward-scan sonar. A single range–azimuth measurement corresponds to an arc of possible 3D locations along the elevation dimension. Any point along this arc can produce an identical measurement, making the inverse problem ill-posed. Multi-view observations are required to resolve this ambiguity.

This forward operator can be abstracted as follows:

$$I = \mathcal{F}(G) \tag{1}$$

where $\mathcal{F}$ maps the 3D scene (G) to sonar measurements (I).

B. Elevation Ambiguity

A key challenge arises from the integration over elevation ϕ. A single measurement (r, θ) does not correspond to a unique 3D point, but rather to a set of points lying along an *elevation arc*:

$$\mathcal{A}(r,\theta) = \{\mathbf{x} \in \mathbb{R}^3 \mid \|\mathbf{x}\| = r,\ \angle(\mathbf{x}) = \theta,\ \phi \in [\phi_{\min}, \phi_{\max}]\} \tag{2}$$

Thus, any point along this arc can produce an identical measurement as shown in Figure 1. This leads to inherent ambiguity in mapping sonar measurements to 3D structure.

C. Inverse Problem

The goal of 3D reconstruction is to recover the scene G from measurements I, i.e.,

$$G = \mathcal{F}^{-1}(I) \tag{3}$$

However, the characteristics of the inverse function $(\mathcal{F}^{-1})$ make the problem ill-posed due to:

1) Non-uniqueness: Multiple 3D configurations can produce identical sonar measurements due to elevation ambiguity.
2) Instability: Variations in measurement accuracy can lead to significant variations in the reconstructed geometry.
3) Incomplete observations: Each measurement provides only partial information about the scene.

As a result, directly inverting $\mathcal{F}$ is not feasible.

D. Optimization-Based Reconstruction

To address this, the reconstruction process is formulated as an optimization problem. The goal of this optimization process is to obtain the scene representation $\hat{G}$ that, when passed through the forward model, best explains the observed measurements :

$$\hat{G} = \arg\min_{G}\ \mathcal{L}(\mathcal{F}'(G), I) \tag{4}$$

where $\mathcal{L}$ is a loss function measuring the discrepancy between predicted and observed sonar measurements. In practice, the forward operator $\mathcal{F}$ is approximated using a tractable rendering model $\mathcal{F}'$, which simplifies the underlying acoustic wave propagation process.

In this work, Gaussian based scene representation is adopted and multi-view observations are leveraged to resolve elevation ambiguity. By aggregating measurements across different viewpoints, the feasible set of solutions is progressively constrained, enabling recovery of a consistent 3D structure.

IV. Simulation Model and Data Collection

A. Forward-Scan Sonar Simulation Model

To evaluate the proposed reconstruction framework in a controlled setting, a physics-inspired forward-scan sonar simulator that generates synthetic sonar images from 3D geometry is used. The simulator follows the general sonar image formation model used in prior work [3], while adopting a computationally efficient ray-based approximation.

A forward-scan sonar is a time-of-flight sensor that measures acoustic returns in a polar image defined over range and azimuth. The resulting sonar image is represented as $I \in \mathbb{R}^{N_r \times N_\theta}$, where N_r and N_θ denote the number of range bins and azimuth beams, respectively.

The continuous sonar image formation process can be expressed as an integration over range, azimuth, and elevation:

$$I(r_i, \theta_j) = \int_{\phi_{\min}}^{\phi_{\max}} \int_{\theta_j^-}^{\theta_j^+} \int_{r_i^-}^{r_i^+} E_e\, T(r,\theta,\phi)\, \sigma(r,\theta,\phi)\, dr\, d\theta\, d\phi \tag{5}$$

where E_e is the emitted acoustic intensity, $T(\cdot)$ denotes transmittance, and $\sigma(\cdot)$ represents the reflectivity of the scene. Here $\theta_j^- = \theta_j - \epsilon_a$, $\theta_j^+ = \theta_j + \epsilon_a$, $r_j^- = r_j - \epsilon_r$ and $r_j^+ = r_j + \epsilon_r$ where ϵ_a and ϵ_r are the azimuth and range resolutions respectively

In practice, evaluating this integral directly is computationally expensive. Therefore, it is approximated in the forward model using discrete sampling within each beam. For each azimuth beam θ_j, finite set of elevation angles $\{\phi_k\}$ and azimuth offsets $\{\theta_l\}$ are sampled within the beam width. For each sampled direction, a ray is cast into the scene to compute intersections with the geometry.

Let r_{hit} denote the distance to the closest intersection point along a sampled ray. The contribution of this ray to the sonar image is assigned to the corresponding range bin r_i if $r_{hit} \in [r_i - \epsilon_r, r_i + \epsilon_r]$. The discretized approximation of the sonar image can then be written as:

$$I(r_i, \theta_j) \approx \sum_{k,l} w(\theta_l, \theta_j)\, \alpha(r_{hit})\, \Delta\phi\, \Delta\theta \tag{6}$$

where $w(\cdot)$ is a beam pattern weighting function and $\alpha(r_{hit})$ represents the range-dependent contribution.

In this study, the beam pattern is modeled as a Gaussian:

$$w(\theta_l, \theta_j) = \exp\left(-\frac{1}{2}\left(\frac{\theta_l - \theta_j}{\epsilon_a}\right)^2\right) \tag{7}$$

The range contribution is approximated using a simplified model:

$$\alpha(r) = E_e\, T\, \sigma\, \Delta r \tag{8}$$

where T and σ are treated as constants for computational efficiency. This corresponds to a linear approximation of the range integral used in the continuous formulation. This modeling choice accounts for the gain adjusted outputs which sonars provide as their measurements.

The final sonar image is obtained by accumulating contributions from all sampled rays across all beams. This formulation provides a tractable approximation of the sonar image formation process while capturing key physical characteristics such as beam spread and range-dependent accumulation.

B. Data Collection Strategy

To generate diverse multi-view sonar observations, an automated data collection pipeline that samples sensor poses around the scene is implemented. The sensor is constrained to lie on a predefined sampling plane (e.g., XY, XZ, or YZ), while the remaining two coordinates are sampled within specified bounds. This enables controlled coverage of the scene from multiple viewpoints.

At each sampled position, the sensor is oriented to face the centroid of the structure, ensuring that the region of interest remains within the field of view. To increase viewpoint diversity, small random perturbations are added to the sensor orientation. This results in a distribution of poses that vary in both position and viewing direction. For each pose, a sonar image is generated using the simulation model, and the corresponding sensor pose is recorded. The dataset thus consists of paired sonar images and poses, which are used for reconstruction. All captures, including sensor intrinsics and extrinsics, are stored for reproducibility.

V. 3D Reconstruction Methodology

A. Gaussian Scene Representation

The 3D scene is represented as a set of N Gaussian primitives:

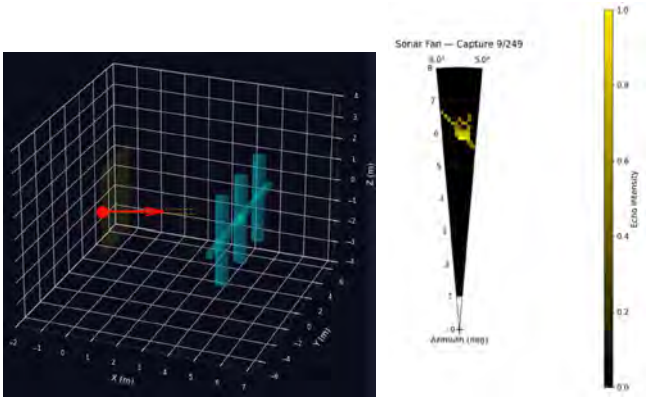
$$\mathcal{G} = \{\mathcal{G}_i\}_{i=1}^{N} \tag{9}$$

where each Gaussian $\mathcal{G}_i$ is parameterized by its mean $\boldsymbol{\mu}_i \in \mathbb{R}^3$, covariance $\boldsymbol{\Sigma}_i \in \mathbb{R}^{3\times3}$, opacity $\alpha_i \in [0,1]$, and reflectivity $\rho_i \in \mathbb{R}^+$.

The covariance is represented using anisotropic scaling and rotation:

$$\boldsymbol{\Sigma}_i = \mathbf{R}_i\, \mathbf{S}_i^2\, \mathbf{R}_i^\top \tag{10}$$

where $\mathbf{R}_i$ is derived from a quaternion and $\mathbf{S}_i$ is a diagonal scale matrix. This representation enables continuous volumetric modeling while remaining efficient for rendering and optimization.



(a) 3D structure used in simulation (b) FSS image

Fig. 2: Example of simulated data. The left image shows the 3D fence structure used in the simulation, while the right image shows the corresponding forward-scan sonar image in (r, θ) coordinates. The sonar image demonstrates how the 3D geometry is projected into the sonar domain with significant elevation ambiguity.

B. Gaussian Initialization from Sonar Observations

Unlike imaging-based methods, forward-scan sonar measurements do not directly correspond to unique 3D points. To initialize the Gaussian set, the sonar measurements are first converted into 3D point hypotheses by sampling along the elevation dimension. For each active sonar pixel (r, θ), a set of candidate 3D points are generated along the elevation arc:

$$\mathbf{x}(r, \theta, \phi_k), \quad \phi_k \in [\phi_{\min}, \phi_{\max}] \tag{11}$$

where $\{\phi_k\}$ are uniformly sampled elevation angles.

To reduce ambiguity, multi-view consistency is enforced by retaining only those points that are observed from multiple viewpoints. Specifically, points are clustered within a spatial radius and retained if they are supported by at least M distinct views. This results in a filtered set of points:

$$\mathcal{P} = \{\mathbf{x}_i \mid \text{observed in } \geq M \text{ views}\} \tag{12}$$

Each retained point initializes a Gaussian with position $\boldsymbol{\mu}_i = \mathbf{x}_i$, reflectivity proportional to the measured intensity, and initial opacity:

$$\alpha_i = \sqrt{\rho_i} \tag{13}$$

Additionally, each Gaussian is assigned a set of *view tags* indicating the sonar scans in which it contributes. This enables selective optimization based on observation support.

C. Sonar Rendering with Gaussian Splatting

Given a set of Gaussians and a sensor pose, a synthetic sonar image is rendered by projecting the 3D Gaussian primitives into the sonar image space and accumulating their contributions along each beam.

1) World-to-Sensor Transformation: Each Gaussian mean $\boldsymbol{\mu}_i \in \mathbb{R}^3$ is defined in the world coordinate frame. To render from a given sensor viewpoint, the Gaussians are transformed into the sensor coordinate frame using a homogeneous transformation matrix:

$$\mathbf{T} = \begin{bmatrix} \mathbf{R} & \mathbf{t} \\ \mathbf{0}^\top & 1 \end{bmatrix} \in \mathbb{R}^{4\times4} \tag{14}$$

where $\mathbf{R} \in \mathbb{R}^{3\times3}$ is the rotation matrix representing the sensor orientation, and $\mathbf{t} \in \mathbb{R}^3$ is the translation vector representing the sensor position in the world frame.

Using homogeneous coordinates, the transformed Gaussian mean is given by:

$$\boldsymbol{\mu}_i^{(s)} = \mathbf{T} \begin{bmatrix} \boldsymbol{\mu}_i \\ 1 \end{bmatrix} \tag{15}$$

The covariance is transformed using only the rotational component:

$$\boldsymbol{\Sigma}_i^{(s)} = \mathbf{R}\, \boldsymbol{\Sigma}_i\, \mathbf{R}^\top \tag{16}$$

where $\boldsymbol{\mu}_i^{(s)} = (x_i, y_i, z_i)^\top$ denotes the Gaussian mean in the sensor frame.

2) Cartesian-to-Spherical Transformation: To map the Gaussian distribution from Cartesian coordinates to sonar measurement space, the mean and covariance in sensor frame is transformed into spherical coordinates:

$$\begin{aligned} r &= \sqrt{x^2 + y^2 + z^2}, \\ \theta &= \arctan 2(y, x), \\ \phi &= \arctan 2(z, \sqrt{x^2 + y^2}) \end{aligned} \tag{17}$$

Following SonarSplat [5], this nonlinear transformation is approximated using a first-order linearization around the Gaussian mean. The covariance is propagated using the Jacobian of the transformation:

$$\boldsymbol{\Sigma}_i^{(r\theta\phi)} = \mathbf{J}_i\, \boldsymbol{\Sigma}_i^{(s)}\, \mathbf{J}_i^\top \tag{18}$$

The Jacobian $\mathbf{J}_i \in \mathbb{R}^{3\times3}$ is given by:

$$\mathbf{J}_i = \begin{bmatrix} \frac{x}{r} & \frac{y}{r} & \frac{z}{r} \\ -\frac{y}{x^2+y^2} & \frac{x}{x^2+y^2} & 0 \\ -\frac{xz}{r^2\sqrt{x^2+y^2}} & -\frac{yz}{r^2\sqrt{x^2+y^2}} & \frac{\sqrt{x^2+y^2}}{r^2} \end{bmatrix} \tag{19}$$

This linearization enables efficient propagation of uncertainty into sonar measurement space while avoiding nonlinear integration.

3) Projection to Image Space: The sonar image is defined over discrete range and azimuth bins. Let H denote the number of range bins and W the number of azimuth beams.

The continuous spherical coordinates are mapped to pixel coordinates as:

$$u_r = \frac{r - r_{\min}}{\epsilon_r}, \quad u_\theta = \frac{\theta + \text{FOV}/2}{\text{FOV}}(W-1) \tag{20}$$

where:

- $r_{\min}$ is the minimum sensing range,
- ϵ_r is the range resolution,
- FOV is the azimuth field of view.

The projected Gaussian mean in image space is:

$$\mathbf{u}_i = (u_r, u_\theta)^\top \tag{21}$$

The covariance is reduced to the (r, θ) subspace:

$$\boldsymbol{\Sigma}_i^{(r\theta)} = \boldsymbol{\Sigma}_i^{(r\theta\phi)}[0:2, 0:2] \tag{22}$$

To convert to pixel units, a scaling matrix is applied:

$$\mathbf{D} = \begin{bmatrix} \frac{1}{\epsilon_r} & 0 \\ 0 & \frac{1}{\epsilon_\theta} \end{bmatrix} \tag{23}$$

where $\epsilon_\theta = \frac{\text{FOV}}{W-1}$.

The pixel-space covariance is:

$$\boldsymbol{\Sigma}_i^{(pix)} = \mathbf{D}\, \boldsymbol{\Sigma}_i^{(r\theta)}\, \mathbf{D}^\top \tag{24}$$

4) Gaussian Splatting: Let $\mathbf{p} = (r_p, \theta_p)$ denote a pixel location in the sonar image grid. Each Gaussian contributes to pixel $\mathbf{p}$ via a 2D Gaussian kernel:

$$f_i(\mathbf{p}) = \exp\left(-\frac{1}{2}(\mathbf{p} - \mathbf{u}_i)^\top \boldsymbol{\Sigma}_i^{-1}(\mathbf{p} - \mathbf{u}_i)\right) \tag{25}$$

where:

- $\mathbf{u}_i$ is the projected mean of Gaussian i,
- $\boldsymbol{\Sigma}_i$ is the covariance in pixel space.

5) Volumetric Accumulation and Transmittance: Following a volumetric rendering formulation, Gaussians are sorted along each beam in increasing order of range r_i.

The opacity contribution of Gaussian i at pixel $\mathbf{p}$ is:

$$\alpha_i(\mathbf{p}) = \alpha_i\, f_i(\mathbf{p}) \tag{26}$$

where α_i is the opacity of the i-th Gaussian. The transmittance up to Gaussian i is defined as:

$$T_i(\mathbf{p}) = \prod_{j<i} (1 - \alpha_j(\mathbf{p})) \tag{27}$$

The rendered intensity at pixel $\mathbf{p}$ is:

$$\hat{I}(\mathbf{p}) = \sum_i T_i(\mathbf{p})\, \alpha_i(\mathbf{p})\, \rho_i \tag{28}$$

where ρ_i denotes the reflectivity of Gaussian i.

6) Approximate Transmittance Computation: Computing per-pixel transmittance for all Gaussians can be computationally expensive. To improve efficiency, the transmittance per Gaussian by averaging is approximated over its effective support region.

Let $\mathcal{N}_i$ denote the set of pixels where $f_i(\mathbf{p})$ is non-negligible. The approximate transmittance is:

$$\bar{T}_i = \frac{1}{|\mathcal{N}_i|} \sum_{\mathbf{p}\in\mathcal{N}_i} T_i(\mathbf{p}) \tag{29}$$

The rendered image is then computed as:

$$\hat{I}(\mathbf{p}) = \sum_i \bar{T}_i\, \alpha_i\, \rho_i\, f_i(\mathbf{p}) \tag{30}$$

This approximation preserves the ordering effects of occlusion while significantly reducing computational cost.

7) View-Dependent Subset Selection: To improve computational efficiency and reduce spurious gradients, only a subset of Gaussians contributes to each rendering pass. Specifically, each Gaussian is associated with a set of views in which it is observed, and only those Gaussians relevant to the current view are considered during rendering. This results in a view-dependent sparse splatting process, which significantly stabilizes optimization.

D. Optimization Objective

The reconstruction is formulated as an optimization problem:

$$\hat{\mathcal{G}} = \arg\min_{\mathcal{G}} \sum_{k} \mathcal{L}(\hat{I}_k, I_k) \tag{31}$$

where $\hat{I}_k$ and I_k denote predicted and observed sonar images for view k. The reconstruction loss is calculated as the ℓ_1 norm between the predicted and the observed image.

$$\mathcal{L}_{\text{recon}} = \sum_{k} \|\hat{I}_k - I_k\|_1 \tag{32}$$

1) Opacity and Scale Regularization: In addition to the reconstruction loss, $\mathcal{L}_{\text{recon}}$, regularization terms are used to minimize the number of Gaussians required to represent the underlying 3D geometry. This is achieved by including regularization terms to reduce the opacity and size of the Gaussians and then pruning the Gaussians whose opacity or distance from the surrounding Gaussians reduces below a specified threshold value.

2) Elevation-Ray Regularization: When only the image reconstruction loss is used, the optimizer may distribute Gaussian opacity along elongated tubes in 3D that project to the same sonar image, resulting in vertical smearing and floating Gaussian trails. To mitigate this ambiguity, an elevation-ray regularization term is introduced. This term is introduced to discretize not only the azimuth dimension, but also the elevation dimension, and encourage the Gaussian mass along each discretized (θ, ϕ) ray to remain compact in range.

For each Gaussian, the mean position transformed into the sensor frame is first converted to spherical coordinates. The azimuth coordinate is discretized using the same field of view and beam spacing as the renderer:

$$b_{\theta,i} = \left\lfloor \frac{\theta_i + \text{FOV}/2}{\text{FOV}} (W - 1) \right\rfloor \tag{33}$$

Similarly, the elevation coordinate is discretized into bins of width $\Delta\phi$:

$$b_{\phi,i} = \left\lfloor \frac{\phi_i - \phi_{\min}}{\Delta\phi} \right\rfloor \tag{34}$$

All Gaussians sharing the same pair of indices (b_θ, b_ϕ) are considered to lie on the same acoustic ray. Within each ray, the Gaussians are sorted by increasing range. For a Gaussian k on a particular ray, a scalar score is computed:

$$\ell_k = n_k \, f_k \tag{35}$$

where n_k is the number of views in which the Gaussian is observed and f_k is an image-consistency weight derived from the measured sonar intensity at the Gaussian's projected range–azimuth pixel. Gaussians supported by more views and stronger sonar returns therefore receive larger scores.

The scores are converted into a normalized mass distribution along the ray using a softmax:

$$p_k = \frac{\exp(\ell_k)}{\sum_j \exp(\ell_j)} \tag{36}$$

A compact reconstruction along the ray is encouraged using two terms. First, the entropy of the mass distribution is minimized:

$$\mathcal{H}_{\text{ray}} = -\sum_{k} p_k \log(p_k + \epsilon) \tag{37}$$

where ϵ is a small constant for numerical stability. Minimizing this entropy encourages the Gaussian mass to concentrate around a small number of locations instead of being spread across many depths. Second, the weighted variance of the Gaussian depths along the ray is minimized. Let

$$\bar{r} = \sum_{k} p_k r_k \tag{38}$$

denote the weighted mean range of the Gaussians on the ray. The depth variance is then

$$\text{Var}_r = \sum_{k} p_k (r_k - \bar{r})^2 \tag{39}$$

The regularization loss for a single ray is considered as

$$\mathcal{L}_{\text{ray}} = \mathcal{H}_{\text{ray}} + \lambda_{\text{depth}} \, \text{Var}_r \tag{40}$$

where λ_{depth} controls the strength of the depth compactness term.

The final elevation-ray regularization is obtained by averaging over all rays containing at least two Gaussians:

$$\mathcal{L}_{\text{elev}} = \frac{1}{N_{\text{ray}}} \sum_{m=1}^{N_{\text{ray}}} \mathcal{L}_{\text{ray}}^{(m)} \tag{41}$$

The overall training objective is modified as:

$$\mathcal{L}_{\text{total}} = \mathcal{L}_{\text{recon}} + \lambda_\alpha \|\alpha\|^2 + \lambda_s \|\mathbf{S}\|^2 + \lambda_{\text{elev}} \mathcal{L}_{\text{elev}} \tag{42}$$

where α denotes the opacity regularization and $\mathbf{S}$ denotes the scale regularization. Thus regularization suppresses diffuse vertical trails and encourages the Gaussians to converge onto compact, physically plausible structures that are consistent across multiple views and with the observed sonar intensities.

E. Opacity Gradient Alignment

Additionally an opacity update strategy is used that aligns opacity changes with the reconstruction loss gradient. To aid 3D geometry shaping with the gaussians, instead of only relying on standard gradient descent, the gradient of the reconstruction loss with respect to opacity is also computed:

$$g_i = \frac{\partial \mathcal{L}_{\text{recon}}}{\partial \alpha_i} \tag{43}$$

Opacity is then updated multiplicatively after the optimization step as:

$$\alpha_i \leftarrow \alpha_i \cdot \exp(-\eta g_i) \tag{44}$$

where η is the hyperparameter to control the strength of opacity gradient alignment. To suppress Gaussians that consistently cause poor reconstruction, an exponential moving average of the gradients is maintained and an additional decay is applied:

$$h_i^{(t)} = \beta h_i^{(t-1)} + (1-\beta)\max(g_i, 0) \tag{45}$$

$$\alpha_i \leftarrow \alpha_i \cdot \exp(-\lambda_h h_i) \tag{46}$$

where β controls the momentum of the contribution of the Gaussians which are causing poor reconstruction, λ_h is the decay rate factor for reducing the opacity of these poorly contributing Gaussians. This encourages removal of inconsistent Gaussians while preserving stable ones.

F. Density-Based Pruning

To remove floating or isolated Gaussians, a density-based pruning strategy is also introduced. For each Gaussian, the number of neighboring Gaussians within a radius r_d is computed:

$$n_i = |\{j \mid \|\boldsymbol{\mu}_i - \boldsymbol{\mu}_j\| < r_d\}| \tag{47}$$

Gaussians with fewer than a minimum number of neighbors are removed:

$$\mathcal{G} \leftarrow \{\mathcal{G}_i \mid n_i \geq N_{\min}\} \tag{48}$$

This effectively eliminates spurious isolated structures and improves reconstruction consistency.

G. Reconstruction-Aware Pruning Guard

To prevent removal of important Gaussians, the contribution of each Gaussian to the reconstruction loss is estimated using a first-order approximation:

$$s_i \approx \left| \frac{\partial \mathcal{L}_{\text{recon}}}{\partial \alpha_i} \cdot \alpha_i \right| \tag{49}$$

Gaussians with high impact scores are protected during pruning, ensuring that important structural elements are preserved even if they have low opacity or density initially during the training.

H. Discussion

The proposed formulation adapts Gaussian splatting to forward-scan sonar by explicitly accounting for sparse, ambiguous measurements. Key design choices such as elevation-based initialization, view-dependent gradient computation, and reconstruction-aware pruning enable stable optimization despite the ill-posed nature of the problem. Furthermore, collecting sonar data from diverse viewpoints also significantly improves reconstruction quality by reducing ambiguity and increasing multi-view consistency.

VI. Results and Discussion

In this section, two test cases from the simulation analysis are shown.

A. Case 1 : Reconstruction of a Fence Structure

The proposed method is implemented on a simple fence structure consisting of three vertical rods and a horizontal bar in the center as shown in Fig 2. This structure is chosen to discuss the various parameters used and highlight the challenges posed by thin, elongated geometries under forward-scan sonar measurements.

1) Data Collection and Preprocessing: Sonar data is collected from multiple viewpoints surrounding the structure. Specifically, data is acquired from all four sides of the scene, resulting in an initial set of poses. From these, a subset of 249 poses is selected by filtering out views that produce excessively sparse sonar returns. Each selected pose is associated with a sonar image, forming a dataset of paired observations used for reconstruction.

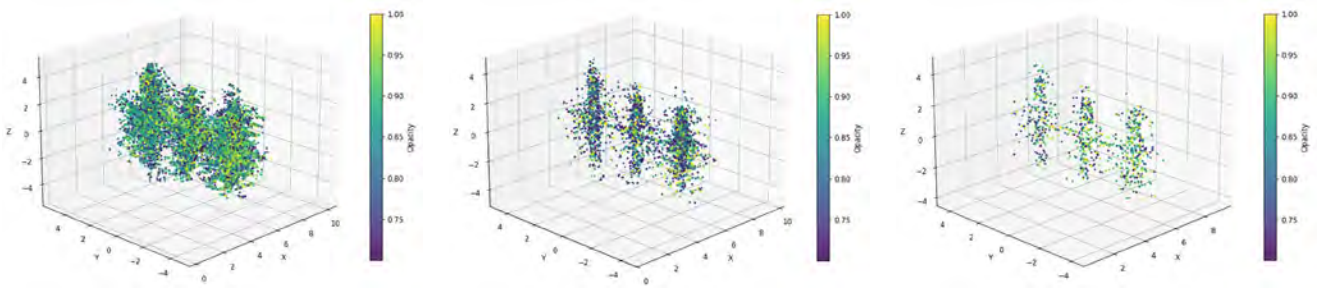
2) Gaussian Initialization: From the collected sonar data, an initial set of 3D point hypotheses is generated using the elevation-based densification approach described in Section V-B. This results in a total of 50,940 candidate points sampled along elevation arcs. To reduce ambiguity and remove spurious points, two filtering steps are applied. First an intensity thresholding is applied to remove low-confidence measurements and then multi-view consistency filtering is applied, which retains only points supported by multiple viewpoints. After filtering, a total of 38,024 points are retained and used to initialize the Gaussian set. The coordinates of these points define the Gaussian means, while opacity and reflectivity are initialized based on the corresponding sonar intensities, as described in Section V-B.

3) Optimization and Reconstruction: The initialized Gaussian representation is optimized using the Gaussian splatting framework described in Section V-C. The optimization process adjusts the Gaussian parameters to minimize the discrepancy between rendered and observed sonar images across all viewpoints.

4) Training Evolution: Fig. 3 illustrates the evolution of the Gaussian representation over the course of training. At early stages, the Gaussians are widely distributed due to elevation ambiguity. As optimization progresses, multi-view consistency and transmittance-based accumulation guide the Gaussians toward the true structure. By the final epoch, the reconstructed Gaussian distribution closely resembles the underlying fence geometry, with clear localization of the vertical rods and horizontal bar.

B. Case 2 : Reconstruction of a Truss Structure

The proposed method is further evaluated with a more complex truss structure as shown in Fig. 4. Unlike the fence structure, the truss contains a larger number of thin members, intersecting beams, and repeated patterns. Such structures are particularly challenging for forward-scan sonar reconstruction because multiple parts of the object may produce overlapping returns in the sonar image, increasing ambiguity along the elevation direction.



(a) Epoch 5 (b) Epoch 15 (c) Epoch 100

Fig. 3: Evolution of the Gaussian representation during optimization for the fence structure. Each plot is showing the opacity of the Gaussians at a particular epoch thresholded at 0.7. At early epochs, the Gaussians are widely distributed due to elevation ambiguity in the sonar measurements. As optimization progresses, the Gaussian set becomes increasingly concentrated around the true structure. By Epoch 100, the three vertical rods and horizontal connecting bar are clearly recovered and most of the spurious Gaussians are pruned.

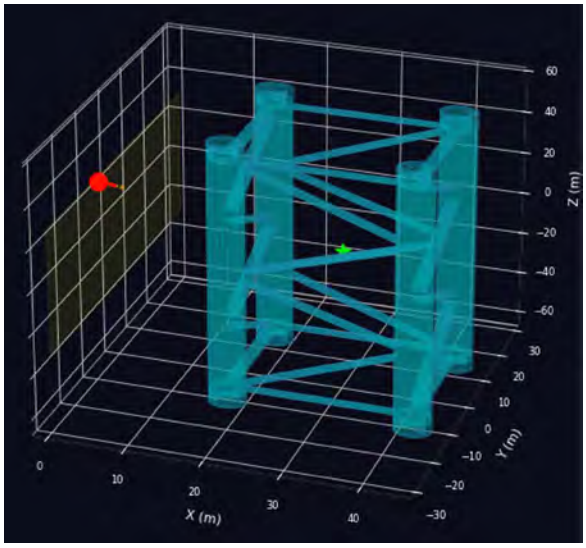


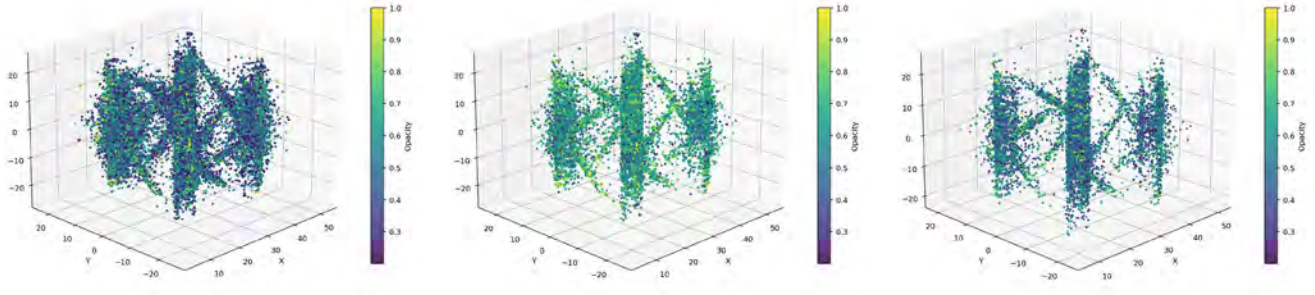
Fig. 4: Truss structure used in the second reconstruction experiment with a sampled location of the sonar sensor (red point). The structure contains multiple intersecting members and repeated geometric patterns, making the reconstruction problem significantly more challenging than the fence case.

1) Data Collection and Preprocessing: Due to the increased structural complexity, view diversity becomes significantly more important in this case. Data is therefore collected from all sides of the truss to ensure that every member of the structure is observed from multiple viewpoints. Without sufficient angular diversity, many of the individual beams become difficult to distinguish and can produce overlapping or incomplete reconstructions.

Similar to the previous case, an initial set of poses is generated around the structure and views producing excessively sparse sonar scans are discarded. The remaining poses and corresponding sonar images are used for reconstruction. A total of 886 viewpoints are selected for reconstructing of the truss structure.

2) Gaussian Initialization: The elevation-based densification approach described in Section V-B is applied to all selected sonar images to generate an initial set of 3D point hypotheses. Owing to the larger spatial extent and greater geometric complexity of the truss, this process produces a substantially larger number of candidate points than in the fence reconstruction case. The total number of candidate points generated before filtering is 811,690. Directly initializing all of these points as Gaussians would result in a prohibitively expensive optimization problem. Therefore, the same filtering procedure used in Case 1 is applied. First, low-intensity points are removed using intensity thresholding. Next, the multi-view consistency filter described in Section V-B is used to retain only points that are supported by observations from multiple viewpoints. After filtering, the number of retained Gaussians is reduced to 174,637. This initial pruning stage significantly reduces the computational cost while also improving the quality of the initialization by removing many of the spurious points arising from elevation ambiguity.

3) View-Dependent Gaussian Selection: Even after the initial filtering stage, the number of Gaussians in the truss reconstruction remains substantially larger than in the fence case. Rendering all Gaussians for every training image would therefore be computationally expensive and would introduce gradients from Gaussians that are not relevant to the current viewpoint. To address this issue, each Gaussian is associated with the set of views in which it is observed. During rendering, only the Gaussians whose view tags include the current image are selected for splatting. This view-dependent subset selection strategy, described in Section V-C7, greatly reduces the number of Gaussians considered in each rendering pass. In practice, this reduces the computational cost during training and leads to improved optimization stability by ensuring that each Gaussian only receives gradients from images in which it contributes to the reconstruction. This is especially important for the truss case, where many Gaussians correspond to



(a) Epoch 5 (b) Epoch 15 (c) Epoch 100

Fig. 5: Evolution of the Gaussian representation during optimization for the truss structure. Each plot shows the Gaussians with opacity greater than 0.2. Owing to the larger size and increased geometric complexity of the structure, the initial reconstruction contains a significantly larger number of ambiguous Gaussians. Over the course of optimization, these Gaussians progressively converge onto the truss members, while many spurious Gaussians are removed through pruning and view-consistent optimization.

different portions of the structure that are only visible from a limited set of viewpoints.

4) Optimization and Reconstruction: The filtered Gaussian set is optimized using the same Gaussian splatting framework as in Case 1. During training, the optimization progressively suppresses spurious Gaussians while strengthening Gaussians that consistently explain the sonar measurements across multiple viewpoints.

5) Training Evolution: The evolution of the reconstruction during training is shown in Fig. 5. Similar to the fence case, the initial Gaussian distribution is diffuse and contains many ambiguous points distributed along elevation arcs. As training proceeds, the Gaussians become increasingly concentrated along the true truss members. By the final epoch, the major structural components of the truss are clearly reconstructed, including the intersecting beams and repeated geometric features. The final reconstruction demonstrates that the proposed method is capable of recovering more complex underwater structures from forward-scan sonar measurements when sufficient multi-view coverage is available.

6) Quantitative Evaluation: To quantitatively evaluate the reconstruction quality, the final Gaussian means are compared against the ground-truth mesh of the corresponding structure. Following the evaluation protocol used in [5], the reconstructed Gaussian cloud is first aligned to the ground-truth mesh using Iterative Closest Point (ICP). The aligned Gaussian set is then cropped to the ground-truth bounding box and compared to the mesh using the RMS L_1 Chamfer Distance (CD-l_1) and Hausdorff Distance (HD), both expressed in meters.

The CD-l_1 metric measures the average bidirectional distance between the reconstructed points and the true surface, while the Hausdorff Distance measures the maximum mismatch between the two sets. Lower values therefore indicate better reconstruction quality.

For the fence structure from Case 1, the proposed method achieves a CD-l_1 of only 0.129 m. Since the rods are separated by approximately 3 m and have a height of approximately 4 m, this corresponds to only a small fraction of the object dimensions. The reconstructed Gaussian cloud therefore closely matches the true geometry. The larger Hausdorff Distance of 1.391 m is primarily caused by a small number of remaining ambiguous Gaussians produced by the elevation uncertainty of the sonar measurements. These outliers do not significantly affect the overall structure but increase the maximum error.

TABLE I: Quantitative reconstruction accuracy for the simulated structures.

Structure	**CD-l_1 (m)**	**HD (m)**
Fence Structure	0.129	1.391
Truss Structure	0.740	10.181

In contrast, the truss structure from Case 2 presents a considerably more challenging reconstruction problem due to its larger size and the presence of many thin intersecting members. The proposed method achieves a CD-l_1 of 0.740 m, which remains small compared to the overall dimensions of the truss (approximately $20 \times 20 \times 40$ m). The reconstruction therefore captures the overall geometry and major truss members accurately. However, the Hausdorff Distance increases to 10.181 m, indicating that a few regions of the structure remain poorly reconstructed.

The degradation in performance for the truss structure can be attributed to two factors. First, the larger spatial extent of the structure increases the ambiguity introduced by the sonar elevation integration. Second, the thin members of the truss often generate similar sonar returns from multiple possible locations along the elevation arc. As a result, some Gaussian mass remains distributed away from the true structure even after optimization.

Fig. 6 further illustrates the reconstruction quality for the truss structure. The majority of the Gaussian means are concentrated around the true truss members, indicating that the optimization successfully recovers the dominant geometry

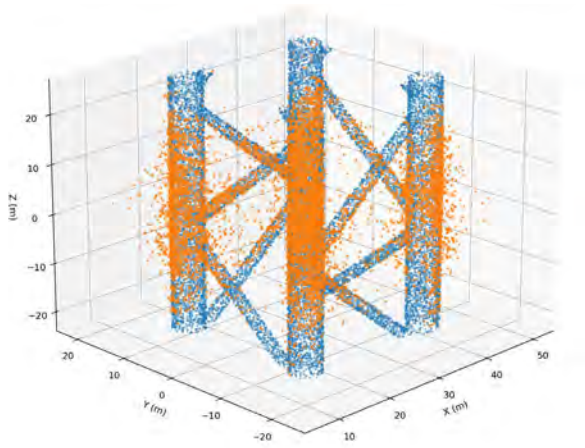


Fig. 6: Comparison between the reconstructed Gaussian means and the ground-truth truss geometry after alignment. The reconstructed Gaussian means are shown in orange and the ground-truth truss mesh samples are shown in blue. The overall structure and the major truss members are recovered accurately, although some residual Gaussian spread remains around the true members due to elevation ambiguity.

of the structure. Nevertheless, a noticeable spread of Gaussians remains around the vertical columns and diagonal members. This residual spread is consistent with the elevation ambiguity inherent in forward-looking sonar, where multiple 3D locations can produce similar observations in the (r, θ) image.

Overall, the results demonstrate that the proposed Gaussian splatting framework is able to recover both simple and complex structures from forward-looking sonar measurements. While the reconstruction quality decreases for larger and more geometrically complex scenes, the method remains capable of capturing the dominant structural elements with sub-meter average error.

VII. Conclusion and Future works

This work presents a Gaussian splatting–based framework for 3D reconstruction using forward-scan sonar, explicitly addressing the challenge of elevation ambiguity inherent in sparse range–azimuth measurements. By modeling each sonar return as an elevation-ambiguous arc and leveraging multi-view consistency, the proposed approach enables the recovery of geometrically consistent 3D structures from sequential sonar data.

The incorporation of elevation-aware initialization, view-dependent optimization, and regularization strategies allows the framework to suppress ambiguity and converge to physically meaningful reconstructions. Results on simulated structures demonstrate the capability of the method to recover both simple and complex geometries using low-cost forward-scan sonar systems. Overall, this study highlights the potential of combining physics-inspired modeling with Gaussian splatting for underwater reconstruction in sparse sensing scenarios, providing a foundation for further development toward real-world deployment.

Future work will focus on validating the proposed framework on real forward-scan sonar data collected from controlled underwater experiments, enabling quantitative evaluation under realistic noise and sparsity conditions. A systematic comparison with baseline methods, including NeRF-based sonar reconstruction, imaging sonar Gaussian splatting approaches, and traditional geometric techniques, will be conducted to assess improvements in accuracy and robustness.

Further extensions will incorporate more accurate acoustic modeling, such as range-dependent attenuation and angle-dependent reflectivity, along with potential sensor fusion using IMU or vision data. Finally, efforts will be directed toward reducing computational complexity and enabling real-time reconstruction, with the goal of deploying the system on autonomous underwater platforms and extending this work into a journal publication.

Acknowledgment

The author, Vallabh Deogaonkar (PMRF Research Scholar), gratefully acknowledges the support of the Prime Minister's Research Fellowship, India, for supporting the completion of this study.

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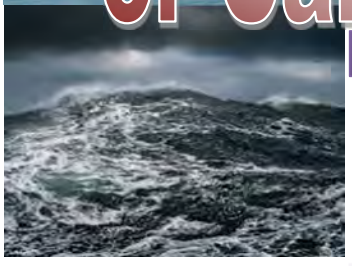
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Who's Who in the IEEE OES

Ye Li, OES AdCom member

I was born in a small coastal town named Wenzhou in the Southeastern China with an over 5000-year history. It is a very unique town that it can only be accessed by bus and boat until 90s because it is surrounded by several mountains and therefore it has a very strong oceanic culture with its own languages and people who are very cohesive and sometime mysterious. For example, a very famous couplet in the temple of Conquest Island in downtown Wenzhou is written with repeating words, but with magnificent and mysterious meanings, by one of Zhuangyuans,[1] Mr. Shipeng Wang in Song Dynasty (Fig. 1). One can find over twenty reading methods and to digest their meanings. In anyway, I guess the seed of my interests to the ocean and reading was planted that time, although my family moved to Beijing after I entered Kindergarten.

When I was twelve years old, I was lucky to enroll into the middle school attached to Peking University where I developed strong interests in mathematics and history, two very famous majors that Peking University has. However, at the last year of my high school time, the seed planted in Wenzhou grew. I decided to study something that can help me explore the ocean, and enter Shanghai Jiao Tong University (SJTU), which offers the best ocean engineering program in the nation and where I joined IEEE OES as a student member. My serious academic life started when I entered graduate school in the University of British Columbia (UBC) where I majored in Mechanical Engineering. I really enjoyed the UBC environment, where I could choose not only courses in Faculty of Engineering but also in Faculty of Science. For example, the graduate level fluid mechanics course I took was offered by department of mathematics. Meanwhile, my interests converged in ocean technology that combines marine hydrodynamics and system dynamics. I started from marine vehicle maneuverability and later concentrated on offshore renewable energy performance, which is a kindly niche field at that time, while booming up shortly after. My supervisor, Professor Sander M. Calisal, a leading researcher in the field, advised me like a philosopher that I could dive deeper in the problems, and his wisdom guided me for a very long time; we still get together once per few years (Fig. 2).

At the end of my Ph.D., I pondered for sometime to think whether I should stay in the university afterwards. I noticed a business card on my desk that Dr. Dan Arvizu (Director of US National Renewable Energy Laboratory, NREL) gave me during a National Science Foundation workshop. After a while, I knew that I wanted to go to a US National Laboratory. I first spent about sixteen months at the Pacific Northwest National Laboratory as a scientist working with energy technologies and marine science

[1]Top scholar in ancient China via national competition started from Tang Dynasty and ended at the end of Tsing Dynasty, one every two to three years, and totally about 600.

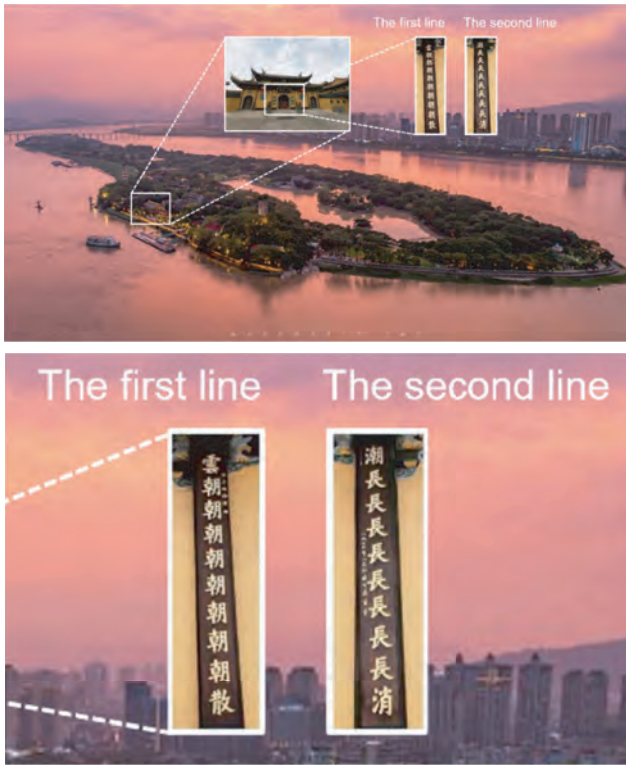


Figure 1. Conquest Island in Wenzhou and the special couplets on the main gate of the Temple at the Island.



Figure 2. Ye Li with Professor Calisal at honorary symposium named after him in Vancouver, 2025, and presented a scaled down model of his old 1972 T2 Volkswagen minibus as a gift.

experts, and then joined in NREL as a strategic hired senior staff to develop their ocean renewable program where I started a very interesting life with different engineers and technologists.

My NREL time was very exciting, not only because I got a chance to develop a new program, but I worked with a group of talents and great mentors such as Dr. Robert (Bob) Thresher and Dr. Paul Veers at NREL and outside mentors such as Prof. Walter Munk at Scripps (Fig. 3). My role in NREL can be considered as two: working with Dr. Thresher to 1) develop the ocean program at NREL and 2) develop numerical codes for ocean energy devices. Within that five years, I learned from Bob, day by day, on how to build up a team, and later on we had a team of twenty some staff members. In the code development task, I worked on nascent version of a few codes development such as **WEC-Sim** (**W**ave **E**nergy **C**onverter **Sim**ulator), **SOWFA** (**S**imulator f**Or** **W**ind **F**arm **A**pplications), and **Harp-Opt** (**H**orizontal **A**xis **R**otor **P**erformance **Opt**imizer). I always remember that Bob told me the most important thing is to have a good time in your work, although the good old days are already gone. In this period, my research focused on offshore renewable energy device modeling and design.

NREL's time was very enjoyable, just like Forrest Gump quoted his mom:"Life is like a box of chocolates, and you never know what you're gonna get." In 2014, I got an offer to be a professor at SJTU and to design and build a 300 meter by 16 meter by 7.5 meter towing tank (the largest one in the university system in the world). I found myself in Shanghai later that year with an office by the construction site of the tank to start the new adventure. On one hand, the design life was fun and I tried to address quite a few technical issues such as second order effect in wave generation and carriage vibration mitigation during high-speed towing. On the other hand, construction life was full of administrative tasks; as a consequence, I did not get a chance to write papers during 2014-2016. In exchange, the tank was finished in 2017 and received great attentions as a world leading facility in the ocean engineering field (Figure 6). We had quite some interesting experimental tests there-theoretically, wave dynamics, and practically, ships, under water vehicles as well as offshore renewables. For example, I worked with Professor Stephen Salter on innovative tidal current turbine and ships, and had one paper published in IEEE Journal of Oceanic Engineering (Fig.5). In SJTU times, my career expanded towards a broader device design with fluid-structure interaction in nature, and I became the founding director of the facility.



(a) (b) (c)

Figure 3. Ye Li's life at NREL: a) on top of a wind turbine at National Wind Technology Center, National Renewable Energy Laboratory, Boulder Colorado; b) with Dr. Robert Thresher at his birthday party, c) with Prof. Walter Munk in his house at La Jolla.

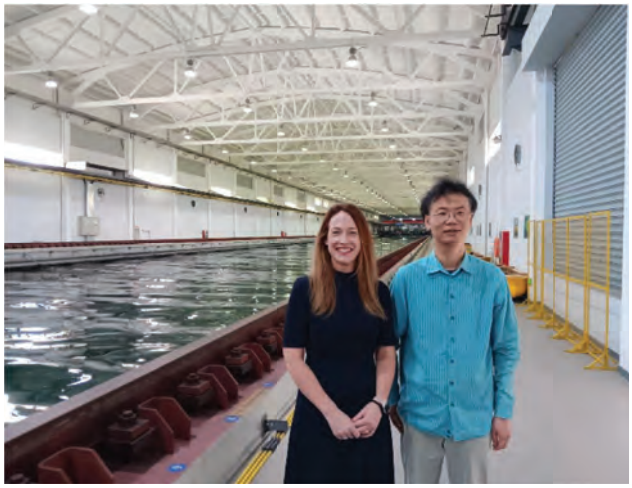
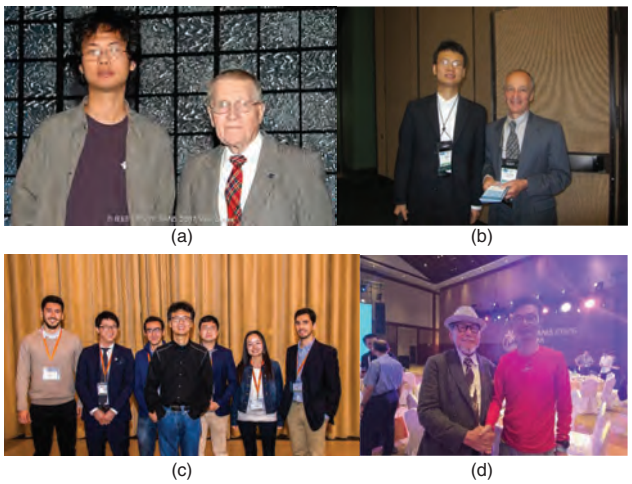


Figure 4. Ye Li with Professor (Vice President from University of Adelaide) at SJTU Multiple Function Towing Tank (2023).



Figure 5. Ye Li with Professor Stephen Salter and Professor Margaret Donaldson in their house at Edinburgh.



(a) (b) (c) (d)

Figure 6. Ye Li's participation in OCEANS: a) With Norm Miller at OCEANS 2007 Vancouver; b) with Bob Spindel at OCEANS 2010 Seattle; c) with student poster winner at OCEANS 2016 Shanghai; d) with Tamaki Ura at OCEANS 2026 Sanya.

One of the big interactions between OES and me is the OCEANS conference (Fig. 6). It is always one of most enjoyable conferences. I deeply appreciate people who introduced me into this conference, Colonel Norm Miller, Dr. Sandy Williams, Dr. Joe Czika, Professor Bob Spindel, Professor Tamaki Ura, Professor Lian Lian, and many others. My first OCEANS is 2006 at Boston where I became one of the student poster winners. I attended OCEANS 2007 Vancouver becoming the first Norman Miller Scholarship recipient and started to serve as session chairs and technical committee chairs since then. Particularly, in 2016, I served as the student poster competition Chair as a ten-year anniversary gift for my participation. COVID-19 and my job transition broke my continuity of participating in the conference, but ten years later, I attended the 2026 OCEANS as an AdCom member again. It was so great to see so many old friends after all these years.

After COVID-19, I decided to step down from the tank founding director position and leave SJTU. After spending half a year in Lyngby, Denmark, as an Otto Monsteds Guest Professor at Denmark Technical University (only a few every year) and then three months in Hong Kong Polytechnical University as a visiting professor as my sabbatical, I chose to move to Shenzhen, a coastal city next to Hong Kong, in the Great Bay Area to continue my work. Now, with my new job at Shenzhen, I am looking forward to more exciting work in the coming years and would like to keep exploring the interesting world and see different things like TinTin does (See Fig. 7).



Figure 7. Ye Li in the Musee Herge at Louvain-la-Neuve, Belgium (2015).

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Remembering Faith Collins

Faith Beverley Collins–30 December 1943–22 August 2026

It is with profound sadness that we announce the passing of Faith Collins, wife of Jim Collins, who is one of our highly recognized OES members. As shown in the following photos, Faith and Jim were always a smiling couple at society events. Jim founded the Victoria Chapter in 1984 and served as Chair for 25 years. He also Chaired OCEANS 93 in Victoria, was on the AdCom and also held VPTA and VPPA positions on the ExCom. Jim's career and family are featured in the December 2022 Beacon's Who's Who article.

Faith was also highly educated with a B.Sc.N., B.A., M.Ed. and Ed.D. Her career included teaching nursing in Canada and the U.S. Following teaching, she joined the University of Victoria as an administrator of health and public relations programs. Faith's keen interest in and knowledge of distance education led her to develop and deliver Canada's first post-basic nursing degree offered through distance education. This achievement led to many requests for consultations in Canada, South Africa, Thailand, Malaysia, Singapore and Hong Kong.

Faith was also committed to serving her community and was a board member for numerous organizations including Garth Home Society, Oak Bay Lodge, Camosun College, Capital Regional Health Board, Mount St. Mary's Hospital, and Government of Canada Review Tribunals. She was elected councilor in Oak Bay and ran federally. Faith is predeceased by her parents, Gertrude Helen McDonald and Wing Commander William Vincent McDonald. She is survived by her husband Jim of 60 years, daughter Beth (Sean), son James (Dolores), grandchildren Seamus, Anna, Vincent and Angus, sister Mary Christine, nephews and nieces. She treasured and loved her family and they will treasure and love her always. The funeral Mass will be celebrated at St. Patrick's Parish, 2060 Haultain Street, Victoria on Saturday, 26 September, 2026 at 1:00 pm. In lieu of flowers, donations may be made to the Canadian Cancer Society.



Jim and Faith Collins.



Jim and Faith at OCEANS 2014 St. Johns.



Jim and Faith Collins and Van and Joe Czika OCEANS 2007 Vancouver.



Jim and Faith at the OCEANS 2016 Monterey Leadership Dinner.

IEEE OCEANIC ENGINEERING SOCIETY (OES) Election of Members to the Administrative Committee for a Three-Year Term 1 January 2027–31 December 2029

Christian de Moustier, IEEE-OES Nominations and Appointments Committee Chair

The election of candidates to replace 1/3 of the OES Administrative Committee members and serve a 3-year term (Jan 1 2027–Dec 31 2029) opens on September 9, 2026, and closes on October 21, 2026. All currently active OES members of IEEE Member grade or higher, may vote in this election. OES Student Members, Graduate Student Members, and Affiliates are NOT allowed to vote.

By 2 September 2026, OES voting members will receive **FROM ieee-oevote@ieee.org TO** their email address their ballot material for this election, including instructions and a link for voting online. Please check your email and Spam filter at that time.

Please review the information on the candidates listed below and vote by the deadline. If you have any questions about the IEEE Oceanic Engineering Society voting process, please contact **ieee-oevote@ieee.org** or +1 732 562 3904.



EIICHIRO ARAKI (M'18) is a geophysicist at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), specializing in seafloor geodesy and submarine fiber-optic sensing. His research focuses on understanding plate boundary processes, including slow slip events, slow earthquakes, and earthquake swarms, particularly in subduction zones such as the Nankai Trough and the Ryukyu Arc.

He has more than a decade of experience in developing and operating seafloor observatories, with involvement in long-term cabled observation system development, including DONET, spanning nearly two decades. He has also played a leading role in the design, development, and deployment of multiple cabled seafloor borehole observatories through international scientific drilling programs such as IODP.

In recent years, he has been actively advancing distributed fiber-optic sensing technologies, including Distributed Acoustic Sensing (DAS) and Rayleigh frequency-based strain sensing, to achieve high-resolution and broadband observations of seafloor deformation. His work has demonstrated the capability of submarine telecommunication cables to serve as dense geophysical sensor arrays, enabling the detection of seismic signals, oceanographic processes, and slow deformation.

Dr. Araki has actively contributed to the IEEE Oceanic Engineering Society (OES) community through presentations at major conferences, including OCEANS and Underwater Technology (UT), and by delivering a keynote lecture at UT 2025. In addition, he has been involved in organizing and contributing to workshops on the scientific use of submarine cables supported by the IEEE/OES Japan Chapter, promoting interdisciplinary exchange between ocean science and engineering communities.

He has also led collaborative efforts with the telecommunications industry to explore the integration of sensing technologies into operational submarine cable systems.

These efforts aim to expand geophysical monitoring coverage across the global ocean and contribute to hazard assessment, including earthquake and tsunami early warning.

Through his work, Dr. Araki plays a key role in bridging the gap between academic research, engineering implementation, and societal applications in ocean observing systems.

He is committed to promoting interdisciplinary collaboration and advancing innovative sensing technologies for ocean science and hazard mitigation.

Statement: If elected to the OES Administrative Committee, I will work to strengthen the role of the Oceanic Engineering Society in advancing integrated ocean observing systems that connect science, engineering, and societal needs.

In recent years, technologies have emerged that enable submarine telecommunication cable systems to be utilized not only for communications but also for ocean observation. Building on my background in geophysics, I aim to promote mutual understanding among stakeholders, including telecommunication operators, communication engineers, and developers of fiber-optic sensing technologies. I believe that fostering such interdisciplinary collaboration is essential to unlocking the full potential of these systems.

A key objective of my activities will be to facilitate international cooperation so that these diverse communities can work together toward reducing global disaster risk, particularly for earthquakes, tsunamis, and other ocean-related hazards. By advancing distributed sensing and real-time monitoring capabilities, OES can play an important role in enhancing resilience in coastal regions worldwide.

In addition, I will support initiatives that encourage participation from early-career researchers and engineers and promote cross-disciplinary engagement within OES activities. I will also work to strengthen the visibility of OES activities in emerging areas such as sensing-enabled submarine cable systems.



JHON ANDERSON BERMUDEZ HURTADO (S'19-M'24) is a Mechatronics Engineer, passionate about ocean conservation. My research focuses on the use of different artificial intelligence techniques for ocean protection. I obtained my engineering degree from ETITC in Colombia and am currently pursuing a master's degree in Machine Learning and Artificial Intelligence at the National University of Colombia. I have conducted various research projects on the construction and use of low-cost ROVs for teaching and application on Colombian beaches.

IEEE OES & Leadership Experience:
I have been actively involved in IEEE OES for nearly a decade, serving on multiple leadership roles:

- IEEE OES Ocean Decade Initiative Ambassador – Promoting student and early-career participation in ocean technology and engineering.
- IEEE OES Social Media volunteer– Expanding outreach and digital engagement to enhance visibility.
- Founder of the first IEEE OES Student Chapter at Colombia.

Technical Skills & Expertise:

- Application of Machine Learning for Ocean Conservation
- Construction of Low-Cost ROVs for Teaching in Schools and Universities
- Numerical Modeling & Data Analysis – Experience with Python, MATLAB, GIS, and ocean circulation models.
- Science Communication & Stakeholder Engagement – Collaborating across academia, industry, and policy sectors.

I am passionate about bridging ocean technology and research to address critical global challenges. I strongly believe that IEEE OES has a pivotal role in advancing marine engineering, fostering interdisciplinary collaboration and mentoring the next generation of ocean scientists and engineers.

If elected, I look forward to contributing my technical expertise, leadership skills, and international perspective to the IEEE OES AdCom and further strengthening the Society's global impact.

Statement: IEEE OES has been instrumental in advancing ocean technology, fostering innovation, and building a strong global community of ocean engineers and scientists. If elected to AdCom, my vision is to enhance engagement, increase accessibility, and strengthen collaboration across disciplines and regions to ensure IEEE OES remains at the forefront of ocean engineering and technology.

Key Areas of Focus:

1) Strengthening Collaboration Between Academia & Industry
   - Promote the integration of emerging technologies (AI, remote sensing, autonomous systems) into ocean research.
   - Promote the Ocean entrepreneurship
   - Foster partnerships between universities, research institutions, and industry leaders.
   - Develop industry-focused technical sessions and training programs at IEEE OES conferences to bridge the gap between research and application.
2) Expanding Student & Young Professional Engagement
   - Enhance student involvement in OES initiatives through workshops, hackathons, and networking events.
   - Strengthen mentorship programs and create more opportunities for early-career professionals.
   - Expand outreach to underrepresented regions, particularly in Latin America and developing nations.
3) Increasing Global Outreach & Accessibility
   - Strengthen IEEE OES's presence in global policy discussions on ocean sustainability and innovation.
   - Support open-access knowledge-sharing initiatives to enhance interdisciplinary collaboration.
   - Expand digital engagement and virtual participation to make IEEE OES more accessible.

IEEE OES has the unique opportunity to lead advancements in marine technology, shaping the future of ocean engineering. As a long-time IEEE OES volunteer and Young Professional Ambassador, I have seen firsthand how this community empowers researchers and engineers globally.

If elected, I will work to ensure IEEE OES continues to be a driving force in ocean Technology, innovation, and global collaboration.



GIULIA DE MASI (M'11-SM'20) Dr. Giulia De Masi is currently Associate Professor at Sorbonne University and Principal Investigator of the Sorbonne Center for Artificial Intelligence (SCAI) and Ocean Institute in Abu Dhabi. After her PhD, and PostDoc, in 2008 she started working in the R&D field for the Marine industry (Snamprogetti Center of Excellence, Italy), joining the Department of Advanced Engineering Services and Technology Innovation Projects, where she led Industrial Research projects on AI and Machine Learning applied to Ocean environment. Since 2016, she worked in several academic institutions in UAE, before joining the Technology Innovation Institute in Abu Dhabi as Principal Scientist and Director of Marine Robotics for 4 years. She is also affiliated with Sant'Anna School of Advanced Studies (Pisa) at the BioRobotics Institute. She has more than 100 peer-reviewed publications (including journals and conferences), 3 patents and more than 40 reports for Industry.

Giulia is an IEEE member since 2011 and Senior Member since 2020. She has been awarded as Women in Engineering (WIE) Propel laureate by IEEE OES in liaison with WIE in 2022-2023 (organizing and participating to multiple IEEE WiE panels), IEEE Honor society membership in 2024, and IEEE-OES Distinguished Lecturer in 2026–28.

She led multiple IEEE-OES events encouraging the participation of local Chapters and student branches, like the two editions of the worldwide IEEE OES Ocean Challenge, and multiple editions of the Career Networking Events (CNET) at Oceans conferences.

She is IEEE OES AdCom member for the term 2024-26. She is part of the IEEE OES Ocean Decade Initiative. She coordinated the activities of the Design the Future Oceans (DtFO) in 2025 under which umbrella she co-organized under IEEE-OES sponsorship a tutorial on AI for Ocean Sensing at the IGARSS2025, and a panel at the IUCN Congress.

At the technical level, she is an Associated Editor of IEEE-JOE, where she also co-edits a Special Issue as Guest Editor. For IEEE-OES she organized one international Forum at IROS2024 and one international Symposium (MARIS-AI), with student poster competition, in Abu Dhabi (UAE). Her main fields of expertise are Collective Intelligence, Machine Learning, Deep Learning, Swarm Robotics, with applications to Oceanic Engineering.

Statement: In submitting my candidacy for a second AdCom term, I build on my active first term, where I led multiple events encouraging the participation of Student Branches and Local Chapters, like the two editions of IEEE OES Ocean Challenge and multiple editions of the Career Networking Events (CNET) at OCEANS Conferences widely appreciated by young students. As part of the IEEE OES Ocean Decade Initiative, I have also coordinated the activities of "Design the Future Oceans" in 2025 culminated in 4 events (1 tutorial, 2 panels and 1 webinar).

Based on my academic background and organizational track record, I am fully committed to continue dedicating the required time and effort, leveraging also my role as Distinguished Lecturer, to the organization of OCEANS Tutorials, Student Poster Competitions, and Workshops & Symposia targeting technical excellence, and modernize OCEANS conferences by introducing special sessions on Artificial Intelligence and Machine Learning.

My goal is to continue running the Society, expanding global participation and multidisciplinary collaboration for Ocean Sustainability. I plan to further engage Students through targeted robotics and poster competitions, ensuring equitable opportunities Worldwide involving also New Members.

To increase female representation, I will actively advocate for WIE by organizing panels featuring inspiring women leaders.



MALCOLM L. HERON (MAL) (M'71-SM'93-LS'10-LF'12) Mal Heron gained his Master of Science (Hons I) in Physics at the University of Auckland, New Zealand in 1967 and went on at the same university to graduate PhD in Radio Science in 1971. He was appointed to the Physics Department at James Cook University in 1971 and had various positions before his appointment as full Professor of Physics in 1984. He served a term in senior management at James Cook University as Pro-Vice-Chancellor for Science and Engineering 1989-1995 and Director JCU Technologies Pty Ltd 1989-1994. He was the Foundation Director of the Australian Coastal Ocean Radar Network (ACORN) 2007-2013. He was appointed Fellow of the Institution of Engineers, Australia in 1990, and Fellow of IEEE in 2012. He is currently Adjunct Professor at James Cook University, Australia, and CEO and Consultant with Portmap Remote Ocean Sensing Pty Ltd.

His fields of expertise are in experimental physics and management. He is currently involved in the Physics of Remote Sensing with a background in electromagnetism, radio wave propagation, instrumentation, and data processing as applied to ionospheric physics, meteorology, and oceanic engineering. His main focus now is on the development and applications of HF ocean radar technology.

Mal Heron joined IEEE in 1977 and is now a Life Fellow. He is a member of the Ocean Engineering Society and the GeoScience and Remote Sensing Society.

He has served at various levels within IEEE and OES:

- Northern Australia Section Executive committee (ongoing) and Chair;
- Associate Editor of the Journal of Oceanic Engineering;
- OES Australia Chapter – Founding chair 2014-2019;
- OES Adcom – several terms, including 2021-2023;
- Chair of OES ad hoc committee 'Future of Oceans Conferences' 2015-2018;
- OES VPTA 2017-2018 and 2019-2020;
- IEEE Corporate Innovations Award Committee 2020-2022;
- OES OTC Asia Programming Committee 2020-ongoing;
- OES Executive VP 2024-2026.

Statement: I would like to work in OES to:

- Continue to improve activity levels in the Technology Committees, and Standing and Operational Committees;
- Raise the profile of the Offshore Technology Conferences within OES and, in particular develop succession planning for OTC committees
- Support succession and forward planning in committees
- Work to improve collaboration between Chapters, and the integration of Chapters into the structure of the Society.

If elected, this will be my opportunity to support activities that I have been involved in and work on succession roles and forward directions as I step away from executive leadership.

My main contribution to OES is, and will be in the technical areas, which I enjoy, and in governance areas where I have some expertise. More generally, I plan to be active in other areas where my experience and expertise may help.



SIGMUND KLUCKNER (M'23) is a socially conscious information and software engineer with more than 15 years of experience working at the intersection of technology, ocean science, and societal & planetary impact. He has participated in multiple EU funded research projects related to ocean observation, including projects expanding EOVs, marine citizen science, and development of digital twins of the Ocean. His thematic expertise includes interoperability, standardization, and stakeholder and community engagement, reflecting a holistic systems perspective. He also recently published the study "Connecting the DOTs" for the European Commission, looking at collaboration potentials for Digital Ocean Twins.

Creating context-appropriate solutions is central to his professional and volunteer motivation. He collaborates closely with non-profits, international organizations, research institutions, and social enterprises to apply existing technologies effectively or co-create new approaches where needed, always with a focus on solutions that are usable and beneficial for people and planet. His work is based in holistic user-, needs-, and people-centered approaches, emphasizing stakeholder engagement, co-creation, and long-term sustainability. Sigmund brings a diverse skill set as an experienced project manager, community manager, event facilitator, and strategic technologist. He has led and contributed to projects ranging from software development and data and knowledge systems implementation to interdisciplinary research addressing challenges such as renewable energy, crisis management, waste reduction, international development, and—most recently—digital twins of the ocean and ocean observation systems.

Within IEEE and the Oceanic Engineering Society, Sigmund has been an active volunteer and leader in standards development. He helped establish the OES Standards Committee, initiated the Society's first standards working group (IEEE P3501), and currently serves as its Secretary, having previously acted as Chair. He is also the initiator and former Chair of IEEE SA P7801 (within the SSIT SC). Beyond OES, he serves as Vice Chair of the IEEE GRSS Austria Chapter, is a member of the IEEE Region 8 ad hoc Committee on Climate Change and the Planet Positive 2030 initiative.

Sigmund has organized and facilitated numerous online and in-person events in English, German, and Spanish and regularly speaks publicly on topics related to ocean technology, standards, and societal impact.

Statement: If elected to the IEEE Oceanic Engineering Society Administrative Committee, I will work to advance OES priorities by supporting the technical leadership, engaging with a broader oceans standards development, digital (ocean) innovation, and with be oceans community as a whole.

A key contribution will be embedding standards and best practices across OES, supporting integration into technical committees, conferences, and collaborations with IEEE SA and other societies. These are critical to scalable, interoperable ocean observing systems, digital infrastructures, and industry uptake.

In line with OES's focus on emerging technologies and the Ocean Decade Activities, I will contribute to activities and projects around the digitalization of ocean observation, including digital twins of the ocean, artificial intelligence and machine learning, and other digital methods, where they can enhance ocean engineering. In all cases, I will emphasize the usefulness, relevance, impact, and awareness.

I am committed to supporting OES priorities in outreach, visibility, and ocean literacy by contributing to conferences, support webinars, and communicating technical topics to diverse audiences, including YP/ECOP and Youth outreach and mentoring. Through these efforts, I aim to help OES remain forward looking, inclusive, and influential.



SRIDHAR KRISHNAMOORTHY (GSM'23-M'26) is currently an Assistant Professor in the Department of Civil Engineering, University College of Engineering, Anna University and a doctoral researcher in the department of Ocean Engineering, Indian Institute of Technology (IIT) Madras, India. His academic and research contributions are centred on offshore engineering, ocean technology, and marine structural systems, with a focus on deep and ultra-deepwater applications. His research focuses on hydrodynamic response analysis of floating production storage and offloading (FPSO) systems, mooring dynamics, and fluid-structure interactions under complex environmental conditions. His work also includes analytical and experimental investigations on sloshing effects in liquid storage systems and structural response under dynamic loading conditions.

He completed his Masters in Structural Engineering and Batchelors degree in Civil Engineering with academic distinction. His interdisciplinary expertise spans offshore structures, hydrodynamics, finite element analysis, and marine renewable systems.

He has been active in IEEE OES from the year 2022, when India hosted the IEEE Oceans for the first time at IIT Madras, Chennai.

He undertook various leadership roles, some of which are:

IEEE & IEEE OES Leadership Roles

- Founder Chair, IEEE OES Student Branch Chapter, IIT Madras
- IEEE OES Young Professional Ambassador (2025-2026)
- Vice Chair, IEEE IIT Madras Student Branch (2024–2025)

- Member, IEEE OES TENCON Working Group
- Volunteer Member, Ocean Decade Initiative (ODI) of IEEE OES

International Collaboration & Research Leadership

- Active contributor to IEEE Oceanic Engineering Society (OES) through Young Professional (YP) Boost initiatives and sustained volunteering.
- Contributed to IEEE OCEANS 2022 (Chennai), 2024 (Singapore), and 2025 (Brest), demonstrating leadership progression:
  - Volunteered at **OCEANS 2022 (Chennai)**
  - Chaired technical sessions at **OCEANS 2024 (Singapore)**
  - Contributing to the organization of the YP Panel at **OCEANS 2025 (Brest)**
- Contributed to major IEEE initiatives including **MTS/IEEE TechSym 2023 and IEEE Global Leadership Connect 2024**, enhancing global engagement.
- Initiated "**AqUaVision 2025**", India's first AUV competition at IIT Madras, promoting
- Innovation and hands-on learning in ocean engineering.
- Promoting collaboration among students, young professionals, academia, and industry through IEEE OES platforms and contributing to interdisciplinary research in offshore engineering, ocean technology, and sustainable marine systems.

Key Contributions

- Founder Chair, IEEE OES Student Branch Chapter, IIT Madras (2024) – established a highly active platform for student engagement and technical activities.
- Expanded IEEE OES presence by supporting new Student Branch Chapters at NIT Calicut and Bannari Amman Institute of Technology, Erode, India.
- Played a key role in enhancing IEEE OES membership growth in India, particularly among students and young professionals.
- Organized and delivered a series of IEEE OES technical lectures through IEEE Madras Section, strengthening knowledge dissemination.
- Actively organized and volunteered in IEEE OES, OCEANS, and Section-level events, improving regional visibility and global engagement.
- Supported the formation of the Women in Engineering (WIE) Affinity Group at IIT Madras, promoting diversity and inclusion.
- Mentored students and young professionals, fostering sustained IEEE participation and leadership.
- Contributed to IEEE OES IIT Madras SBC outreach through social media initiatives and authoring multiple IEEE Beacon articles, enhancing visibility and communication of OES activities.

Awards & Recognitions

- IEEE OES Young Professional Boost Laureate (2025–2026).
- Offshore Technology Conference (OTC) Emerging Leader Award 2025.
- Royal Institution of Naval Architects (RINA) Contribution to STEM Award 2025.
- International Coral Reef Society (ICRS) John Ogden President's Membership Award 2025.
- Associate Member, Indian National Academy of Engineering (INAE) – Prestigious recognition of professional excellence.
- Prime Minister's Research Fellowship (PMRF), IIT Madras.
- Marine Technology Society (MTS) Charles H. Bussmann Graduate Scholarship 2024.
- Best Paper Awards – Structural Engineering Convention (SEC) 2024, International Conference on Smart Technologies and Applications (ICSTA) 2022.
- Outreach Scholarship Award – ASME International Conference on Ocean, Offshore and Arctic Engineering (OMAE) 2023.

Statement: If elected to the IEEE OES Administrative Committee (AdCom), he is committed to strengthening the Society's global impact through focused efforts in membership expansion, grassroots engagement, and inclusive professional development, building on his experience in establishing student communities and driving IEEE OES growth in emerging regions.

- **Expand Global Membership & Chapters:** Drive IEEE OES membership growth, particularly in emerging regions, by establishing and mentoring sustainable Student Branch Chapters and creating scalable models based on successful implementations at IIT Madras
- **Empower Students & Young Professionals:** Strengthen engagement through mentorship networks, technical competitions, and structured initiatives such as IEEE OES YP Ambassador and YP Boost programs, enabling a clear pathway from student to volunteer leader
- **Promote Innovation & Hands-on Learning:** Encourage student-driven innovation by supporting initiatives like AqUaVision (AUV competition model) and similar platforms that integrate practical learning with ocean engineering challenges
- **Strengthen Volunteering & OCEANS Engagement:** Foster a strong volunteering culture by increasing participation in IEEE OCEANS conferences, YP activities, and technical committees, while encouraging members to take up leadership roles
- **Enhance Knowledge Dissemination:** Expand global outreach through IEEE OES lecture series, workshops, and technical sessions, improving accessibility to cutting-edge research and industry insights
- **Enable Chapter Collaboration & Growth**: Facilitate cross-chapter collaboration and knowledge sharing, connecting Student Branch Chapters, Sections, and global OES communities for sustained engagement
- **Promote Diversity, Inclusion & Community Building:** Support initiatives such as Women in Engineering (WIE)

and ensure inclusive participation across regions, institutions, and career stages
- **Strengthen Global Collaboration & Technical Impact:** Foster stronger connections between academia, industry, and research organizations, and align IEEE OES initiatives with global priorities such as ocean sustainability and the UN Ocean Decade

He seeks your support in the AdCom election to strengthen IEEE OES through membership growth, active volunteering, and global engagement, ensuring a vibrant and inclusive community for future ocean engineers.



SHYAM MADHUSUDHANA (GSM'08-M'16-SM'19) is a Research Group Leader at the University of Zagreb (FER/LABUST) in Croatia. With a multidisciplinary background spanning Computer Engineering (Bachelors, Visveswaraya Technological University), Computer Science (MS, San Diego State University) and Applied Physics (PhD, Curtin University), his career is characterized by a truly global presence, having held key research and academic positions across the USA (Cornell University), India (NIO and IISER), Australia (Curtin University), and Mauritius (Curtin Mauritius).

This interdisciplinary and international trajectory has provided him with a unique understanding of the diverse challenges facing the global maritime and oceanic engineering community.

A Senior Member of the IEEE, Shyam's extensive volunteering record within the Oceanic Engineering Society (OES) is highlighted by his current role as the Vice President for Technical Activities (VPTA). In this capacity, he has spearheaded several transformative initiatives:
- **Educational innovation:** He founded the **IEEE-OES Summer School** program, successfully piloting the first edition in Singapore (2024), and serves as the long-standing Chair of the Student Poster Competition (SPC).
- **Technical expansion:** He created the **Living Resources Technology Committee** (TC), successfully bridging the gap between traditional engineering and the biological/ecological sciences to attract a broader research community.
- **Institutional vitality:** He reinvigorated the Distinguished Lecturer (DL) program (achieving delivery of over 14 lectures annually) and implemented structural changes to better integrate Chapters with TCs and DLs.
- **Global outreach:** He founded the biennial **WIO Futures** conference series, establishing a critical and sustained OES presence in the Western Indian Ocean (WIO) and Africa.

Beyond these leadership roles, Shyam is a top contributor to the OES' quarterly newsletter Beacon, where he has also introduced innovative content strategies to highlight Chapter and Student achievements. He also represents the Society on the steering committee of the IEEE Data Journal, ensuring OES remains at the forefront of the open-data movement in ocean science.

Statement: If elected to AdCom, my priority will be to continue to push for OES' transition from a collection of technical and geographical silos into a unified, globally inclusive ecosystem.

My plan for the Society focuses on three strategic pillars:
1) **Codifying the "OES Academy":** I intend to formalize the **Summer School** program into a recurring "OES Academy." This will provide tangible, credit-bearing educational value to our student and professional members, ensuring OES remains the premier educational resource for students and early-career professionals globally.
2) **Strengthening science-engineering bridge:** Building on the success of **Living Resources** TC, I will work to lower the "barrier to entry" for researchers in marine biology, ecology, and data science. Positioning OES as a truly interdisciplinary home, helps drive membership growth among the thousands of scientists currently working in ancillary disciplines who may currently view OES as "engineering-only."
3) **The "WIO Model" for geographic inclusion:** The success of the **WIO Futures** conference proved that OES can thrive in underrepresented regions by focusing on local "Blue Economy" needs. I will advocate for establishing similar regionally focused avenues in Latin America and Southeast Asia, using our Chapters and TCs as a combined force to foster local leadership.



SULEMAN MAZHAR (S'08-M'10-SM'14) received his PhD from Tokyo University, Japan and a post doctorate from Georgetown University, USA. Currently, he is working as a professor at Harbin Engineering University and managing funded research projects related to environmental/water pollution monitoring and endangered cetacean conservation. His research interests are in ICT based solutions for environmental and development related challenges, especially in a developing world context. He works on conservation of Indus river dolphin and environmental monitoring of dolphin habitat in Pakistan and has previously worked on humpback whales and the bottlenose dolphins in Japan. He is an alumnus of Japanese Monbukagakusho program and US State department program (NIH fellow and a Fulbright grantee). He has got an extensive experience in mentoring undergraduate and graduate students as a faculty member at the technology universities in Pakistan, as a postdoctoral fellow at the University of Tokyo (Japan) and the Georgetown University (DC) and currently as a professor at HEU in China.

IEEE ACTIVITIES:
He is an IEEE senior member, member of the Ocean Engineering Society and the Signal Processing Society, and has been associated with OES since 2007. He served as technical program chair for COA 2021 and COA 2024 (technically co-sponsored by IEEE-OES), the chair-TC Underwater Acoustics, the acting chair for the student activities committee IEEE-OES, coordinator OES Berth of Opportunity program and had been engaged in social media and student activities at IEEE Oceans 2018(Kobe) and IEEE Oceans 2019(Seattle). He helped establish student branch chapters of IEEE-OES at Xiamen University and Southwest Petroleum University Chengdu and has actively contributed to student/young professional support activities and technical activities of the society.

He actively contributes to the review process of OES (JOE and Oceans) and other IEEE conferences/journals related to Signal Processing & Machine Learning. He has published in JOE, JASA, CVIU, Pattern Recognition, IEEE T-ITS, IEEE Sensors J., Oceans conferences as well as many other IEEE flagship venues (ISBI, VTC, IPSN, Sensors and PerCom).

Statement: I have been part of IEEE-OES since 2007 and have worked in multiple roles in technical and student engagement activities (e.g. Student Activities Committee 2019-22, TPC-chair for COA 2021 and COA 2024, chair for TC-UA 2022-24 and TC-LR 2025-26, coordinator Berth of Opportunities program 2024). As an OES AdCom member, I am interested in enhancing the role of student branch chapters and local sections through their active engagement in Oceans conferences.

Moreover, I look forward to contributing to the e-initiatives of the society (via Beacon, Earthzine and society workshops/conferences) and leveraging these tools to cater to the technical and career needs of our members. Given my research/faculty roles in East Asia and Europe region, I am interested in extending society activities and wider society membership engagement in these regions. If elected, I am keen to promote career-building and mentorship opportunities for students and young professionals through regional chapters and through social mixers and professional networking sessions at OES meetings.

Given my background in environmental and endangered species monitoring, I look forward to developing opportunities at OES-platform for students, researchers and industry to cooperate for a sustainable blue economy with a greater focus on water, endangered species and livelihood.



RAJAT MISHRA (GSM'16-M'19) is a Research Fellow at the Acoustic Research Laboratory, Tropical Marine Science Institute, National University of Singapore, where he works on marine robotics, informative path planning, multi-modal sensor fusion, and systems development for underwater vehicles. Dr. Mishra has been an active IEEE OES volunteer for over six years, contributing across chapter, regional, and global levels. He currently serves as the Webmaster for the IEEE OES main website, responsible for maintaining and improving the Society's primary digital platform.

At the chapter level, he currently serves as Chair of the IEEE OES Singapore Chapter, one of the most active IEEE chapters in the region, having previously served as its Secretary. In 2022, he was appointed Chair of the Organizing Committee for the Singapore AUV Challenge, one of the world's largest autonomous underwater vehicle competitions, overseeing logistics, judging, and international coordination. That same year, he served as Technical Chair for the IEEE/OES Autonomous Underwater Vehicle Symposium, managing the technical programme and ensuring the quality of accepted research.

From 2020 to 2022, **Dr. Mish**ra was the IEEE OES YP-BOOST Laureate, a two-year appointment that involved direct engagement with Society leadership and active participation in the planning and execution of OES/MTS OCEANS conferences.

Professionally, he holds a PhD from the National University of Singapore in adaptive path planning for environmental monitoring, validated through sea trials. He actively reviews for the IEEE Journal of Oceanic Engineering and has published in many publications managed by OES. He holds two patents, giving him a combined perspective across research, industry, and the Society's volunteer ecosystem.

Statement: The IEEE OES has shaped my career and my identity as a researcher. Having served the Society in roles ranging from chapter leadership to webmaster and a YP-BOOST fellow, I have seen both what works well and where we have room to grow. If elected to AdCom, I would focus on three priorities.

First, strengthening Technology Committees and their reach. I am keen to take on roles within TCs where my experience in marine robotics, sensor fusion, and underwater systems can directly support the Society's technical mission. Equally important, I want to use my outreach and web platform experience to make TC activities more visible to the broader membership — and to channel promising researchers from events like the AUV Symposium and AUV Challenge into active committee participation.

Second, making OES more organized digitally. As the person currently managing the Society's web infrastructure, I see first-hand how events often reach members too late or too narrowly. I want to ensure that OES events gain wider global visibility with enough lead time for meaningful participation — driving membership growth across chapters and regions.

Third, listening to the membership. I want to engage both experienced and early-career members to

improve their experience — through better programming, stronger chapter support, and new pathways for young professionals.

I take pride in being part of OES and, if elected, would strive to build a platform that every member takes pride in too.



LUYUAN PENG (GSM'20-M'24) Dr. Luyuan Peng is a Research Fellow at the Acoustic Research Laboratory, Tropical Marine Science Institute, National University of Singapore. Her research focuses on underwater robotics, perception, and communication, spanning visual localization, 3D scene representation, and communication-efficient autonomy for marine vehicles.

Within IEEE OES, she has built an active record of volunteer leadership across Women in Engineering, member engagement, communications, student competitions, and chapter operations — contributing not as an occasional participant but as an organizer and owner of programs from start to finish.

She serves as an OES Women in Engineering Representative, onboarding new WIE ambassadors and coordinating related activities across the Society. She has organized five WIE luncheons at OCEANS conferences, managing each from initial concept through final execution, and has helped build these gatherings into a valued space for connection and professional development within OES.

She has contributed to broader member engagement through two editions of the Career Networking Tour, an initiative that connects students and young professionals with industry exhibitors at OCEANS to make conference participation more meaningful for emerging members. She currently serves as Editor-in-Chief of the OES Young Professionals and Student Newsletter, the Society's primary communication channel for students and early-career members, which she leads with a focus on relevance, reach, and member voice.

As Chair of the Singapore AUV Challenge 2026, she has driven a comprehensive rebrand and expanded international team participation to strengthen the competition's global reputation. She also contributed to the organization of OCEANS Singapore and the OES Summer School Singapore 2024, and serves as Secretary of the local OES Singapore chapter, supporting event organization and chapter operations.

Across these roles, Luyuan has demonstrated a consistent commitment to making OES more accessible, connected, and compelling—particularly for students, young professionals, and first-time members finding their place in the Society.

Statement: OES thrives when its members feel genuinely connected to each other, to the Society, and to a shared sense of purpose in the field. That connection has to be built deliberately.

I am running for AdCom because I want to help build it, and because, as a younger member who has spent years organizing these programs from the ground up, I have a clear understanding of what draws the next generation in and what makes them stay.

My first priority if elected would be a structured volunteer onboarding and mentoring program for OES. Many new volunteers currently learn by trial and error. A lightweight but intentional framework that pairs new volunteers with experienced ones and recognizes contributions meaningfully would strengthen retention and grow the Society's pipeline of future leaders.

More broadly, I would support the programs that give members their first real connection to OES: YP and WIE programming, student competitions, and chapter activities. I would bring this same perspective to AdCom's governance responsibilities, always centering what members, especially younger ones, actually need.

OES gave me real opportunities to contribute and grow. I want to help it offer that to far more people.



YANG YANG (M'21-SM'22) is a Professor at Harbin Institute of Technology, Shenzhen. From 2020 to 2026, he also served as a Professor and Principal Investigator leading a research team of around 20 members at the Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences. His research focuses on the design, fabrication, integration and application of sensors, instrumentation, and energy harvesting systems for oceanographic and low-altitude scenarios. With more than 10 years of research experience in marine electronics, intelligent systems and marine observation technology, he has gained in-depth insights into the challenges and opportunities within the ocean engineering community.

He has extensive volunteer engagements with OES and IEEE. He currently serves as OES Representative on the Sensors Council (2026–present) and Co-Chair of the OES Metrology and Instrumentation Technical Committee (2025–present). He was appointed as an OES Ocean Decade Ambassador in 2023, and has acted as Special Session Chair for IEEE Oceans 2024. He also holds editorial roles as Associate Editor of the IEEE Journal of Oceanic Engineering and Topical Editor of the IEEE Sensors Journal, promoting academic collaboration across the OES community.

Dr. Yang earned his Ph.D. in Electrical Engineering from IMEC and Ghent University, Belgium. He has published over 50 SCI-indexed papers, including first-author and corresponding-author articles in high-impact journals such as Nature Communications.

His research outputs also cover 2 U.S. patents and more than 20 Chinese patents. He has received prestigious honors including the R&D 100 Award (20021) and the NSFC Excellent Young Scientists Fund (2022). His solid

professional expertise combined with rich OES/IEEE volunteer experience well equips him to represent OES members and advance the development of the society.

Statement: If elected to the OES AdCom, my primary goal is to enhance OES's influence in oceanic sensor technology and energy harvesting, strengthen collaboration between academia and industry, and support early-career professionals in the field. I believe OES plays a critical role in advancing oceanic engineering innovation, and leveraging technical expertise and global networks is key to its mission.

To achieve this, I plan to propose initiatives to promote interdisciplinary cooperation in ocean and low-altitude observation technologies, leveraging my experience in sensors and energy harvesting; advocate for more resources to support early-career OES members through mentorship and training programs; and enhance OES's technical programs by integrating cutting-edge research on marine electronics and intelligent systems.

I am committed to dedicating the required time (2+ hours/week) to AdCom responsibilities, including meetings and committee work. I will listen to OES members' needs, collaborate with fellow AdCom members, and ensure OES remains a vibrant community advancing oceanic engineering.



XUEBO ZHANG (M'17-SM'23) Dr. Zhang received his B.Eng degree in electronic engineering and the Ph.D. degree in underwater acoustic engineering in 2009 and 2014, respectively. From 2014 to 2020, he worked with the Underwater Antagonizing Laboratory in China. Since 2020, he has been an associate professor at Northwest Normal University, China. His research interests include underwater acoustic signal processing, underwater remote sensing, target detection and recognition, etc.

Up till now, he has authored and coauthored more than 100 papers, including 6 highly cited papers and 3 hot papers. In addition, he owns 27 Chinese patents. Currently, his Google/Scopus/ResearchGate H-index is 29, and his Web of Science H-index is 25. Furthermore, He has authored and co-authored 6 books. He was the Session Chair and Invited Speaker for Conferences such as IEEE IGARSS, IEEE ICCT, IEEE ICCSN, etc. Dr. Zhang served as the Technology Committee Co-Chair for the IEEE Oceanic Engineering Society (OES) from 2023 to 2024.

Since Jan. 2026, he has been appointed as the IEEE OES Distinguished Lecturer (DL). Since Jan. 2026, he has been serving as the Editor-in-Chief for Recent Patent on Engineering.

Besides, he is currently the Associate Editor/Editorial Board Member for some famous journals such as IEEE Signal Processing Letters, Circuits Systems & Signal Processing, Electronics Letters, IET Radar Sonar & Navigation, IEEE Access, Journal of Electronics & Information Technology, Journal of Marine Science and Engineering, Remote Sensing, etc.

Furthermore, he served as the Guest Editor for IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Remote Sensing, etc.

Dr. Zhang received the titles of IOP 'Outstanding Reviewer', Springer-Nature 'Editorial Contribution Award 2025', and 'Outstanding Editorial Board Member' for prestigious journals, along with the Science and Technology Progress First Prize and other honors. Furthermore, he has been listed from 2023 to 2025 as a "World Top 2% Scientists" created by Stanford University and Elsevier.

Statement: I am committed to elevating OES through the following key initiatives.

1) I will work to foster greater collaboration and unity across its various components, enabling more effective and impactful outcomes for the society. Additionally, I would broaden OES global societal impacts through OES initiatives for ocean engineering technology translation, industry engagement, and policy makers outreach/lobbying.
2) Recognizing the critical importance of nurturing future talent, I am particularly focused on expanding opportunities for students and early career professionals. This includes developing initiatives such as competitions, workshops, and networking platforms designed to provide crucial professional development, facilitate their integration into the OES community, and support their long-term involvement. Furthermore, I will work to enhance networking opportunities for experienced professionals at both global and regional levels, promoting valuable connections and knowledge exchange.
3) I seek to work with other AdCom members to facilitate the exchange of ideas and promote innovation within OES, ensuring the society continues to grow and serve its members effectively and remains a vital hub for advancing the field.

Welcome New and Reinstated Members

From 6 May through 13 August 2026
Total: 107 (incl 66 student: 31 graduate & 35 student)

Australia
Simon T Stobie
Hongjie Zhang

Bangladesh
Areeb Ayman Haq
Md Hasinur Rahman Hasin
Anisul Islam Khan
Taki Imdadullah Nur
MD. Rokonuzzaman Shaad
Sheikh Tanvir Islam Udoy

Brazil
Andre Luis Sousa Sena

Canada
Scott A Charles
Ziaul Hossain

Chile
Matias Fierro

China
Xiaorong Li
Zhenglin Li
Zhang Nunhao
Yan Xi
Wen-Bo Xie
Changkui Xu
Fengjie Xue

Croatia
Hana Slipogor

Denmark
Michal Antoni Posluszny

Ecuador
Aridna Belen Crespin Alzamora
Steven Isaac Santillan

Egypt
Yahia Mostafa

Estonia
Yuya Hamamatsu

Germany
Nathalie Bauschmann

India
Mohamed Aamir
Nishma Nishma Hakeem
Anisha Sri M
Sunil Kumar Mishra
Divya Mohan
Nasma Noor NV
Charan Paila
Amal Salam
Vikash Chand Sharma
Krishna Siddharth Kunapuli

Indonesia
Putu Harry Gunawan

Italy
Davide Eccher
Francesca Gennai

Japan
Ryotaro Suga

Korea, Republic of
Minwoo Lee

Mozambique
Ivaldo De Jesus Fumo

Pakistan
Muhammad Aamir
Rameez Ahsan Ahsan
Anusha Farooq
Rida Fatima
Alishba Jaffri
Syed Talha Jamal
Adeel Ahmed Khan
Saad Ullah Khan
Maryam Khursand
Dua Najam
Syed Muhammad Ashhad Abbas Naqvi
Sarfaraz Natha
Sonia Saad
Muhammad Imran Saleem
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Peru
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Global Innovators Shine at the Second Edition of the OES Ocean Challenge

Prof. Giulia De Masi and Prof. Francesco Maurelli, AdCom Members

The second edition of the IEEE Oceanic Engineering Society (OES) Ocean Challenge has officially concluded, celebrating groundbreaking technological solutions aimed at tackling the United Nations Ocean Decade challenges. Designed to inspire students and young professionals to create innovative, data-driven approaches for marine conservation, the competition saw entries from across the globe.



The organizers, Francesco Maurelli and Giulia De Masi, during the ceremony of awards for the winners of the second edition of the OES Ocean Challenge at OCEANS 2026 Sanya.

Out of a highly competitive pool of worldwide submissions, four outstanding finalist teams representing Asia, Europe, and the Americas successfully advanced to the competition's second stage. Each of these finalists received an initial seed grant of $2,000 from the IEEE-OES to bring their theoretical proposals to life and construct working prototypes.

Following the final presentations and product implementations, the winners of the second edition are:

First Place: IPB University, Indonesia
Project: *Passive Marine Soundscape Monitoring using AI Algorithms for Rapid Assessment of Coastal Ecosystem Health*
Team Members: Daniel Hermans Manurung, Tiara Anggraeni, Nabila Aishi Octaviana, M. Ridha Ramadan, and Akbar Hannan Ibrahim
Supervisor: Prof. Dr. Indra Jaya

Securing the top spot and an additional $6,000 grant, the team from IPB University's Department of Marine Science and Technology developed a real-time, non-invasive



The organizers, Francesco Maurelli and Giulia De Masi, during the ceremony of awards for the winners of the second edition of the OES Ocean Challenge at OCEANS 2026 Sanya.



The winners of the second edition of the OES Ocean Challenge from IPB University, Indonesia, with the Project:"Passive Marine Soundscape Monitoring using AI Algorithms for Rapid Assessment of Coastal Ecosystem Health".

acoustic monitoring system. Their AI-driven solution records and analyzes underwater soundscapes to provide a rapid health index of coastal ecosystems without disrupting marine life, directly addressing UN Ocean Decade Challenges regarding ecosystem protection, restoration, and expansion of the global marine observing system.

Second Place: Fluminense Federal University, Brazil
Project: *Arandu*
Team Members: Lara de Oliveira Melo Castro, Brenda Guimarães da Matta Rangel, Giulia Ferrare Silva, Jamilli da Silva Fernandes, Júlia da Silva Bueno de Moraes, Julia Xavier Santana, Luiz Henrique Damazio Leite, Mauro Gonçalves Bueno, and Sarah Ramos Marques de Almeida

Representing the Americas, this large multidisciplinary team from Brazil secured second place for their innovative technological approach to marine challenges with project *Arandu*.

Third Place: Tallinn University of Technology, Estonia
Project: *Open-Source Cross-Layout AUV Actuation Controller*
Team Members: Yuya Hamamatsu, Jaan Rebane, and Roza Gkliva

Representing Europe, the team from Estonia took third place with a highly technical, open-source engineering solution designed to improve the maneuverability, control, and accessibility of Autonomous Underwater Vehicles (AUVs).

These winning projects demonstrate that empowering the next generation of engineers and scientists is critical to understanding, monitoring, and sustainably protecting our global marine ecosystems.

This issue includes information about the third edition of the OES Ocean Challenge. We look forward for your proposal submission.


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OES Student Branch Chapter (SBC)



About OES SBC

OES **S**tudent **B**ranch **C**hapters (SBCs) give students a local connection to the IEEE Oceanic Engineering Society and the broader oceanic engineering community. SBCs provide opportunities for technical learning, professional development, networking, leadership, and general support through the OES.



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