OES BEACON

Newsletter of the Oceanic Engineering Society

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Welcome to OCEANS 2023 Limerick

Wishing Everyone a Happy New Year!

From Hampton Roads to Limerick

IEEE

IEEE Oceanic Engineering Society

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

OCEANS 2022 Hampton Roads photos on the front cover:
Virginia Beach artwork by Yessine Karray
OES AdCom group photo by Francisco Pinto

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Member Benefits—Did You Know?

The Gateway International Insurance Plans offer solutions for special insurance needs when traveling abroad. They are available to members, their families, and dependents.

The plans are useful in many situations, and particularly when existing coverage is limited, during international business or leisure travel; when participating in academic, business or cultural exchange activities; or for employees, contract workers or consultants on international assignments.

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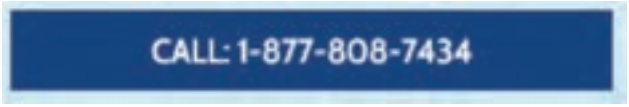


From the OES BEACON Editors

Harumi Sugimatsu and Robert Wernli

Welcome to the December 2022 issue of the Beacon. We did it!! OCEANS 2022 Hampton Roads was a success. As shown in the articles in this issue, in person attendees were able to "Grip, Grin and Hug Again!" In addition to the excellent in person aspects of the conference, all technical papers were available virtually. And, don't miss the announcements of next year's OCEANS in Limerick, Ireland, and the Gulf Coast in the U.S.

The return from fully virtual events continued as reported in this issue. We have reports from several chapters that includes our newest student chapter in Bogotá, Columbia. The University of Zagreb, Croatia, Student Branch Chapter was busy with the Breaking the Surface 2022 conference and other events. The French chapter participated in SeaTech Week 2022 and the Italy chapter in MetroSea 2022 and the Underwater Communications and Networking (UComms 2022) conference. Another popular competition is the Singapore AUV Challenge 2022 (SAUVC 22) that followed the AUV 2022 Symposium, hosted by the Singapore chapter. The Japan chapter, which supported a team to compete in the SAUVC 22 competition, also sponsored the JAMSTEC 2022 Underwater Robot Competition and the 8th Underwater Technology Forum • ZERO.

We also have several year end reports from our ExCom VPs for Technical Activities (VPTA), OCEANS (VPO), Workshops and Symposia (VPWS) and Professional Activities (VPPA), which also highlights OES support of WIE, YPs, etc. The Journal EIC also provides a list of recently released papers that are available to our members. You will also see in the report from the OES president the results of the ExCom elections for open positions that will begin next year. Thanks to all AdCom and ExCom members who work to support the society.

Following every OCEANS conference we provide a report on the Student Poster Competition that includes the abstracts of all accepted posters, highlights the winners and provides a copy of the winning poster's technical paper. If you're a student, consider participating in the future; if a graduate, we can always use judges.

Have you done something exciting lately? Received an award or professional recognition? Be sure to contact your editors about submitting an article. You'll see a good example from one of our very active members in this issue's Who's Who in the IEEE OES.

Harumi at KOYO22-01 Cruise.

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

OCEANS 2022 Hampton Roads…"Grip, Grin, and Hug Again."Was my pleasure to be the OES Liaison on the"in person"conference LOC, shown here receiving an award from the society presidents. Photo by Yessine Karray.

From the President

Christopher Whitt, OES President

It was a pleasure to see so many of our colleagues and partners together again at OCEANS 2022 Hampton Roads. As we close 2022 with success, we also look forward to 2023 with even more activity across the Society and opportunities for us as members.

While our community came together in Hampton Roads for the latest technology, your Society leadership, the Administrative Committee (AdCom) met for the first time in person since 2019. The AdCom meeting had a strong focus on strategic planning for the future of the Society. Earlier this year, we adopted an update to our Mission and Vision. Our Vision is "a collaborative community working towards a safe, healthy, and productive ocean" and our Mission is "to be the professional home of people passionate about ocean science, engineering and technology." As you can see, this reflects our understanding that the Society exists to bring our community together.

Another important responsibility of the AdCom is to elect our Executive Committee (ExCom). At this year's meeting, an unusual number of officers were due for election, partially because of the Constitution change which we as members approved this past summer. Our first Executive Vice President (2023-24) is Brandy Armstrong. Brandy was previously our VP for Professional Activities. The new office of Exec VP will be responsible for Strategy, Governance, Equity, Diversity, and Inclusivity, as well as supporting the President. I am grateful to my colleagues to be re-elected to serve a second term as President, from 2023-24.

Our new VP OCEANS is Venugopalin Pallayil, who has just completed a term as VP Technical Activities. Succeeding Venu as VP Technical Activities is Shyam Madhusudhana. After being elected as Executive Vice President, Brandy resigned as VP Professional Activities. Therefore, in an interim election, Stephen Holt was elected as VPPA for 2023. For the JOE Editor-in-Chief, Karl von Ellenrieder was elected as EiC-elect for 2023, to become EiC for 2024–25. Finally, Bill Kirkwood was elected as Treasurer-elect for 2023, to serve as treasurer for 2024–25. The office of Secretary had no candidates and remains open. You can expect to hear more from the new ExCom in the first Beacon issue of 2023.

The ExCom election resulted in two vacancies on AdCom, and so the AdCom voted to appoint Andreas Marouchos and Hari Vishnu to complete the terms for the vacated seats. We look forward to welcoming Andreas and Hari to AdCom in 2023.

With our next leadership team in place, we are looking to 2023 to see a full spectrum of meetings and activities. Of course, there will be the OCEANS Conferences, in Limerick, Ireland, in June and Gulf Coast USA in September. Additionally, there are several workshops and symposia around the world on more specific topics (see the report from the VP of Workshops and Symposia). We expect to have increased presence at the Offshore Technology Conference in Houston as well as OTC Brazil in October. In addition to these meetings, we also know many Chapters and Student Branch chapters are planning more activities for 2023.

Finally, we intend to expand the Society efforts to address sustainability in 2023. We already have the Ocean Decade Initiative, which aims to connect our members to the needs and opportunities within the science community, which is coalescing around the UN Decade of Ocean Science for Sustainable Development. In addition, we intend to address the sustainability of OES activities directly.

As always, there are more exciting projects and opportunities than there are people to develop them. If you wish to get more involved in Society activities in any way, please email me!

VPTA Report and Outlook for the Future

Venugopalan Pallayil, Vice President for Technical Activities, IEEE OES

As my term as VPTA ends on 31 December 2022, it is appropriate that I provide a summary of the OES activities under my care during this period and reflect on how we can, as a society, do better in the future towards achieving our goals and mission. The activities that VPTA currently leads include DL programme, Chapter activities and Technology Committee activities. VPTA is assisted by the TC Coordinator and Chapter Coordinator for the associated activities. TCs are expected to assist VPTA in identifying and recommending DLs under the DL programme.

Distinguished Lecturer Programme (DLP)

Distinguished Lecturers are experts in their fields of study and the purpose of the DL Programme is knowledge dissemination among the OES community through lectures given by the DLs. DLs have been organized in the past through in-person lectures at the request of chapters or OES members. Often, this is clubbed with the travel by the Distinguished Lecturers to a conference or some technical event and delivered to a select group. However, last two years this has not been possible as most of the technical activities have been through virtual platforms owing to the restrictions imposed by the Pandemic. Some DLs utilized this opportunity to reach out to a larger OES community by giving virtual talks.

Currently, OES has 13 Distinguished Lecturers who are experts from various fields of oceanic engineering including underwater acoustics. A record five appointments were made in the year 2021, but only two DLs expressed interest to join the programme in 2022. Despite the large number of DLs, the DL activities were limited to a select few in the last two years. Both virtual and hybrid DLs delivered were well attended, and all the talks were recorded and made available on the OES YouTube Channel. To make this programme more attractive and relevant to OES members, it is recommended that DLs reach out to the OES community by announcing the titles of their talk and their availability on the OES website rather than having to wait for an interest from OES members/chapters. DLs are more aware of emerging and cutting-edge research topics in their own fields of study and hence in a better position to understand the need to disseminate such knowledge among the OES community. Such an approach would make the programme more meaningful and generate sufficient interest among the members. Chapter coordinator can also help to facilitate DL programme by announcing them to the chapter chairs. DLs are encouraged to continue delivering virtual talks, whenever an in-person talk is not feasible. There are many new student branch chapters (SBC) who might also be interested in organizing DLs. This is an area less explored. With travel possibilities opening up, there may be more opportunities for engagement between the DLs and OES members in future during conferences and symposia. Thanks to all the DLs for continuing to support the DL programme.

Chapter Activities

There are 23 chapters, 16 joint chapters and 14 SBCs as listed under the IEEE Organisational Unit (OU) Analytics. This is somewhat different from the statistics we have on our OES website. Neither Australia nor Japan is listed under OES Chapters but are figuring out under joint chapters. Japan has 8 to 9 joint chapters under various Sections. I would recommend the Chapter coordinator to work with IEEE to understand how this classification has been arrived at. Is there a way we can merge members of some of the joint chapters in Japan to form a proper OES Chapter? Something to be pursued for our future operations.

Not all chapters have been very active during 2021-22 period as per the activity reports available via IEEE vTool. It is possible that some chapters would have organized activities, but were not reported under the vTools, which is necessary for recognizing a technical event. Chapter coordinators may also want to follow up regularly on this and ensure these are updated so that relevant chapters get both the chapter rebate as well as the chapter funding support from OES. This year chapter funds to the tune of $20K are available for disbursement. As per the current technical activity Policy and Procedures (PnP), proposals for technical events were to be sought from the chapters and funding was then provided to accepted proposals on completion of the event. Due to uncertainties associated with funding availability for the last two years (with no funds available for 2021), it was not possible to follow this approach. Hence, it has been decided that funds currently available could be distributed to chapters who have been proactive during 2022 in the organization of events. An amount of $5K has been provided to Houston Chapter (towards OTC contribution) and $2K to Providence Chapter to the Alvin Milestone event. The balance of $13K will be distributed to chapters based on the technical events they have organized in 2022 and reported both in IEEE vTool and the Beacon Newsletter. This exercise is planned to be completed by 30 Nov 2022.

Chapter Engagement on IEEE OES UN Decade of Ocean Initiative (New Activity)

Proposals were sought from Chapters towards UN Decade of Oceans Initiative funding 2022. The objective was to get the chapters engaged in the theme ‘The science we need for the

oceans we want' and contribute to the UN Decade 2021-30 objectives. The following chapters put up their proposals and were funded

- Singapore Chapter ($2k)—UN Decade of Oceans discussion panel during AUV 2022 symposium
- Canadian Atlantic Section Chapter ($2k)—Panel discussion to increase visibility of ocean decade in Halifax and CCECE professionals (workshop)
- ETITC, Columbia ($1.95k)—Challenges in implementing Ocean Decade solutions for Columbia
- IIT Delhi SBC ($2k)—Student hackathon on ocean sustainability (marine pollution as specific topic)

Funding is also expected for 2023 and proposals for the same will be called by late 2022 or early 2023.

Two virtual meetings (to cover the time zones) with the chapter chairs were organized by the chapter coordinator, Gerardo Acosta, and OES volunteer Amy Deeb. During these meetings the Chapters were briefed about various activities they can be part of and different funding opportunities. Both meetings were well attended. There needs to be more engagement with the Chapters. Chapters come under Sections for operational purpose. It has been noticed that there is a disconnect between some of the chapters and their sections. For example, some chapters are unaware of chapter rebates and incentives that are being received into the Sections for the use of their activities. Similarly, sections have a responsibility to monitor and manage the chapter activities and support them. Sections are also responsible for making sure that the annual election for the administrative office of the chapters are held and the same is reported to IEEE. I would like to recommend that the chapter coordinator work with the Section and Chapter Chairs to bridge this gap. If need be, the VPTA/VPPA or the President of the Society could step in to facilitate this interaction. It is recommended that at-least two to three meetings are held annually to engage the chapters on OES technical activities and promote interaction of chapter members at an international level.

Technology Committees

There are 11 TCs at present under OES. One of the TCs, Underwater Cables and Connectors, has been inactive for few years and hence was decided to be dissolved by VPTA in discussion with TC Coordinator and the relevant TC Chair. But this is yet to be implemented. Two virtual meetings of the TCs were held to discuss activities for the year 2022. It has been observed that all the TCs have seen a significant increase in the number of sign-ups by the society members. However, these members are required to be engaged with TC activities such as in the organization of workshops and symposia more regularly if we would like to build a stronger technical community. Their services could be used in the review of conference manuscripts, organizing special sessions at OCEANS, etc. Many TCs have identified co-chairs, who could also succeed as future chairs. TCs play an important role in identifying DLs and I would like to request an active participation of all TCs in this regard. This is an area of activity that needs improvement.

Ocean Science Meeting (OSM22) (New Activity)

This year some TCs were active in organizing virtual technical sessions and plenaries at the Ocean Science Meeting (OSM) and all the sessions were well organized and attended. The theme for the technical sessions was in support of the UN Decade of Oceans where the science meets engineering. More TCs could explore this avenue to engage with ocean scientists who may have an interest in oceanic engineering and eventually become members of OES. OSM2024 may be the next opportunity to connect with OSM community in-person.

A call for new TC Chairs has been sent out to the OES community as the term of the current TC chairs expire by the end of this year. The responses received so far have been lukewarm. This is concerning as the TCs are considered as the driving force for the technology areas for our society and they form the science and engineering foundation of OES. The policy allows the current TC Chairs to be considered for another term if they had expressed interest in continuing. Alternatively, they could propose names of their co-chairs or other suitable candidates from their TC members list. Self-nomination of OES members is also encouraged if they meet the requirements for the TC chair. A list of new TC chairs will be finalized by the end of this year and after approval from AdCom will be appointed for a period of 3 years starting from 01 Jan 2023.

Volunteering

Before I close this report, a word about volunteering. Why should we volunteer? First and foremost, it is a unique opportunity for engagement with your OES community at a personal level. It is an opportunity to serve them and support the society activities. You agreed to volunteer because you have identified availability of some of your time for the said purpose and one would expect you to honour that decision. To me, taking up a volunteer position is a commitment as well and not something 'I will do if I have the time.' We all have a job, which pays us, and a family that needs your valuable time. This could at times compete with your volunteering time. But if this happens regularly, then there is an issue with your time management, which you need to fix. You do not need to be a member of AdCom or ExCom to serve your OES community. There is a whole suite of other avenues where OES needs help from volunteers. You can serve on the Chapter committee, OES Ocean decade initiative activities, YP Boost, WIE, many workshops and symposia which we organise, Beacon and Earthzine publications, etc. ExCom and AdCom are leadership positions, and one should expect to shoulder more responsibilities than merely attending the meetings. You may want to reflect on how you have been valuable to OES as an AdCom member and what more you can do to serve the OES community.

Finally, I would like to welcome Dr. Shyam Madhusudhana, the new VPTA for the period 2023–24. As the newly elected VP for OCEANS, I shall now turn my attention towards helping organising OCEANS in more useful ways. I would also like to take this opportunity to thank the OES members for supporting me during my time as VPTA and look forward to even more support in my new role.

Distinguished Lecturer Roster

Venugopalan Pallayil, Vice President for Technical Activities, IEEE OES

The following OES members have been appointed as Distinguished Lecturers for the period 2023-25. The Chapters and Student Branch Chapters are highly encouraged to take advantage of their expertise and get enriched from their experience in related fields. The DLs may work directly with the relevant groups and fix the date and time of their lectures. Keep the VP for Technical Activities informed once a lecture has been finalized. DLs are advised to announce their availability and topics for lectures on OES website. DLs can be advertised through IEEE eNotices, Beacon Newsletter and Earthzine magazine. Please provide details of the talk to VPTA who would help to publicize this through various social media channels.

Dr. Junku Yuh

Junku Yuh is currently the President of Korea Institute of Robotics and Technology Convergence (KIRO). He is an IEEE Fellow who has held many coveted positions such as Founding Director, Robotics and Media Institute, Korea; Head of Lunar Exploration National Programme, Korea Institute of Science and Technology (KIST); President, Korea Aerospace University etc. During 1996–2004 he also served as Professor, Department of Mechanical Engineering, University of Hawaii. He has won many international awards, served as keynote and plenary speaker for both national and international conferences.

He has expertise in the following areas:

Adaptive Control and Neural-Net Control • Advanced Sensor for Automatic Object Ranging • Adaptive Path Planning • Intelligent Navigation and Guidance • Underwater Robotic Arm Control • Design of Autonomous Underwater Robots • Intelligent Task-Oriented Control Architecture • Virtual Collaborative World Simulator • Macro/Micro Control of Smart Space Structures • Predictive Virtual Environment • Design and Control of Flexible Structures

More details about his credentials can be found in his CV available on OES website.

Ferdinando Nunziata

Ferdinando Nunziata is an Associate Professor at the Department of Engineering, Universitá degli Studi di Napoli Parthenope Centro Direzionale Isola, Naples, Italy. He had also held positions like Visiting Scientist at the Danish Meteorological Institute, Copenhagen, Denmark and Guest Professor at the Shanghai Ocean University, College of Marine Science, Shanghai, China. Ferdinando has widely published his work both in international conferences and journals. He is a senior member of IEEE and a member of OES since 2016. He serves as a reviewer for international journals and has been serving as session chair for many international conferences.

Ferdinando can give talks on the following topics:

1) *Synthetic Aperture Radar (SAR) for coastal observation and*
2) *Microwave radiometer for coastal applications*

Detailed CV of Ferdinando Nunziata has been provided on the OES website.

Let us welcome them into our pool of Distinguished Lecturers and look forward to hearing exciting technical talks.

Living in the Present and Planning for Our Future Oceans

Brandy Armstrong, VP of Professional Activities, vp-professional-activities@ieeeoes.org, Photographs taken by Jhon Bermudez and Yessine Karray

2022 is coming to a close and I can hardly believe how much we've accomplished. This year saw the addition of several new Student Branch Chapters in locations around the world including Columbia, Tunisia and Chile.

OCEANS 2022 Hampton Roads

The mood at OCEANS this year was enthusiastic. It seems we are getting back into the swing of things following a tough time during the pandemic. The Oceanic Engineering Society sponsored several events at OCEANS 2022 Hampton Roads, which were well received and we hope continue at future OCEANS conferences, budgets permitting.

The Women in Engineering (top) and Young Professionals (bottom) breakfast events saw record attendance this year.

Student Branch Chapter representatives from all over the world met to discuss plans for the future.

OES Student Branch Chapter (SBC) representatives from the USA, Scotland, India, Tunisia, Italy, Chile, and Columbia were supported by the Society to attend OCEANS. The student mixer was held before the ice breaker to ensure students were introduced to Society leadership and to encourage students to think about what they hoped to get out of their week at OCEANS. I found the student mixer was a great opportunity to meet the students and for them to meet each other. The SBC representatives helped at the Society booth, chose panels and sessions to cover in Earthzine or Beacon, attended Conference and Society events, and held a Student Branch Chapter meeting to culminate the week. The students shared what their respective Student Branch Chapters have done, what they plan to do, and made plans to work together on virtual events across SBCs.

We have been holding panels to engage and support Young Professionals and Women in Engineering at OCEANS for several years. Normally, it can be difficult to get good attendance at these early morning events. However, at OCEANS Hampton Roads the YP and WIE breakfast events both attracted more attendees than available seats. Attendees were engaged, conversation and networking was excellent, and both events lasted well over their scheduled hour time slot. For more information on the WIE panel, please read the article written by WIE PROPEL laureate, Giulia De Masi, also in this issue of Beacon. WIE PROPEL is accepting applications through January 15th. Please see https://ieeeoes.org/member-communities/women-in-engineering/ for more information on applying for WIE PROPEL.

IEEE OES leaders Farheen Fauziya (WIE liaison), Brandy Armstrong (VP Professional Activities), Amy Deeb (YP BOOST) and Christopher Whitt (President) in deep discussion at the Society booth.

Potential senior members were invited to visit the Society booth to discuss the process of applying for senior membership. Senior member volunteers helped them to find senior member referees for their applications and answered questions about the benefits of, and how to apply for, senior membership.

The Ocean Decade Initiative was highlighted with a booth within the Society pavilion. Also, a special panel on Engineering and Scientific Challenged of Ocean-based Carbon Dioxide Removal and a booth in the exhibition. Expect to see more Ocean Decade activities, panels and workshops at the next OCEANS. For more information please visit https://ieeeoes.org/oceandecade/ .

Laura Meyers and Hari Vishnu highlighting IEEE OES efforts to support the Ocean Decade.

In addition to the awards ceremony held Tuesday morning (video on YouTube), a members only reception with dinner was held Tuesday evening following the exhibitors reception. Members and leaders of the Society intermingled sharing ideas, building trust and comradery, and discussing opportunities to become more engaged within the Society. As a result, several members visited the Society booth later in the week to volunteer for positions within standing and technical committees.

Members and leadership enjoying refreshments and each other's company at the IEEE OES members reception.

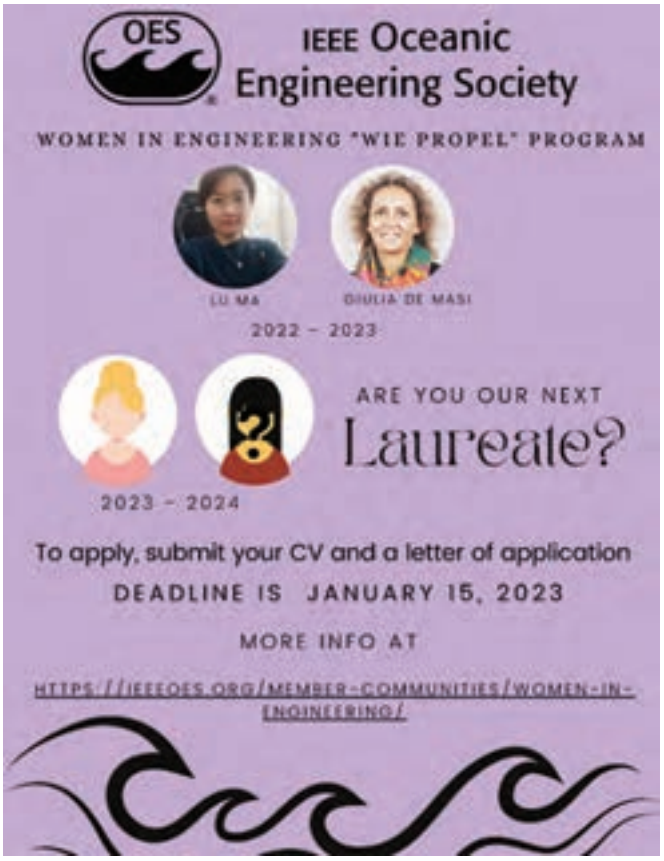
We all were sad that our long time photographer Stan Chamberlain was unable to attend in person this year. However, I want to give a special shout out to Jhon Bermudez and Yessine Karray, student branch chapter representatives from Columbia and Tunisia respectively, who did an amazing job taking pictures during OCEANS.

Student representatives and photographers Jhon Bermudez (left) and Yessine Karray (right).

For those of you unable to attend, you can find recordings of the awards ceremony, plenaries, Future OCEANS presentations and more on the IEEE OES YouTube Channel .

What to Expect in 2023

It has been another successful year. I am thrilled to have accomplished so much during my term as VP of Professional



Activities. Make sure to pay attention to our media outlets (Beacon, Earthzine, social media) for announcements about Ocean Decade, YP BOOST and WIE PROPEL opportunities. There is also a new initiative in the works for next year to mentor students and young professionals at OES sponsored conferences, assisting them to meet with potential employers to discuss opportunities such as jobs, internships and equipment grants. Of course, we are planning more activities at OCEANS 2023 Limerick and Gulf Coast, and we hope to see you there!

Finally, as the newly elected Executive Vice President for 2023–2024, I would like to welcome long-time volunteer Stephen Holt as the newly elected VP of Professional Activities for 2023. Please continue to reach out to **vp-professional-activities@ieeeoes.org** with your ideas and any inquiries about volunteering.

IEEE OES leadership in Hampton Roads, VA.

From the Vice President for Workshops & Symposia

Fausto Ferreira, Vice President for W&S

Nearing the end of the year, it is now time to make a balance and lay down plans for 2023. As you will be able to read in this Beacon, 2022 was a very intense year with many conferences and well attended events. I am very glad to see that all types of conferences (hybrid, virtual and in-person) were successful and that even the in-person only events had a large audience. In terms of organization of the portfolio and improving communication with conference organizers, it was also a very productive year. After having the Policies and Procedures (PnPs) for VPWS approved mid-year, I have nominated the Workshops & Symposia (W&S) Committee for the term 2022-2024, which is formed by Hari Vishnu, Kenneth Foote, Harumi Sugimatsu, Andreas Marouchos, Gerardo Acosta. As per the PnPs, the committee nominees come from different backgrounds and geographical regions. Finally, we had a first W&S Committee meeting at OCEANS 2022 Hampton Roads and a meeting with all OES conference organizers in what was a first of what I expect to be a very useful and successful series of meetings. The goal was to improve the coordination of the different W&S, share experiences and best practices and hear suggestions for improvements from the organizers and a series of action points came out of this meeting as will be detailed below. Next year looks exciting as well with several established conferences and plans for new conferences coming up!

Underwater Communications and Networking (UComms) 2022

The 2022 Sixth Underwater Communications and Networking (UComms) took place in Lerici, Italy, from 30 August to 1 September, 2022, with almost 90 participants in-person. In the occasion of 10th anniversary of this high-quality single-track conference, VPWS awarded the LOC a commemorative plaque highlighting and thanking the LOC for their efforts over the past 10 years. A full report on UComms 2022 is included in this Beacon edition.

2022 IEEE OES Autonomous Underwater Vehicles (AUV) Symposium

The IEEE OES Autonomous Underwater Vehicles (AUV) 2022 took place in a hybrid format, both in Singapore and online from the 19th to the 21st of September, 2022. Over 80 attendees attended (mostly in-person) this high-quality single track OES Symposium. One innovation brought by AUV 2022 was the discussion panel with the presenters at the end of each technical session. Moreover, awards were given by the Autonomous Marine Systems Technological Committee. I would like to congratulate the awardees Nikola Mišković, Blair Thornton and Hanumant Singh! More about AUV 2022 can be found in the dedicated report.

Breaking the Surface (BTS) 2022

The 14th edition of International Interdisciplinary Field Workshop of Maritime Robotics and Applications—Breaking the Surface (BTS) 2022, co-organized by the OES University of Zagreb Student Branch Chapter (SBC) was held from the 25th to the 30th of September in Biograd na Moru, Croatia. BTS 2022 had around 200 participants going back to pre-COVID attendance levels which is excellent news. More about BTS 2022 can be found in the OES University of Zagreb SBC report in this Beacon.

Marine Litter session and workshop at Sea Tech Week

OES has organized a special session entitled "Marine Litter: Solutions for Monitoring, Mitigation and Prevention" on the

27th of September, 2022, during the Sea Tech Week in Brest, France. This session preceded a 2 day workshop on "Marine Litter: Solutions for a Cleaner Ocean" on the 28th-29th of September co-organized with the Laboratory for Ocean Physics and Satellite remote sensing (LOPS). A full report on these two events is in this Beacon.

2022 IEEE International Workshop on Metrology for the Sea (MetroSea 2022)

The 2022 IEEE International Workshop on Metrology for the Sea (MetroSea 2022) took place from the 3rd to the 5th of October in Milazzo, Italy. The OES Italy Chapter was involved in the organization for the first time of this conference with over 100 participants and papers! A dedicated report is also included in this Beacon edition.

IEEE 9th International Conference on Underwater System Technology: Theory and Applications (USYS 2022)

USYS 2022 will take place from the 5th to 6th of December in Kuala Lumpur, Malaysia and online. USYS 2022 is being organized by our OES Malaysia Chapter. By the time you will be reading this newsletter, USYS will already be finished. A report is expected in the next Beacon edition.

2023 IEEE Underwater Technology (UT)

The International Symposium on Underwater Technology (UT23) will take place from the 6th to the 9th of March, 2023, in Tokyo, Japan. 125 abstracts were submitted and 99 were accepted. In addition to the technical sessions program and to the 3 keynote talks, including one dedicated to the UN Ocean Decade, a pre-event Workshop on Career Path Benefits of AUV/ROV Competitions will take place on the 6th of March. Early bird registration is open until the 20th of January. For registration and more information please check http://www.ut23.org/

10th Annual IEEE Conference on Technologies for Sustainability (SusTech 2023)

The 10th Annual IEEE Conference on Technologies for Sustainability (SusTech 2023) will take place from the 19th to the 22th of April 2023 in Portland, U.S.. IEEE SusTech pursuits of environmentally sound development that meets the needs of the present without compromising the future. It is technically co-sponsored by OES while having many other IEEE societies and sections as financial and technical co-sponsors including Region 6 and the IEEE Standards Association among others. While the paper submission is now closed for regular papers, late paper submissions will open in January so there is still a chance to submit your work. Please follow the updates on https://ieee-sustech.org/

Workshops & Symposia meeting at OCEANS 2022 Hampton Roads

As mentioned, an inaugural meeting dedicated to all OES W&S organizers took place on the 20th of October during OCEANS 2022 Hampton Roads (and online). A good and diverse attendance, including organizers from Asia, Australia, Europe, North and South America, made this meeting very fruitful. Among the topics discussed was the need to revise the Guidelines due to some omissions. These are currently being revised by the W&S Committee and then will be open for comments from the W&S organizers as well. Another topic widely discussed was the need for good reviewers. As part of the effort to better include the OES technical community in the reviewing process, TC chairs will contact TC members regarding potential reviewing assignments. Finally, another major point discussed was the different paper/abstract management systems and registration systems. As each W&S uses different systems, we have discussed briefly benefits and cons of some of these systems. However, a study on potential options will be conducted by the W&S Committee to understand what are the best options available to organizers.

Future Plans for 2023

2023 is ramping up with events. Besides UT 2023, OES is supporting RAMI 2023 to take place in July in Italy, Breaking the Surface 2023, to take place in Montenegro in late September and MetroSea 2023, to take place in Malta in early October, making sure we widen our geographic reach and attracting new people to our society. More news on these events will come at a later stage.

Moreover, two other events in new geographical areas are under confirmation and will hopefully be announced in the next Beacon.

On the other side, we plan to present revised guidelines and the result of the paper management system study in the first quarter of next year so that upcoming conferences in late 2023, and in 2024, can be informed by the results of the study and can follow the revised guidelines.

Future Plans for 2024

Albeit it may seen early, I would like to remind all OES W&S planning to organize W&S in 2024, wishing to have a financial (co-)sponsorship or a technical sponsorship with financial implications, that requests for these sponsorships should be sent to VPWS before Spring Administrative Committee takes place as per the guidelines https://ieeeoes.org/conferences/workshops-and-symposia/. Dates are still under confirmation but even if you are not sure of all the details, please contact me directly vp-workshops-symposia@ieeeoes.org in the first quarter of 2023.

As always, I would like to remind any OES members that wish to get involved in current workshops, or propose new ones, to feel free to contact me. We are here to serve the OES members and the larger community, and if you have ideas on improving current workshops, you are more than welcome to forward them to me!

OCEANS VP Report

John Watson, OES Vice-President for OCEANS

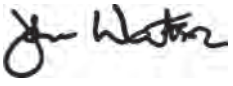
When you read this, I will just be signing-off as your OES Vice-President for OCEANS (VPO). As we move into 2023 your new VPO will be Dr. Venugopalan Palliyal of NUS in Singapore—known as Venu to colleagues and friends. My four years as VPO, since Jan 2019, have certainly been momentous. Who could have predicted the onset of COVID and its impact on all our lives, not just its effect on OCEANS? We had only finished with 2019 Seattle when COVID struck an unprepared world and the whole structure of how we deal with and connect with each other changed. This affected the whole world of conferences and symposia; from our point of view, the impact on OCEANS was profound and the concept of "virtual" conferences came to the fore.

The impact of COVID unfortunately meant that we had to revise and reshape the whole concept of OCEANS. In 2020, we lost Singapore and Gulf Coast, and in 2021, Porto and San Diego as stand-alone in-person events. However, in 2020 Singapore and Gulf Coast morphed into one single online GLOBAL meeting. In spite of all the difficulties it was hailed as a success. Following the success of that model, Porto and San Diego did the same thing in 2021. In these events we had to get used to the "virtual" concept of running a conference. We had to get accustomed to all preparatory meetings (e.g., local organizing committees) being held online using a variety of platforms like Zoom, Teams, GoTo Meetings, etc. Live attendance at OCEANS could not take place, so presentations were either given online or with pre-recorded video. However, there were some advantages to the virtual concept, and it is likely that future OCEANS will retain some form of virtual content.

In 2022, both Chennai and Hampton Roads did go ahead more or less as planned, but embracing the "hybrid" concept, where presentations were a mix of in-person and virtual. Because of COVID restrictions in India, this unfortunately meant that the delegates were primarily from India with very few from the rest of the world. Hampton Roads has just finished and once again deemed to be a major step forward.

Moving into 2023, we have Limerick on the west coast of Ireland to look forward to in June, followed by a return to Gulf Coast in September 2023. The Limerick LOC (co-Chairs Daniel Toal and Edin Omerdic) are well ahead in their preparations for what looks like being a memorable conference. The early program looks exciting and, coupled with some traditional Irish hospitality, I think we can anticipate a great conference. We have been to Gulf Coast on several occasions; they are always well-liked and well-attended events, and the 2023 event is likely to be no exception. The co-Chairs are Capt. Craig Paterson and Dr. Laurie Jugan.

But of-course these two 2023 OCEANS, and the ones that follow, are no longer my responsibility and fall under Venu's remit. So, I would like to wish Venu all the best in his new role, and offer my thanks to all of you who have supported my efforts as OES VP OCEANS. As I have said before, the OCEANS conference is the flagship event in the OES calendar (and also for MTS) and is well-respected the whole world over; and I hope it will continue to be at the forefront of the OCEANS community. It has been an honour for me to serve as OES VP OCEANS.



OTC Asia 2024
Offshore Technology Conference Asia
Dates: 2/27/2024–3/1/2024
Venue: Kuala Lumpur Convention Centre (KLCC), Kuala Lumpur, Malaysia

From the Journal Editor's Desk: IEEE Journal of Engineering Early Access Papers

Mandar Chitre, Journal Editor-in Chief

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

- A. Immas, M.-R. Alam, "Guidance, Navigation and Control of AUVs for Permanent Underwater Optical Networks."
- J. Yan, Q. Su, R. Li, J. Xu, Q. Lu, Z. Yang, "Optimization Design Method of the Umbilical Cable Global Configuration Based on Representative Fatigue Conditions."
- W. Li, Y. Lei, X. Y. Zheng, S. Gao, H. Zheng, S. Zhao, "Nonlinear Low-Frequency Response of a Floating Offshore Wind Turbine Integrated with a Steel Fish Farming Cage."
- Z. A. H. Qasem, J. Wang, H. A. Leftah, H. Sun, S. Hong, J. Qi, H. Esmaiel, "Real Signal DHT-OFDM with Index Modulation for Underwater Acoustic Communication."
- J. G. Jimenez, D. J. Stilwell, A. Wolek, J. McMahon, B. R. Dzikowicz, "Improved Multitarget Tracking in the Presence of Port-Starboard Measurement Ambiguity Using the Bayes Factor."
- H. H. Helgesen, T. Fuglestad, K. Cisek, B. Vik, Ø. K. Kjerstad, T. A. Johansen, "Inertial Navigation Aided by Ultra-Wideband Ranging for Ship Docking and Harbor Maneuvering."
- L. Lu, M. Yao, B. Sun, S. Guo, L. Ma, "Analysis of Sound Fluctuations in Shallow Water in High Sea States."
- F. Xiao, F. Yuan, Y. Huang, E. Cheng, "Turbid Underwater Image Enhancement Based on Parameter-tuned Stochastic Resonance."
- J. Li, Y. R. Zheng, "Experimental Evaluation of JANUS Fast Modes in Very High Acoustic Frequency Bands."
- T. Li, S. Rong, L. Chen, H. Zhou, B. He, "Underwater Motion Deblurring Based on Cascaded Attention Mechanism."
- W. Zhao, S. Rong, T. Li, J. Feng, B. He, "Enhancing Underwater Imagery via Latent Low-rank Decomposition and Image Fusion."
- J. Meng, A. Humne, R. Bucknall, B. Englot, Y. Liu, "A Fully-Autonomous Framework of Unmanned Surface Vehicles in Maritime Environments Using Gaussian Process Motion Planning."
- Y. Xie, N. Bore, J. Folkesson, "Neural Network Normal Estimation and Bathymetry Reconstruction from Sidescan Sonar."
- C. Wang, W. Yu, S. Zhu, L. Song, X. Guan, "Safety-Critical Trajectory Generation and Tracking Control of Autonomous Underwater Vehicles."
- M. Yang, Y. Wang, X. Zhang, Y. Liang, C. Wang, "Parameterized Dynamic Modeling and Spiral Motion Pattern Analysis for Underwater Gliders."

Remembering Claude Brancart

Claude's Friends

Note: The following is adapted from the Press Herald obituary on Claude P. Brancart at: https://www.pressherald.com/?p=6401069

Claude P. Brancart 1934 – 2021 BRUNSWICK – Claude Pierre Jules Brancart, of Brunswick, passed away peacefully at the age of 87 on Dec. 21, 2021. He was born in Alexandria, Egypt on Nov. 5, 1934, to French-speaking Belgian parents, Arnould Paul Brancart and Reine Marie Garat Brancart.

Claude referred to himself as an ocean engineer who spent his life in, on, or under water. His career began in 1958 with the Electric Boat Division of General Dynamics. As a Program Manager in their Underwater Development Group, he did the engineering in the creation of several small research submarines. He designed Star II and took Star II and Star III, on their first deep dives. He also worked on nuclear submarines.

Eventually he took a contract in Hawaii to refurbish Star II, conduct some studies for the Navy, Shell, and Exxon, and design an underwater habitat. He also used Star II to harvest coral for a Hawaiian jeweler and to assist in the filming of an episode of "Hawaii Five-O". Claude joined BK Dynamics in Washington, D.C., in 1972, working on Department of Defense contracts with the US Navy and spending months at sea. After opening a branch in Houston, Texas, he struck out on his own, running an engineering firm that specialized in building equipment for oil companies. He joined the Institute of Electrical and

Electronic Engineers (IEEE) and from then until well into retirement served as an officer in its Ocean Engineering Society (OES), helping to plan Offshore Technology Conferences there and abroad. Claude spent the final years of his career attached to the Washington office of MIT's Charles Stark Draper Laboratory, focusing on the design and deployment of autonomous underwater vehicles for DARPA, the Defense Advanced Research Projects Agency.

To share his love of the ocean with future engineers, Claude helped found and then manage the International Submarine Races (ISR), a biennial design competition that brought together students from around the world to test their human-powered submarines in the Navy's test tank at Carderock, Va. By 2016 he had become Chief Judge and liaison officer.

Claude also established the Symposium on Autonomous Underwater Vehicle Technology in 1990 (AUV '90) at Washington, DC, USA.

On a personal note, Steve Holt, who is still a Senior Member of the IEEE and is presently on the OES AdCom, recalls that it was Claude who was the first OES member that he ever met and it occurred at the OCEANS 2000 MTS/IEEE Conference in September, 2000 in Providence, Rhode Island, USA. Claude asked Steve to consider joining the IEEE and then run for the OES AdCom, which he promptly did and then was elected. Steve then was asked by the new President, Dr. Thomas Wiener, to accept the position of Secretary. The rest is history and Steve always felt that Claude had a major influence on both the direction of his career and his life.

On another personal note, René Garello, past President of the OES and life fellow, recalls his first encounter with Claude when helping to prepare the first OCEANS conference outside North America, in 1994 in Brest, France. The first non-expected feature was that Claude was speaking French. The second one was that he was a very imposing figure with a stout voice. He was very supportive and helped in the following years and, especially when he was President, to bring back OCEANS to France (Nice, in 1998), along with Glen Williams (RIP, Glen). Claude and René worked together for disseminating the AUV conference, with a venue in Brest in 2007. He really was along the year the front figure of OES for our participation to OTC Houston, along with Jerry Carroll. Too many anecdotes to tell! Claude will always be a man to remember!

Jerry Carroll added: I enjoyed working with Claude for several years and we had many good adventures at OTC Events. His wife Leslie did an excellent job of taking care of Claude in his later years. We all miss our times with Claude and thank him and remember him for all his support of IEEE/OES.

Robert Wernli recalls his long relationship with Claude. As an engineer at the Navy laboratory in San Diego, Robert first met Claude during autonomous vehicle development at Charles Stark Draper Laboratory. This continued periodically as additional vehicles were developed and tested. The pleasure of working with Claude on society activities continued for decades. In OES, Claude was a former AdCom member (1994-1996, 2001-2003, Secretary 1993-1996, Chairman of OCEANS '96 MTS/IEEE in Ft. Lauderdale, FL, and was OES President in 1997-1998. (Claude wrote a very inspiring Incoming President's Message in the archives for the Fourth Quarter, Winter 1996 edition of the OES Beacon, which can be read on our website.) He received the OES Emeritus award in 2015 and was a two time recipient of the OES Distinguished Service Award in 2001 and 2005. And his work as the OES representative on the OTC board helped the society maintain a high level of participation on this event. As a tribute to Claude, his photos are highlighted in this issue's Blast From the Past.

May his soul rest in peace.

Claude, we thank you very much!

Obituary on Pino Casalino

Andrea Caiti, René Garello, IEEE Fellow

Giuseppe "Pino" Casalino died suddenly last summer at 73. He was Emeritus Professor at the University of Genova, Italy, where he spent most of his research and academic activity as Professor of Robotics. Before his final appointment in Genova in 1993 he had positions at the University of Calabria and the University of Pisa. He had been also in different periods visiting scientist at Australian Nat. University in Canberra and at Warsaw Polytechnical School.

Starting from original fundamental contributions to learning control theory in the mid '80s, autonomous cooperative robotics has been his main area of research. While he was a fine theoretician indeed, characterized by both clarity and rigour, he was adamant in pretending that theoretical developments should always be linked to real-world applications. As a consequence, his "pencil and paper" work has been coupled to an intense laboratory activity with his colleagues and his students. He was the leader of the first Italian group to participate in an EU-funded robotics research project, back at the time of the EU 1st Framework Programme. He went on in having a leadership role in a wealth of other EU, National and Regional projects since.

In the mid-90s, one such EU project, AMADEUS, was focused on underwater manipulation systems. This was the starting point of an intense, though not exclusive, activity in marine robotics, again with theoretical contributions (as motion planning in 3D for non-holonomic systems) coupled with the development of experimental prototypes (as the hybrid glider/AUV "Folaga", multi-arms multi-bodies underwater manipulation, control and coordination of autonomous surface vehicles).

One characteristic tract of Pino research was his never posing as "one-man-band". He actively worked to favour the spreading and sharing of his original research ideas. In 1999 he founded and was the first Director of the Italian Interuniversity Research Centre on Integrated Systems for the Marine Environment (ISME), creating an effective way for the Italian researchers in Oceanic Engineering to join their resources together, including experimental facilities and instrumentation. ISME is now a consortium of 9 Italian Universities, shares a joint laboratory with the Italian Navy (the SeaLab) and it has a number of different activities and resources going far beyond those of its starting time. Pino rejoiced of the success of ISME, considering it one of his most relevant contributions to the Italian research system growth.

Indeed, Pino's contributions to research growth in Italy, at regional and national levels, have been many and all relevant: he has been Department Director, Vice-Rector of the University of Genova for Technology Transfer, Scientific Director of the Ligurian District for Intelligent Integrated Systems (SIIT), President of the Italian association of researchers in Control and Automation. But at ISME, marine robotics and oceanic engineering have always had a special place not only in Pino's brain but also in in Pino's heart.

The members of the OES may remember him, in addition to his numerous conference participation, as Technical Chair of the IEEE/MTS OCEANS'15 Conference in Genova. He did a great and very intense job in dealing with an unprecedented number of scientific submissions. But, indeed, he was also part of many other aspects of that conference. Pino insisted that the first ever OCEANS conference in Italy should involve in the organization as many Italian research groups as possible and feasible. He rightly felt that the OCEANS'15 Genova Conference was a milestone in the development of the Italian oceanic engineering research community, and everyone in the community should share the honour and the pride for this recognition. And he was keen in supervising that this was indeed happening, that no one was left out and that everyone was put in the condition to work efficiently and happily for the conference.

As a matter of fact, several members of the IEEE/MTS OCEANS'15 Genova local committee were formerly Pino's students. Pino was a professor and mentor of exceptional quality. Many of his former PhD students have now relevant positions in Italy and abroad, in the Academy, Research Centres, Industry. In the day-by-day, work he was always informal and sympathetic with everyone: the students, the younger and the older colleagues. He was bringing in any circumstance curiosity, optimism, enthusiasm and team spirit; this sincere attitude allowed him to overcome difficult situations and conflicts with a constructive attitude.

Prof. René Garello was the liaison between OES and the OCEANS'15 team. He remembers vividly all the contacts he had for preparing the conference, starting to meet the Local Organising Committee (LOC) several years before. In particular, one of his visits was in the Fall of 2013, during his first year as President of the OES. He had the opportunity to give a

Pino and Andrea displaying their gift. Hopefully, they did enjoy the music (2015).

Field work on the pier (2018).

At sea test in Portugal—getting ready (2018).

Distinguished Lecture (DL) at the University and more important to visit Pino's lab where he could be entertained by all the marvels developed there (especially the skin sensitive underwater devices). Pino was a man with many skills, intellectual as well as manual, and a dinner with him was an entertainment by itself, for all the stories he could tell. The picture below, was taken during the social dinner we had at the conference with the LOC, MTS and OES.

No one, having worked with him, may forget his joyful character and attitude, his dedication, his encouragements and his criticisms—while always constructive, Pino was indeed an objective and severe reviewer of his collaborator's work. But when criticism had been overcome, "Steady as she goes" he would cry and try to pat on the back the one closest to him. This was the moment everyone feared: Pino, a top class waterpolo player in his youth, had an incredible physical strength, of which he himself was not always aware; his "pat on the back" could knock you down!

Pino leaves a wife and two daughters; a conspicuous number of important scientific contributions; a respectable number of wooden manufacts and furniture he crafted by himself, literally starting from chopping woods; a never-ending collection of anecdotes and curious events; a community in mourning.

His wife and daughters, announcing his death, have written*: He is now talking maths with the greats of the past. Remember him this way.*

Passing of James R. McFarlane

Robert Wernli and Harumi Sugimatsu, BEACON Editors

We recently received notification of the passing of James R. McFarlane on 1 November, in Port Moody, BC, Canada, at the age of 88. Jim, a Mechanical Engineer, was best known for his company International Submarine Engineering (ISE) that he founded in 1974. He has been recognized internationally for the large array of tethered and autonomous underwater vehicles developed by ISE. Jim received the OES Distinguished Technical Achievement Award in 1987 and was the General Chair of OCEANS '07 Vancouver. We will provide an in-depth article on his achievements in the March issue of the Beacon. If you have any personal comments that you would like included in the article, please send to the Beacon editors prior to the 14 February 2023 deadline.

Jim McFarlane, General Chair of OCEANS 2007 Vancouver.

OES Society Awards

Jerry Carroll, Chair of IEEE/OES Nominations and Appointments Committees

Each year the Oceanic Engineering Society honors several members and volunteers through our various awards. This year, we recognized one OES member for outstanding service in furthering the objectives and activities of the Society with the Distinguished Service Award, and presented the Presidential Award to a member for consistent volunteer service to the Society. This year the awards ceremony was held during the OCEANS 2022 Conference in Hampton Roads (please enjoy the video at the following URL: https://www.youtube.com/watch?v=9bmrY5LnCeE).

2022 Distinguished Service Award: John Watson

John Watson receives the Distinguished Service Award from OES president Christopher Whitt.

It was an honor to present this year's Distinguished Service Award to **Dr. John Watson**. John was chosen for his long involvement with the OCEANS Conferences and Exhibition, serving as Chair of OCEANS Aberdeen (2007 and 2017), Reconnaissance Committee Member since 2010, OES Administrative Committee Member (2006–2011, 2013–2018), and VP for OCEANS (2019–2022).

John is Emeritus Professor of Optical Engineering at the University of Aberdeen, Scotland. His research group has acquired an international reputation in underwater holography and digital holography and has developed several subsea holographic cameras to image and analyze plankton. Prof Watson was recently elevated to IEEE Fellow.

John guided OCEANS through several challenging years and can hand the reigns to the next VP OCEANS after a very successful OCEANS 2022 Hampton Roads. 2021 saw a major update to the OCEANS Conference Operating Policy (OCOP), which was an enormous undertaking. In addition to the pandemic challenges, John has advised numerous OCEANS proposals from the earliest stages through to the final conference closure.

2022 Presidential Award: Michael Romer

Michael Romer receives the Presidential Award from OES president Christopher Whitt.

The Oceanic Engineering Society honored **Michael Romer** with this year's Presidential Award for his leadership of the OES Houston Chapter (2011-2016) and long-standing commitment to the Offshore Technology Conference (OTC). Michael served on the OTC Technical Program Committee (2011-present) and on the OES Technical Program Subcommittee (2014-present).

Michael is a Principle Artificial Lift Engineer at ExxonMobil and is currently a member of the Completions & Well Management team in the ExxonMobil Upstream Integrated Solutions Company in Houston. He has been with ExxonMobil for more than 15 years, learning, deploying, developing, and teaching artificial lift solutions in US Production, Global Production Operations, and Upstream Research. Michael's current research/technology interests include artificial lift, production surveillance and optimization, and inflow/outflow modeling.

He holds BS and MS degrees in electrical engineering from the University of Tennessee and the University of Illinois, respectively. Michael was awarded Young Engineer of the Year in 2014 by the IEEE Houston Section during Engineer's Week Houston.

Michael is the Secretary of the ALRDC Board of Directors, IEEE Oceanic Engineering Society Subcommittee Chair for the Offshore Technology Conference and is active in various SPE AL events and the API 19G Subcommittee.

The OES contribution to the OTC technical program is substantial, and our impact on that event is powered by people like Michael. Everyone who meets and works with Michael on OTC or any other activity knows that he is an incredibly smart, hard worker, and a joy to work with. Thank you for your contributions, Michael.

Request for Nominations for OES Awards 2023

Jerry Carroll, Chair of IEEE/OES Nominations and Appointments Committees

Each year at the beginning of January, the Oceanic Engineering Society is proposing a call for four Awards, with **a closing date of June 30th**. A reminder call for nominations is issued mid-March. The Awards Committee requests the nominator to provide the listing of qualifications of the nominee relevant to the award criteria, and up to 5 references, by filling the Awards Nomination on-line form (https://ieeeoes.org/menu/award-forms/oes-awards-nomination-form/).

The Awards descriptions are given below.

Request for Nominations for DTAA: The Distinguished Technical Achievement Award 2023

The Distinguished Technical Achievement Award is given to honor an outstanding technical contribution to oceanic engineering in either the fundamental or applied areas. The award recognizes either a single major invention or scientific contribution or a distinguished series of contributions over a long period of time.

Request for Nominations for DSA: The Distinguished Service Award 2023

The Distinguished Service Award is given to honor an individual IEEE OES member for outstanding contributions towards furthering the objectives of the Oceanic Engineering Society.

Company/Institution Award

The award will be presented to a corporation or institution that has significantly supported the activity and goals of OES through such areas as conference participation, patronage, technical innovation and technical or administrative participation.

Emeritus Award

The award will be presented to an OES member having been particularly important for the Society and who is no longer in any position of Society governance.

For more info, please visit the OES website as below: https://ieeeoes.org/menu/award-forms/

IEEE Medal for Environmental and Safety Technologies

Do you know someone or a small team who have made a special contribution to Environmental and/or Safety technologies?

Prof. John Potter, IEEE Fellow, OES Distinguished Lecturer, Provisional Chapter Chair, Norway.

Safety has come increasingly into focus in recent decades, and industries such as fisheries and offshore oil and gas production, once considered 'dirty and dangerous', have made enormous strides in improving safety. There have of course been some notable exceptional disasters in the maritime domain, which have in their turn spurred further learning, commitment and safety development.

The IEEE has a specific award for safety technology, presented annually to an individual or small team (up to three persons). The scope of the award to recognise outstanding accomplishments in the application of technology in the fields of interest of IEEE that improve the environment and/or public safety.

This year I have the honour of serving on the evaluation committee for this award and am looking for worthy nominees.

The IEEE Medal for Environmental and Safety Technologies is relevant to a wide community including not only obvious areas such as intelligent transportation but also wireless communication, sensor networks and control and automation, all of which are very relevant to OES. Where partially- or fully-automated systems are involved in operating or protecting critical infrastructure or processes with potential safety hazards in the event of failure, the award could also cover computing, and signal processing.

The award consists of a gold medal, a bronze replica, a certificate, and honorarium.

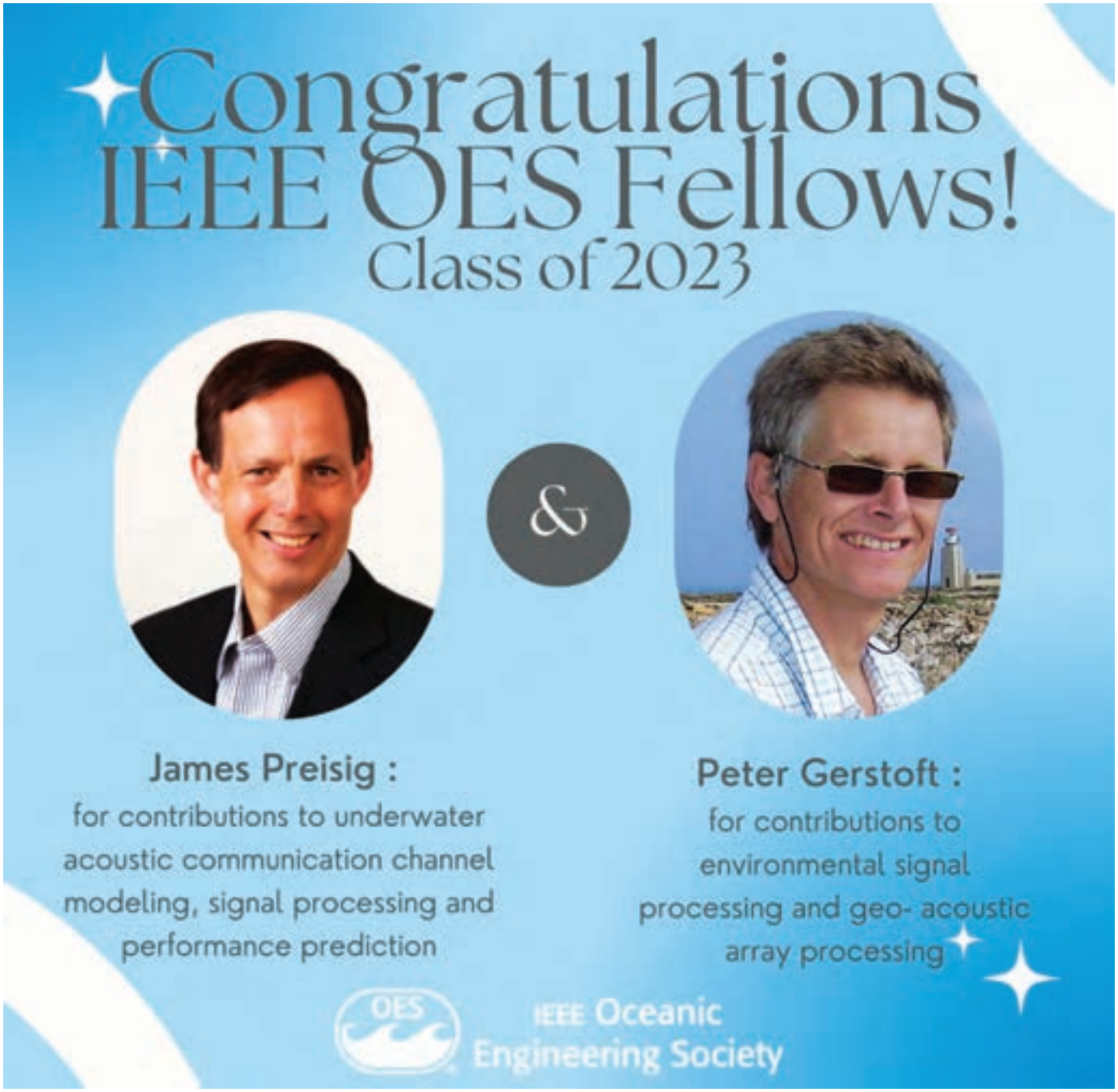
The evaluation process considers the following criteria:

- Public benefits of the contribution
- Improvement in important performance metrics
- Innovative design, development, or application engineering
- Positive influence on contributions to technical professions
- Quality of nomination.

The award was established in 2008 with past awardees being recognised for developments in environmental assessment, hybrid electric vehicles, smartgrids and renewables, battery technologies, navigation, automotive safety, low-emission engines and vehicular environmental perception, to name but some. To date, the award has not been made in the ocean engineering space. But surely there must be worthy maritime safety technology developments among our OES members that we should recognise!

If you think you have a good candidate, the deadline for nomination is 15th June. You can make a nomination online (you will need to log in with your IEEE credentials and go to IEEE awards). Let me know at John.R.Potter@iee.org if you have someone in mind.

For information about the IEEE Medal for Environmental & Safety Technologies please visit: https://corporate-awards.ieee.org/award/ieee-medal-for-environmental-and-safety-technologies.



Women in Science and Engineering—Take-Home Messages From the WIE Panel at OCEANS 2022 Hampton Roads

Giulia De Masi, OES WIE PROPEL Laureate 2022-2023,
Photographs taken by Jhon Bermudez and Yessine Karray

During the MTS/IEEE OCEANS 2022 conference at Hampton Roads, Virginia, a dynamic panel session was organized by the IEEE Oceanic Engineering Society (OES) during the women-in-engineering (WIE) breakfast. The panelists included Allisa Dalpe (Woods Hole Oceanographic Institution), Corinne Bassin (Schmidt Ocean Institute), and Yahong Rosa Zheng (Lehigh University), under the moderation of Farheen Fauziya (Enhanced Communications & Technologies). More than 60 participants enjoyed the breakfast and panel presentations. They were intrigued by the three women, three different stories, at three different stages of their life and career. Some common traits and experiences emerged during the panel presentations and sparked lively discussions.

I was very glad that I attended this event, finding many of the experiences resonating with me. After the three panelists briefly shared their personal experience, many professionals and young students were motivated and asked a lot of questions. The discussion was engaging and thought provoking. The conference general chair and the OES president were also among the few male participants, who were listening to the conversation with great interest. I would like to capture a few key points that were discussed in the panel.

Adaptability Opens New Opportunities

In the experiences shared by all three panelists, the career path taken was nonlinear. Allisa, a young researcher at WHOI, presented her choice of career path using a decision tree approach: some tracks have been pursued and some others have been put aside. She credited her passion for engineering to her father's encouragement when she was young. Corinne, being a mid-career professional, had to move back and forth between industry and academia, changing jobs to suit her family situation, which was changing from time to time along her way. In contrast, Rosa is a senior researcher, a fellow of IEEE, and a mother of two children. She presented a timeline of her career, along with her husband's career and her family milestones. She showed that changes in life can be opportunities. For instance, while pregnant with her second child, Rosa decided to start her Ph.D. study after working in industry for seven years and she appreciated the flexibility of an academic job to take care of family while advancing her career.

Adaptability allows women to develop a career and raise a family in an ever changing world. As Allisa said: "It's ok not to have an exact plan," still, your professional profile will be growing, often with contributions from different experiences that make you unique. Allisa started with a bachelor in Physics and ended up with a Ph.D. in Ocean Engineering. Now, her job at WHOI led her to work in autonomous systems. Her experience in many disciplines makes her a well-rounded researcher. Corinne shared her experience in raising a kid as a single parent while balancing professional work, which can be extremely difficult at some moments in life. Rosa described the interesting comparison of her career advances to that of her husband, and suggested some creative ways to leverage 'two-body' opportunities.

Allyship and Intersectionality

Corinne emphasized that allyships play a crucial role in women when pursuing their talent and leadership. She offered a great and easy method of allyship called "echoing": it is a common complaint that women are often not heard in meetings due to various reasons, and it is more frustrating if there are only three women in a room of 20 - 50 people. Nevertheless, if the three women take turns to echo an opinion multiple times, making direct reference to what was said before, then their "echoes" would greatly increase the chance of being heard. For example, after the first person expressed her opinion, which was ignored, the second person would say something like "As Corinne said before, I also agree that…"; the third person would say: "As Corinne and Allisa said before, I believe it is a good idea that …." It is a great idea to also ask the men in the room to refer to our opinion and be our ally too.

Allyship also means building a strong support system from family members and colleagues. Build a support team with people who know your value and can step in at difficult times, for example, when you have to go to work while your kid is sick. On the society scale, networking events and meetups with other women are great places to find support and mentorship. It is also important to know that mentorship goes in both directions - mentors and mentees benefit each other. All three panelists mentioned that they had received great advice from other events like this WIE panel, and they were happy to give back to the community.

Allyship is critical particularly in cases of 'intersectionality', which describes the cases where more than one way of inequality is expressed in the same person, producing higher forms of discrimination, like gender and religion, or gender and ethnicity. In these cases, allyship is particularly important in defending from any form of combined discrimination.

Be Proud of Yourself

Women should be aware of how they stand out. When there are only 3 women in a class of 100 students, the 3 women are known more than the 97 men. This was the experience shared by Corinne, very common in STEM. This is true also in our daily life. Quite often, at work, women are few and for this reason they stand out. We may sometimes not be aware of it, but we have a power on it, because the job market needs women to take an active part of the work life. We have to express this power, expressing our needs such as flexible working time or reasonable maternity leaves.

Rosa said women have to remember to be confident in themselves and proud of their work and their achievements, not rely on the other people to support them, nor wait for others to celebrate their achievements. Sometimes women lack self-confidence, which is very important at work, just like in the family. This leads to the expression of new ideas and creativity, which can differ from the majority opinion. Moreover, women have a tendency to take responsibility. Self-confidence should be an important factor that also helps one to say "no" when too many commitments are assigned, as pointed out by Rosa and Corinne.

Self-confidence does not mean to pretend to have a knowledge that we do not have. The knowledge opportunity today is huge given the online availability of scientific content. It is ok to say "I do not know this." To be humble is paying off in terms of trustability and reputability.

How to Stop the Leaking Pipeline?

Rosa drew our attention to the story of the trombonist Abbie Conant and asked how the STEM community could develop a strategy of "blind audition" to increase the percentage of women in science, technology, engineering, and math. Once we attract more women, how do we keep the pipeline flowing? Many women leaders, including Cathy Hogan-Dixon (Executive Director of OceansAdvance Inc. from Canada), Donna Kocak (L3Harris Fellow/Senior Scientist and past MTS president), and Sonja Smith (Scientist at Navy), shared encouraging facts that many companies in the marine industry and Department of Defense have put in family-friendly policies, in terms of working time flexibility that enhances the work-family balance, paid parental leave for both working mothers and working fathers, and paid childcare expenses, etc. Those policies are taking effect in women retention, job performance, and life satisfaction.

From left to right: the moderator Farheen Fauziya (Enhanced Communications & Technologies) and the 3 panelists: Corinne Bassin (Schmidt Ocean Institute), Prof. Yahong Rosa Zheng (Lehigh University) and Allisa Dalpe (Woods Hole Oceanographic Institution).

A Concluding Remark

Events like those organized by IEEE-WIE and women-focused events by OES are a great opportunity to meet other women professionals. This is in line with OES efforts to improve on diversity and gender representation in the Society, which also fits within one of the key aims of the UN Decade of Ocean Sciences. These events can be the right venue for women to find new allyships and mentoring opportunities in both directions. "Make the interactions count" as Allisa said. Indeed, I was happy to make this one count! I left the conference enriched and strengthened by all the meetings, testimonies, and interactions I had during the conference, especially in the WIE panel. I very much look forward to the next opportunity. If you have any comments about the WIE panel, or the topics we discussed in the panel, please write to me.

Acknowledgments

I would like to thank Prof. Rosa Zheng for helping on the revision of this article.

Q&A session after the panel.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Japan Chapter

The 8th Underwater Technology Forum • ZERO -Hybrid

Reported by Harumi Sugimatsu

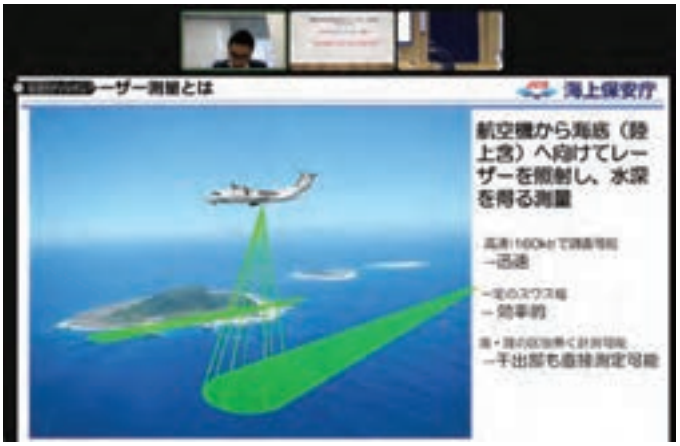
The 8th Underwater Technology Forum • ZERO was held from 13:00-17:00 on 14 October 2022, at the Atmosphere and Ocean Research Institute, The University of Tokyo, in Kashiwa Campus (https://www.aori.u-tokyo.ac.jp/english/index.html). This time, we have about 50 in person attendees and more than 230 online attendees. Most of the speakers were on-site.

The topics of the forum follow:

1) OCEAN DNA Project (https://www.nature.com/articles/s41598-020-77304-7)
2) Special Session—easuring the underwater world form the sky
   - 2.1) Future vision of the Flying Car
   - 2.2) From the sky to the ocean—Potential use of unmanned aircrafts
   - 2.3) From the sky to the ocean—Ocean observations by flying boat drone
   - 2.4) Measuring the bathymetric feature from the sky—Hydrographical surveying by airborne laser
3) Predatory activity of elephant seals in the deep sea—Using whiskers as foraging sensors
4) Acoustic measurements of organisms in deep-sea sediments
5) Harvesting of seafloor observation data by optical wireless system

This time, we organized the special session "Measuring the underwater world form the sky" and had four lectures. Realizing the collaboration between the sky and ocean technologies in near future is expected.

Q and A from the floor (L) Prof. Michida chairing the special session (R).



From the special session "Measuring the underwater world form the sky".

From the talk "Harvesting of seafloor observation data by optical wireless system".

IEEE OES at Sea Tech Week 2022

René Garello (Life Fellow—IMT Atlantique / IEEE OES), Christophe Maes (IRD), Philippe Courmontagne (Naval Group / IEEE OES)

Context

The Sea Tech Week (STW) conference is set every other even year in Brest, France. It has a very good relationship with OES, via an MOU we signed in 2009 for exchanging booths when OCEANS is in Europe (every other odd year) and helping develop sessions. This year STW (see at https://www.seatechweek.eu/) main theme was "Maritime transport: towards smarter and greener solutions", and India was the featured country of honor. It was the opportunity to meet Dr. Atmanand who was the recent general chair of OCEANS 2022 in Chennai, India.

Figure 1. A partial view of the OES booth showing one of the European projects (Eurosea - https://eurosea.eu/) the French section and OES chapter is involved with.

This year the OES French chapter organized two sessions during the conference:

"Marine Litter: Solutions for Monitoring, Mitigation and Prevention", co-convened with the Laboratory for Ocean Physics and Satellite remote sensing (LOPS, https://www.umr-lops.fr/en), a joint unit between CNRS, Ifremer, IRD and UBO).

"Underwater noises: Understanding and Preventing it", co-convened with Technopole Maritime du Québec (Canada) and Institut France-Québec Maritime (France-Canada)

Marine Litter Session

The session on Marine litter and Marine Debris was focused on solutions. Indeed, while quantitative information on production and use of plastics is somehow available, the amount and fate of plastics discarded or leaked into the environment is highly uncertain. In particular, knowledge of how much plastics, at different scales down to micro and nano levels, reaches the ocean and the pathways and fate of such plastic in the ocean remain poorly known.

A focus is needed on how science and technology could quantify the pervasiveness of marine pollution and facilitate an understanding of the mitigating impact of reducing the stock of plastics in the ocean. The goals for meeting such a challenge go through the determination of a strategy for monitoring marine litter in the ocean and develop solutions for addressing the problem.

To this extent, the session touched on the diverse pre-requisite for creating the knowledge on marine debris and plastic in the ocean needed by societal stakeholders. The following topics were addressed:

- Knowing where the pollution is and how much is observable.
- Where does it come from?
- Developing prevention and reducing the amount through adapted solutions.

The session ended with a Panel on Communication and Decision supports.

We had an attendance of 35+ all day long, and I'm proud to observe that, concerning the speakers, we had almost a Woman/Man parity. Here is the list of presentations, which will be available on the IEEE OES 'Plastic in the Oceans' Initiative website (https://www.gstss.org/2022_SeaTech/).

Session a: Knowing where and How Much

'Tools for the monitoring of micro and macro plastics at sea.' Sébastien Smet, Actimar, Brest, France

'WERA HF Radar to support monitoring of marine litter and pollutants.' Thanh Huyen Tran, Helzel Messtechnik GmbH, Kaltenkirchen, Germany

'Remote Sensing Spectral Visibility of Plastics under laboratory conditions.' James Delaney, University of Plymouth, Plymouth, United Kingdom

'Towards the use of the giant clam T.maxima, as a biological integrator of environmental contamination in French Polynesia.' Irène Godéré, Université de la Polynésie Française, UMR 241 EIO, Tahiti, Polynésie Française

Session b: Where Does it Come From?

'Quantifying the Use Chains of Plastics and the Sources of Plastic in the Ocean.' Hans-Peter Plag, MARI, Old Dominion University, Norfolk, VA, USA

'Fish & Click: how participatory science helps to map and inventory lost fishing gear.' Marie Morfin, IFREMER, Lorient, France

'Towards a new decision support tool for marine litter monitoring in the eastern English Channel.' Sloane Bertin, Laboratoire d'Océanologie et de Géosciences (LOG), UMR 8187, CNRS, ULCO, ULILLE, IRD, Wimereux, France

'Deep Learning approaches to simulate Lagrangian particle dynamics at sea surface.' Daria Botvynko, ENIB, UMR CNRS 6285 LabSTICC, Brest, France

'Monitoring and modelling the circulation of marine debris in Indonesia.' Christophe Maes, LOPS IRD Plouzane, France

Figure 2. Young PhD student Daria, presenting her topic.

Session c: Preventing and Reducing

'Deep learning-based approaches to detect floating marine debris for reducing marine pollution.' Ramnath Prabhu Bam, Indian Institute of Technology Goa, Ponda, Goa, India

'Preventing Plastic Pollution – a catchment-based approach to reducing the stock of plastics in the ocean.' John Iwan Jones, Queen Mary University of London, London, UK

'An agent-based modelling approach for maritime plastic recovery optimization.' Loic Salmon, Isen Yncrea Ouest Brest, France

Session d: Communication and Decision Support / Panel Session

'Towards Mitigation of Marine Litter: Increasing Social Capital Through an Ecosystem of Virtual Community Centers for Marine Litter.' Hans-Peter Plag, MARI Old Dominion University, Norfolk, VA, USA

Underwater Noise Session

In the past hundred years, the anthropogenic noise introduced into the marine environment has reached unprecedented levels. Effects of shipping noise on individuals and populations range from communication masking, behavioural disturbance. Production of stress hormones, etc. which consequently negatively affect both the animal individual fitness and population dynamics.

World maritime traffic has increased sharply in the 20th century. It has grown from about 30,000 ships in the 1950s to nearly 95,000 today. This increase in traffic has resulted in an increase in the underwater noise generated by ships and therefore in the overall oceanic ambient noise. The figure most put forward by the scientific community is an increase of 3 dB (doubling of the acoustic energy introduced) per decade.

Marine animals, marine mammals, fish, invertebrates and sea turtles have a hearing apparatus and are able to listen to sounds in the frequency range of traffic noise. While Canada and the European Union has recognized maritime traffic noise as a marine pollution, the scientific community has shown that maritime traffic noise has negative effects on wildlife, especially Canadian endangered cetaceans (orca, beluga, North Atlantic right whale, blue whale). Adverse effects include the masking of animal communications, behavioural disturbances and physiological reactions. To date, the scientific community does not know how to translate these effects into impacts on the life cycle of individuals and populations. However, in accordance with the precautionary principle, solutions are already being sought to limit the ambient noise caused by traffic by mitigating vessel underwater noise.

The two main sources of noise radiated by underwater vessels are machinery and propeller cavitation. The noise radiated by a ship is described by its acoustic signature, defined as the sound that would be heard by an ear placed at the standard distance of 1 meter from the vessel.

The scientific community has produced several databases of acoustic signatures, the analyses converge on two conclusions. First, the noise radiated by ships has a great dispersion. Secondly, the noisiest quarter of ships is responsible for 80 % of the sound energy injected into the water by maritime traffic.

The purpose of this dedicated session concerned, on the one hand, all the systems or methods enable to prevent or reduce the pressure of shipping Underwater Radiated Noise (URN) on the marine environment and, on the other hand, all the methods allowing the quantification of the URN level. The latest advances in marine acoustics research were presented: passive and active acoustics, impacts of anthropogenic noise on marine organisms (from invertebrates to marine mammals) and also at ecosystem level.

Among other presentations, two main projects were presented.

The MARS Project

The MARS (Marine Acoustic Research Station) project focuses on the noise radiated by ships. The objectives are (i) to measure the acoustic signatures of a representative sample of the St. Lawrence fleet, (ii) to understand the origins of this underwater noise, and (iii) to propose mitigations with the project's partner shipowners that are acoustically efficient, compatible with the vessels' operations and offer co-benefits such as a reduction in fuel consumption and greenhouse gas emissions.

The MARS project is co-led by the *Institut des sciences de la mer de Rimouski* (ISMER) of the *Université du Québec à Rimouski* (UQAR) and the *Centre de recherche appliquée Innovation maritime* (IMAR) with the support of MTE and OPDAQ as well as shipowners (ALGOMA, CSL, Desgagnés, FEDNAV). The project is financially supported by Transport Canada and the *Ministère de l'Économie et l'Innovation du*

Québec. The principles of the MARS project are objectivity and scientific excellence.

The project is centered around the construction and deployment of a world-class acoustic station in the St. Lawrence Estuary, a vital area for cetaceans, near Rimouski compliant with ANSI/ASA S12.64 2009 standard. Four autonomous 3-hydrophone vertical arrays will make it possible to measure the ambient noise and underwater acoustic signature from vessels. This acoustic station will be operated 6 months annually -- from May to November until 2023. Its position in the center of the two shipping lanes enables the measurement of the acoustic signatures of the candidate ships without them needing to divert significantly. Noise measurements can be done in less than 30 minutes.

The scientific program of the project is divided into 5 actions.

Action 1 concerns the acoustic station. It includes its design, annual deployment from May to November until 2023, maintenance and annual calibration.

Action 2 is dedicated to the measurement and interpretation of underwater radiated noise signatures. 150 to 250 signatures will be acquired per year according to the ANSI/ASA S12.64 2009 standard. These signatures are provided in near real time to the project's partner shipowners. They serve as a support for a research activity to study the links between the acoustic signatures, the characteristics of the vessel and its conditions of operation and to optimize the measuring station by studying the relationship between the accuracy of the signatures and the complexity of the platform.

Action 3 is dedicated to the development, manufacture and installation of on-board instrumentation on ships to establish its vibratory and acoustic state.

Action 4 deploys the instruments on board partner ships, develops an analysis methodology and carries out vibration diagnostics (on up to 16 vessels).

Actions 3 and 4 follow steps of increasing complexity: test in the basin, test on ships at the dock, experiments on ships during operations especially during their passage in the acoustic station.

Action 5 synthesizes the knowledge produced from the MARS project to propose noise reduction solutions, and to implement them and measure their effectiveness. Action 5 addresses both the operating conditions (such as the speed of the ship) and maintenance (such as the condition of the propellers), the architecture of the ship (such as the vibration insulation of the machines). Action 5 searches for solutions that combine the reduction of underwater noise with other related benefits, such as the increase in comfort on board or the reduction of fuel consumption, in order to encourage the adoption of quiet technologies by shipowners.

The MARS project aligns with the Government of Canada's priorities (Transport Canada (TC), Fisheries and Oceans Canada) regarding the protection of the oceans and its program to reduce disturbances caused by marine traffic and TC's Quiet Vessel Initiative. It enables the development of research and innovation capabilities that are unique in Canada. It federates membership and attracts the support of domestic navigation professionals in Eastern Canada (Algoma, Canada Steamship Lines, Desgagnés, Fednav), as well as the *Société de Développement Economique du Saint-Laurent* (SODES).

The Project Life PIAQUO

The first one is the Project Life PIAQUO (Practical Implementation of Achieved QUieter Oceans). It is a European collaborative project aiming at reducing the issue of underwater noise and its impact on ecosystems.

Average level of noise in the most patronized seas has increased by about 20dB in the last 50 years.

The radiated noise of working and pleasure boats is the main factor in this growth of underwater noise. Marine areas with protected species and/or representing zones with major biological interests (reproduction, nursery, food…) are located nearby vessels' routes. Recommendations were established to encourage underwater noise reduction generated by human activities and European regulation is going to oblige the establishment of ambitious actions in this field. The European project AQUO (FP7) has created tools to estimate the noise generated by maritime traffic and to realize noise cartographies.

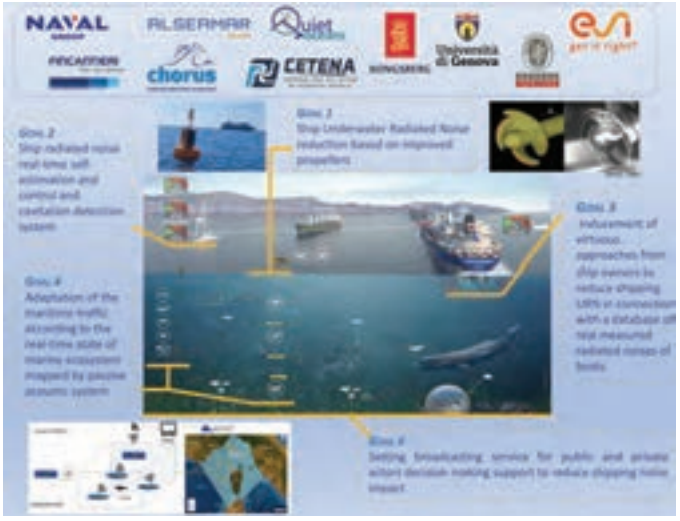


Figure 3. Project Life PIAQUO presentation.

The Project has 5 goals:

Goal 1: Demonstration on two types of ships of the possibility to reduce on existing ships the underwater radiated noise thanks to the integration of new optimized propellers focusing on fuel consumption and Underwater Radiated Noise (hereafter "URN") reduction

Goal 2: Demonstration of a real time on board self-estimation system, measuring the URN generated by the ship and detecting ship's own cavitation

Goal 3: Implementation and evaluation of proactive ships underwater noise radiation incentives together with a data collection of actual URN measured with buoy on a long period of time

Goal 4: Implementation and evaluation of a real time ship traffic adaptation to the surrounding ecosystem, together with a

passive acoustic cartography for shallow and deep waters designed with drones, ships and fixed observatories

Goal 5: Creation of impact cartography together with a web service used as a decision-making tool for institutional and private sectors actors

The Session

During the whole day several plenary talks and technical presentations were delivered in front of an attendance of 30+:

Plenary talk on 'The acoustic world of silence', Cedric Gervaise, Chorus acoustics, France

Plenary talk on 'The project Life PIAQUO', Eric Baudin, Bureau Veritas, France

'SubSea Quieter® Pile Driving: a disruptive, low cost and highly efficient noise mitigation system', Damien Demoor, GREENOV-ITES, France

'PIAQUO: Practical Implementation of the European project AQUO', Philippe Courmontagne, Naval Group, France

Figure 4. Eric Baudin (Bureau Veritas) presenting PIAQUO.

'On the role of the tailored Green's function within underwater radiated ship noise prediction', Nicolas Trafny, Naval Group, France

'SHIP URN: UNIGE activities in the context of LIFE-PIAQUO project', Michele Viviani, Università degli studi di Genova, Italy

Plenary talk on 'The Marine Acoustic Research Station (MARS) project: a unique infrastructure to determine the noise generated by ships and search for mitigation solutions', Guillaume St-Onge and Sylvain Lafrance, ISMER-UQAR, Canada

Plenary talk on 'MARS station: A real time long-term equipment to measure URN following the standard ISO/ASA', Cedric Gervaise, Chorus acoustics, France

Figure 5. Cedric Gervaise (Chorus acoustics) during his plenary talk.

'Assessment of the St. Lawrence soundscape at the MARS station', Jeanne Merindol, ISMER-UQAR, Canada

'Analysis of 36 URN signatures collected in 2021 with the MARS station', Cedric Gervaise, Chorus acoustics, France

'A specific development of inboard vibration and acoustics sensors to identify sources of URN', Jean Christophe Gauthier Marquis, IMAR, Canada

'Detection of cavitation from inboard measurements', Kamal Kesour, IMAR, Canada

'Silence of Global Oceans: Acoustic Impact of COVID-19 Lockdown', Artash Nath, Monitor My Ocean, Canada

'Underwater noises monitoring using DORI underwater acoustic recorders', Caroline Magnier, ABYSSENS, France

'Experimental study and control of a hydrofoil generating a tonal noise', Paul François, Ecole Navale, France

OES Conference Calendar

Qianyi Yang and Muhammad Mohsin, OES Calendar Coordinators

OCEANS

OCEANS 2023 Limerick
June 5–8, 2023
Limerick, Ireland
https://limerick23.oceansconference.org

OCEANS 2023 Gulf Coast
September 25–28, 2023
Gulf Coast, USA
https://gulfcoast23.oceansconference.org

OTC

OTC 2023
May 1–4, 2023
Houston, U.S.A.
https://www.otcnet.org

OTC Brazil
October 24–26, 2023
Rio de Janeiro, Brazil
http://www.otcbrasil.org

OES Sponsored

USYS 2022
December 5–6, 2022
Kuala Lumpur, Malaysia
https://oes.ieeemy.org/about-us/ieee-usys-2022/

UT23
March 6–9, 2023
Tokyo, Japan
http://www.ut23.org

SusTech 2023
April 19–22, 2023
Portland, Oregon, U.S.A.
https://ieee-sustech.org

Non-OES

5th International Conference on Synthetic Aperture in Sonar and Radar
6–8 September, 2023
Villa Marigola, Lerici, Italy
https://www.ioa.org.uk/civicrm/event/info?reset=1&id=718

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

2022 IEEE OES AUV Symposium, Singapore, 19–21 September 2022

Bharath Kalyan, Venugopalan Pallayil (General Co-Chairs) & Hari Vishnu (Publicity Chair)

The IEEE OES AUV Symposium is a collaborative symposium sponsored by IEEE OES and organized once in every two years. It aims to bring together those working in the field of marine robotics, including but not limited to autonomous underwater vehicles (AUV), to exchange new knowledge and explore future directions.

The 2022 IEEE OES AUV Symposium was held in Singapore, at the Shaw Foundation Alumnus House (SFAH), located within the main campus of National University of Singapore. The event was followed by the underwater robotics competition Singapore AUV Challenge (SAUVC). The symposium was endorsed by UN Decade of Ocean Science for Sustainable Development underlying the importance and alignment of the event with the goals of this global movement.

Figure 1. A snapshot of in-person and virtual participants in 2022 IEEE OES AUV Symposium.

Given the challenges associated with post-COVID travel, the event was held in the hybrid format, even though the initial plan was to have it as an in-person only event.

Below are the some of the statistics from the event.

- 56 submissions (full paper + abstracts),
- 42 papers accepted for oral presentation,
- 30 full papers accepted following peer review,
- 100 registered participants,
- 18 countries,
- 7 Student travel grants,
- 5 patrons.

Technical Program

The opening address was given by the guest of honor, Prof. Chan Eng Soon, CEO, Technology Centre for Offshore and Marine, Singapore (TCOMS), who emphasized the role of

Figure 2. Prof. Chan Eng Soon delivered the opening address.

marine robotics in ocean observation, asset management and combating climate change.

Plenary Sessions

As part of the symposium, we had three plenary talks:

1) **"Challenges in Deploying Robust Autonomy for Robotic Exploration in Marine Environments" by Prof.** Stefan Williams, University of Sydney, Australia.
2) **"Learning-based Design and Control of Underwater Robots" by Prof. Daniela Rus,** Massachusetts Institute of Technology, USA.
3) **"Marine robotics challenges and applications—Current research at the Italian center ISME" by Prof.** Gianluca Antonelli, University of Cassino and Southern Lazio, Italy.

Figure 3. A Snapshot from each of the plenary sessions.

Technical Sessions

In a departure from traditional format, the 2022 edition of the AUV symposium introduced two categories of submission:

1) Full paper submissions—These papers were fully peer reviewed and the accepted authors were given an opportunity to present their work at the symposium and have their papers published in IEEE Xplore.
2) Presentation-only submissions—This involved submission of extended abstracts. The accepted extended abstracts were included in the symposium proceedings and the registered authors were given an opportunity to present their work, however, these abstracts were not published in IEEE Xplore.

The symposium had 9 single track technical sessions categorized based on technical topics. Each presenter was given 12 minutes to present and 3 minutes for questions from the audience specific to the author. At the end of each technical session, we had a 15-minute panel session with the panel comprising of presenters in the session and the session chair moderating it. The idea was to encourage discussions and questions relevant to the broad theme of the session, which could be shared amongst all the authors, and also to take up questions that could not be asked during the individual talks. This format was appreciated by the participants as it fostered better audience-presenter interactions, which was one of the aims of the symposium.

Figure 4. A snapshot from a technical session—A technical presentation and a panel discussion.

Panel Discussion

The UN Decade of Ocean Science for Sustainable Development (2021–2030, known as the Ocean Decade) is generating increasing enthusiasm and energy in the ocean science communities. Marine robotics and autonomous systems community have a big part to play in taking technology forward in the coming decade for improved sensing and ocean exploration. The panel discussion focused around the Decade theme, namely, how to achieve the **"Science we Need for the Ocean we Want."** The panelists included John Potter (NTNU, Norway), William Kirkwood (MBARI, USA), Neil Bose (Memorial University, Canada) and Mark Roberts (Kongsberg) with the session moderated by Richard Mills (Kongsberg). The panel session was in hybrid format, allowing virtual participation to non-registered participants as well. The event saw a small amount of virtual participation.

Figure 5. Richard Mills, Kongsberg moderated the panel session (above); Audience at the panel session (below).

Award Ceremony

During the 2022 symposium, several awards were presented to researchers in the field of marine robotics and autonomy, in recognition of their contributions to the international AUV community. The following awards were presented:

Lifetime Achievement Award

This award is presented to individuals in recognition of lifelong impact in the field of Autonomous Marine Systems. The 2022

Figure 6. Dr William Kirkwood from IEEE OES AMS technology committee announcing the awards during gala dinner (above). The awardees and the members of the awards committee joined us in sprit, virtually (below).

IEEE OES Lifetime achievement award was presented to Prof. Hanumant Singh, Northeastern University, Boston, USA.

Rising Star Award

This award is presented to mid-career individuals in recognition of early career impact and future potential in the field of Autonomous Marine Systems. The 2022 IEEE OES Rising Star

Figure 7. The rising star award was presented to Prof. Nikola Mišković (above) and Prof. Blair Thornton (below).

Award was presented to Prof. Blair Thornton, University of Southampton, UK with a cross appointment at the Institute of Industrial Science, University of Tokyo, Japan, and Prof. Nikola Mišković, University of Zagreb, Croatia.

The award ceremony culminated with an appreciation to the local organizing committee by AMS-TC of IEEE OES for organizing the 2022 edition of the symposium. The AMS TC chair, Prof Hanumanth Singh, also announced that the 2024 edition of the AUV symposium will be held in Boston, USA.

Figure 8. The local organizing committee with the appreciation plaque (avobe). Prof. Hanumant Singh announcing the next edition of the AUV Symposium (below).

Ocean Basin: Site Visit

The Technology Centre for Offshore and Marine, Singapore (TCOMS), is a national R&D centre dedicated to the Marine & Offshore and Maritime sectors. It integrates research and industry expertise to co-create innovative concepts and solutions to address real world challenges. A core feature of TCOMS is the next-generation Deepwater Ocean Basin research facility (60 × 48 × 12 m basin with a 50 m deep hole), which is equipped with advanced wave and current generation systems to simulate challenging ocean environments that marine platforms and ships operate in.

A technical site visit to TCOMS Ocean Basin facility was arranged for all attendees of the AUV Symposium 2022. The visit garnered significant interest amongst the participants and facilitated good discussions between the visitors and the CEO of TCOMS, Prof. Chan Eng Soon.

Figure 9. An overview of the Ocean basin capabilities was presented to the symposium attendees by the TCOMS team (above). Ripples from a plunging wave that greeted the AUV Symposium attendees moments earlier. The 3D wave was created to demonstrate the wave-making capability of the TCOMS ocean basin facility (below).

Social Events

The ice-breaker reception, symposium gala dinner and pub-grub evening during the panel session provided excellent opportunities to network and engage with participants. The ice breaker reception and the pub-grub evening were held at Shaw Foundation Alumnus House. The gala dinner and the awards ceremony were held at Vineyard@Hort park, Singapore. Overall, we received good feedback on the organization of the symposium, including on the technical sessions and discussions, social events and the site visit.

Figure 10. The ice-breaker reception.

Sponsorship

The symposium was organized by IEEE Oceanic Engineering Society with the members of the local organizing committee from Singapore Chapter. The National University of Singapore was the host institution where the symposium was held. Kongsberg, Office of Naval Research (ONRG), Schmidt Ocean Institute, Larsen & Toubro and National University of Singapore were the patrons. Further, the event was supported by Singapore tourism board. We would like to express our sincere gratitude to all our patrons for their support.

Figure 11. Sponsors.

The Singapore Autonomous Underwater Vehicle Challenge (SAUVC) and workshop 2022: The 8th Edition

Hari Vishnu, Bharath Kalyan, Venugopalan Pallayil, Rajat Mishra With Inputs From SAUVC Organizing Committee, Photos Courtesy of Manu Ignatius and Hari

The 8th edition of SAUVC was organized from 23–26 September 2022 in the Singapore Polytechnic. Following in line with its consistent growth in previous editions, this edition was the largest ever in terms of team registration and second largest in terms of participation. This year saw 72 teams registering interest for the event, of which 49 teams participated by submitting videos of their AUVs as part of pre-qualification requirements. Of these, 25 teams made it into the event, which is lower than that in 2019. Some teams could not make it due to non-receipt of a travel-visa on time. Like the previous editions, we also had a student technical workshop on autonomous vehicles and sensing, and in addition, this time we also conducted an IEEE OES Distinguished lecture.

A highlight for this year was the endorsement from the UN Decade of Ocean sciences for the event. This underlined the importance and alignment of the event with the goals of this grand global movement, especially to 5 of its 10 challenges, and imprints IEEE OES's important role in the Decade as well. Another unique feature of this edition was that it followed the AUV Symposium held earlier in the week. The idea was that teams from SAUVC could benefit from participation in the symposium, and interactions with some of the marine robotics

experts who would stay back for the SAUVC event. This idea worked out well, and we had 2 student teams presenting papers in the AUV symposium, as well as several AUV symposium attendees staying on to witness the challenge and interact with the teams.

Participating Teams

The 72 teams that registered for the event had to prequalify for participation. The teams were required to submit a video of their AUV swimming underwater for at least 10 seconds and demonstrate the usage of their AUV's kill switch as part of the safety feature of their AUVs. Based on these criteria, 42 teams were selected to compete in the event. Of these, 25 teams made it to Singapore for the challenge. Student teams from more countries were expected to join as well, but many of the teams faced visa issues or funding issues, which stopped them from traveling to the event (notably, 9 teams from Bangladesh, Turkey, and Poland). Nevertheless, despite the travel, visa and funding issues faced in the post-covid era, it is impressive that so many teams made it and were able to participate. In total there were around 180 student participants at the event from 8 countries (India, Singapore, Indonesia, Malaysia, Turkey, Russia, Taiwan, Hong Kong). The representation of teams from across Asia, particularly from South-Asia & South-East Asia was phenomenal and shows the value that SAUVC brings to this region. There were many first-timers and some regulars in the participating teams. This was the first time we saw participation of teams from Turkey, and one of them was from a high-school, which made their presence even more impressive. We also saw visits from alumni of previous teams (notably, the team from China, which won in previous editions of the competition).

Teams setting up in the Singapore Polytechnic hall and interacting with the organizers.

Team from the home ground (Singapore Polytechnic) and teams interacting with visitors (John Potter from NTNU).

The Challenge

SAUVC 2022 was similar in tasks to the previous edition, in that it consisted of two tiers—qualification round and final round. To qualify, the AUV had to swim from the qualification starting line and pass through the qualification gate without surfacing, touching the bottom/wall or the qualification gate. The top 16 qualified teams, with the fastest time for the qualifying round, were allowed to advance to the final round. In the final round, the AUV would accumulate points by completing a series of tasks aimed at testing its acoustic and visual navigation capabilities, positioning, actuation and robotic manipulation. The table below provides the different functional capabilities of the AUV being tested and the related tasks.

No.	Task	Aspect of operation
1.	Passing through a gate, avoiding red flare	Navigation, Obstacle avoidance
2.	Locating a particular bucket amongst 4 options, and dropping a ball into it	Target acquisition and manipulation
3.	Moving out of the bucket arena, returning and reacquiring the ball dropped.	Target reacquisition and manipulation
4.	Bumping against a flare holding a ball to drop it (one with acoustic pinger, one without)	Acoustic/Visual Localisation
5.	Resurfacing at the end of the run	Controls

The introduction of the red flare in the first task, and the introduction of a decoy flare without an acoustic pinger in task number 4, were new additions in this year. This was to make sure the tasks were more challenging this year, thus progressively upgrading the challenge. Each task carried a certain number of points, depending on the challenge and the difficulty involved in performing it. There was also a timing bonus, and a bonus associated with weight and dimensions of the AUVs.

AUVs in action underwater.

Apart from this, the tasks were made more challenging through randomization of the position of the buckets, flare and gate and its orientation. A complete description of the tasks, static judging criteria and award of points are covered in the competition rule book available at https://sauvc.github.io/rulebook/.

Some judges of the Best innovative engineering award, beside the OES membership poster.

Teams deploying their AUVs at the competition.

SAUVC 2022 Award Winners

This year, the competition was wide open because the consistent champions from the last few editions, namely the team from Northwestern Polytechnical university (China) and Far Eastern Federal university (Russia) did not make it to the event, possibly due to Covid or visa-related issues. Instead, this time the winner was a debutant at SAUVC, namely the team from Turkey. The first runner-ups were the team from Bauman state Moscow technical university who were prize winners in 2019 as well, and the second runner-ups saw 2 teams from India and Indonesia (who have not won in previous editions). The top 4 teams in the finals were as follows:

1) ITU AUV from Istanbul Technical University, Turkey
2) Team Hydronautics from Bauman Moscow State Technical University, Russia
3) BIT-AUV from Bannari Amman Institute of Technology, India, and Tech_SAS from Telkom University, Indonesia.

In addition to the top 4 finalists, we also awarded the IEEE OES "most innovative engineering" award, which was constituted in 2019. This was judged by a technical panel consisting of 5 members. Innovation was defined as anything that is new/different and intentionally implemented for a specific stated purpose in SAUVC, with practically shown application. Based on the above criteria, the team from Bauman Moscow State Technical University, Russia, was awarded the OES "most innovative engineering" award.

First prize winner from Istanbul Technical University, Turkey.

First runner-up team from Bauman Moscow State Technical University, Russia, who also won the Best innovative engineering award.

Joint second-runner up from Bannari Amman Institute of Technology, India.

Joint second-runner up from Telkom University, Indonesia.

Gala Dinner & Award Ceremony

The event ended with a gala dinner on the 26th where the prizes were announced. This event gives the teams a chance to have their fist-pumping moment and celebrate, as well as have a relaxed networking session where they can interact with each other, as well as the organizers who are also from the underwater engineering community themselves (spanning academia, industry and defense sectors). The ceremony was held at the School of Design and Engineering, National University of Singapore. The spirited and exciting evening included a presentation of the participation certificates, as well as announcement of the winners. Some joyous moments and celebrations ensued, followed by long discussions that went well into the night.

Some moments of joyous celebrations.

Event Publicity and Social Outreach

As in previous events, the event has been well covered on social media. The event was also publicized via the ECOP programme's social media portal (e.g. https://twitter.com/OceanDecadeECOP/status/1572871356840120320 and https://twitter.com/sauvcsg/status/1574211781722898432), and flyers of the ECOP programme and OES Earthzine were distributed at the event. The event will be reported in the ECOP programme's newsletter as well, and in this sense, we established a good synergy between our event and the ECOP programme (ecopdecade.org/).

Summary of social media statistics for the event.

Specifically, our Twitter handle saw 81 tweets that made 11811 impressions over January to September. There were 6563 impressions in September alone, and 12800 profile visits. Instagram saw 5470 accounts reached in September alone, and 975 accounts who engaged with our profile. Facebook saw 7300 impressions in September alone, with 5200 engagements. The posts reached followers mainly from South Asia (Bangladesh, Pakistan, and India), Singapore, Thailand and Hong Kong. This year, we decided not to award the "Most viewed photo social media" prize in order to focus our efforts towards technical achievements, and given that our social media handles already had good visibility.

Student AUV Workshop

Following SAUVC 2022, a student workshop on autonomous vehicles and sensing technologies was organized on 26 March at the Singapore Polytechnic. The objective of the workshop was to complement the hands-on learning the students obtained during the competition, with talks and hands-on workshops on technologies related to marine robotics. Mentoring from expert

Mr. Manu Ignatius delivering the workshop on underwater communication.

student teams, and networking were the other objectives. This also goes hand-in-hand with outcomes #6 and #7, and challenges #9 and #10 of the UN Decade of Ocean Sciences, which has endorsed the SAUVC and the AMV workshop.

The chair of SAUVC 2022, Rajat Mishra, gave the welcome address followed by an introduction on IEEE OES membership by the OES Singapore Chapter chair. The workshop had 3 sessions covering 3 different aspects of marine vehicles, a precursor to introducing new tasks for future competitions and equip the participants with relevant knowledge:

1) Improving on the vehicle's capabilities by **learning from successful teams** on their approach towards robotics tasks such as vision, navigation, and sensing
2) Taking the robot's capability to the next level by introducing **underwater communication** into the picture
3) Learning on large-scale monitoring applications using a larger-scale counterpart of autonomous robots—sailboats

Towards this, we had:

1) A hands-on workshop on underwater communication, an important task that goes with marine robotics. The workshop was delivered by Manu Ignatius, CEO of Subnero, supported by Chinmay Pendharkar (CTO of Subnero). Teams were taught how to use basic tools and equipment for this, including via acoustics, optical methods and RF, using DIY sensor setups, cheap electronic equipment, and freely available software stacks such as UnetStack. Teams were shown an example of how they could use their laptop soundcard to transmit coded acoustic messages to other counterparts. The workshop was clearly very engaging, because pretty soon students were all sending acoustic messages to each other across the hall using these tools. The video of this workshop is available at https://www.youtube.com/watch?v=iu5tRlNhxdY&list=PLIdhGHLNlpMGSwMsZZJNzwnGbNg5l04Wp&index=1

Students and other participants happily debugging and 'communicating' at the workshop.

2) A sharing-session by Bumblebee, a previous SAUVC team that has been successful in other competitions, to guide existing teams on what they could do. Bumblebee shared information on their lessons learnt on sensing, navigation, and control, and shared specifics of the approaches they used on their current version of the vehicle. After the talk, workshop attendees interacted with Bumblebee while they described their vehicle, which was on display at the workshop, learning about its key features. A video of this talk is available at https://www.youtube.com/watch?v=lfundEfDwAQ&list=PLIdhGHLNlpMGSwMsZZJNzwnGbNg5l04Wp&index=4

Sharing session by Team Bumblebee from NUS.

3) Talk on the use of sailboats as a research monitoring platform: Dr. John Potter (designation) from NTNU, delivered an IEEE OES Distinguished Lecture talk on how sailboats can be used as research monitoring platforms, filling in a niche gap between autonomous robots and expensive large research vessels. The talk also saw good engagement

IEEE OES Distinguished Lecture by Dr. John Potter from NTNU.

from the audience. A video of this talk is available at https://www.youtube.com/watch?v=Mrh0vaEOaik&list=PLIdhGHLNlpMGSwMsZZJNzwnGbNg5l04Wp&index=2

The workshop was attended by 130 students and 20 non-students. Following the talks, there was a networking lunch session.

A networking lunch session.

Address by SAUVC Chair.

It is also noteworthy that this year, SAUVC students benefited from the presence of experts from the marine robotics community who stayed on after the AUV Symposium. SAUVC student teams were also present at the AUV Symposium, presenting papers on how they designed their AUVs, and the various lessons they learnt from it. In this sense, we delivered a good synergy between the 3 events (AUV Symposium, Singapore AUV challenge, and the student workshop), benefiting the student community with a well-rounded learning experience.

One of the student teams at SAUVC presenting at the symposium.

Sponsorship

IEEE OES has always been a regular supporter of SAUVC in terms of sponsorship. Apart from OES, SAUVC 2022 was sponsored by Mathworks, Kongsberg, Evologics, BlueRobotics, SubCTech, Nortek, IEEE Young Professionals, National University of Singapore and Office of Naval Research Global (ONRG). Some of these sponsors had supported us towards the 2020 event, which did not materialize, and thus the sponsorship funds were carried over to the 2022 event. SAUVC is run solely on sponsorship, and we would like to sincerely thank all our sponsors for their support. Additionally, this year, Kongsberg helped us out with 5 of their representatives attending the event and helping with judging during the qualifiers. Representatives from Kongsberg and ONRG also interacted with the teams.

Sponsors.

Concluding Remarks

SAUVC has been successfully organized for 8 consecutive editions now over 10 years. It is possibly the largest and most well represented autonomous underwater vehicle competition for students in Asia and Europe, and this year, the branding has taken one step forward with the endorsement from the Ocean Decade. Being an event that does not charge a blanket registration fee for teams to participate, it is impressive how much participation the event still garnered despite the post-Covid restrictions such as visa, travel and airline fees. Our no-registration policy is aimed at promoting fledgling teams to compete. IEEE OES membership drives were conducted as part of registration, as well as during the SAUVC workshop event. We believe the significant representation in terms of countries, number of students and diversity, is encouraging. We also have significant educational outreach—the teams benefit not only from the hands-on competition, but also from interactions with committee members and attending marine robotics experts who give them mentoring and advice. Furthermore, the student workshop on autonomous robotics and sensing, completes their learning cycle. This time as well, we saw teams helping each other out in achieving tasks such as acoustics, and we hope this collaborative nature and spirit of the challenge continues in future editions.

Video highlights of the first 3 days of the event:
https://www.youtube.com/watch?v=SQs1-rJd8Ao Day 1 (registration and setup)

https://www.youtube.com/watch?v=VS-W7J8bLH8 Day 2 (qualifiers)

https://www.youtube.com/watch?v=Tb71p32hGsA Day 3 (finals)

The Sixth IEEE OES Underwater Communications and Networking (UComms'22) Conference

João Alves (UComms 2012 General Chair, OES AdCom member)

Figure 1. Group photo of UComms 2022 participants.

Introduction

The sixth edition of the renowned Underwater Communications and Networking (UComms) conference was held from August 30th to September 1st in the coastal town of Lerici, in the Italian Riviera.

UComms is a biennial, international event organised by the NATO STO Centre for Maritime Research and Experimentation (CMRE) with the support of the IEEE Oceanic Engineering Society.

This conference series aims at gathering leading contributors in the field of underwater communications to discuss the latest developments, review the state-of-the-art and collectively find new ways ahead in the challenging world of underwater communications.

This edition marked 10 years since the first UComms was held in Sestri Levanti. Despite the climate of uncertainty, this commemorative edition of UComms was announced as an in-presence event. Following the cancellation of UComms'20 and on-line edition in 2021, this was a much-needed opportunity to re-connect with the community and spend time together for the first time in four years.

Just like in 2018 (the previous in-person edition), this 10-year anniversary took place at the charming Villa Marigola congress centre, a traditional venue for CMRE conferences and a place that continues to please the attendees with its spectacular views and elegant environment.

Topics Covered and Conference Format

With the increased interest in better understanding the Oceans, as well as explore and protect the resources they host, we have seen a similar increase in the demand for technological tools to help with the job.

This has driven the interest in underwater communications as a fundamental enabler to many of the technological solutions on offer. Autonomous vehicles, moored sensors or seabed installations, employed in coastal or deep waters, benefit from underwater communications as an enabler for collaborative autonomy, real-time monitoring, and data fusion.

The physics limitations presented by the underwater domain (which severely impair the usage of optical and electromagnetic radio frequencies) have naturally driven the work on acoustics for applications requiring communication ranges of more than a few tens of meters.

Working with underwater acoustics to establish communications, networks and communication-related services presents fundamental challenges imposed by the physics limitations of pressure waves travelling through water. From high latency to reduced available bandwidth and dependencies on parameters like water temperature and salinity, direct translations from the terrestrial domain are simply not an option.

For these reasons, several sub-domains of interest within the field of underwater communications have naturally established themselves and cover topics such as channel characterization, waveform design, transceiver topologies, networking strategies and security approaches, to name a few.

The UComms conference series aims at discussing all these topics and adopted a format where a series of structured sessions are coordinated by established researchers in the field. Session coordination involves overview of the submission process from invitation of contributions to acceptance decision

with the aim of gathering top quality contributions that can lead to a vibrant exchange of knowledge and increased common understanding of the state-of-the-art.

During the conference, the multiple sessions are handled in a single track, giving the opportunity to all participants to follow all the talks and take part in all discussions.

The UComms'22 call for papers was answered by 41 submissions and after a very strict review process (where each final paper was independently and blindly reviewed by at least three reviewers), 32 were invited for presentation, of which 31 were eventually presented.

Figure 2. View from the charming conference room of the Villa Marigola congress facility.

The technical program of UComms'22 was presented around the following sessions:

- "Physical layer: Propagation, Modulation and Signal Processing" (Hosted by François Socheleau & Konstantinos Pelekanakis), which tackled all aspects of the acoustic communications physical layer, from acoustic propagation to channel equalisation and signal modulation.
- "New Applications Enabled by Next-Generation Underwater Communications" (Hosted by Georgios Sklivanitis and Roberto Petroccia) that looked at interesting new use cases for underwater communications exposing a wide range of communication requirements from an end-user point of view.
- "Underwater Communications Security" (Hosted by Paolo Casari and Roald Otnes) addressed the issues related with data protection and confidentiality of communications in the underwater domain.
- "Optical and Quantum Communications" (Hosted by Norm Farr and Pietro Paglierani) explored the topic of classical optical and Quantum-enabled communications techniques.
- "Adaptive Modem Architectures and Smart Networking Strategies" (Hosted by Henry Dol and Koen Blom) gathered contributions on the development of adaptive communications and machine-learning techniques to improve performance of underwater communications.

In addition to the regular technical contributions, we had the privilege to host three distinguished keynote speakers who delivered fantastic talks on their specific fields of expertise.

Prof. Andrew Singer (Uni. Of Illinois) kicked off the technical program of UComms with his keynote address titled "Underwater Communications Over Many Media and Scales (UCOMMS)" where he presented innovative and unique usages for underwater communications including inside the human body.

Figure 3. Prof. Andrew Singer during his invited talk.

On the second day of conference, Prof. Davide Bacco (Uni. Of Florence) addressed the audience on "How Can Quantum Technologies Change Our Business In Underwater Comms?", providing his expert view on this emerging topic.

For the closure day, the keynote talk was delivered by Prof. Mandar Chitre (NUS Singapore, OES JOE EiC). The title was "Can Machines Learn to Communicate Underwater?" and offered fascinating and very concrete approaches on the usage of machine learning to improve underwater communications,

Eighty-five delegates registered and attended UComms 2022, representing institutions from 16 different countries. As in previous years, generous breaks between sessions provided enhanced networking opportunities.

All papers presented at UComms'22 can already be found in IEEE Xplore. We invite everyone to browse through them, get updated on the latest of underwater communications and find a (little) bit of what UComms is about.

A Special Issue of the IEEE Journal of Oceanic Engineering, with expanded versions of selected papers presented during UComms will be prepared as for previous editions.

During the social dinner held at the closure of the conference, the Local Organising Committee was presented with a commemorative plaque from the OES in appreciation for 10 years of outstanding conferences and JOE special issues." This was a particularly proud moment for those that have been involved in the organisation of the conference series since 2012.

Besides the IEEE OES sponsorship, the 2022 edition of UComms had patron support by the following commercial and non-commercial institutions: NATO Allied Command Transformation (ACT), ONR/ONR-Global, ATLAS Elektronik, Popoto Modem, and Thales UK.

Over the years some important lessons have been identified and learnt in the process of setting up such type of conference. We believe some of those lessons could be of use for other similar events, namely:

- UComms contributions follow a strict 4-page format (plus references). In our experience this contributes to a more concise manuscript and helps the reviewing process. The "short paper" format also plays to the authors advantage when considering an extension into full article for JOE submission.
- All pre-print versions of the manuscripts are shared with registered delegates (secure link, password protected and available to registered delegates only) one week before the conference starts. This has shown to considerably improve the quality of discussions by giving participants an opportunity to read the manuscripts before the presentation.
- The presentation slot includes 10 minutes of Q&A moderated by the session organisers, which has proven to be a great contribution for the overall value of the event.
- The abstract sections of all manuscripts are openly shared in the conference website in a compiled "Book of abstracts," increasing awareness and interest in the conference technical content.

Figure 4. Prof. Mandar Chitre during his invited talk.

Participant Feedback

A key aspect of shaping UComms is collecting feedback from participants. Just like in previous editions, an anonymous online survey was conducted to which 57 participants kindly responded.

The responses collected show us that:

- 98% of participants were either "extremely satisfied" or "very satisfied" with the conference. One participant declared to being "neither satisfied nor unsatisfied."
- 98% found the technical content to be either "very strong" or "strong."
- 91% found the networking opportunities to be "extremely useful" or "very useful."
- In terms of location, 51% prefer to keep the conference in Lerici again while 21% favor a rotating location. 13% voted to keep it in Europe while 9% voted to move it around in Italy.
- Concerning format, schedule and periodicity, the vast majority agrees with keeping it a biennial event, single track, with 25 minutes per presentation to accommodate discussions over 3 days.

Future UComms Conferences

Following the encouraging feedback from authors, participants and sponsors, we will, with no doubt, aim at continuing to organize UComms.

Several institutions from different locations in the world have expressed the willingness to host UComms in the future. This is certainly appealing as a possible way to maintain vitality of the conference series. No decisions have been made and we are certainly conscious of the participants feedback discussed above.

In any case, the aim will remain to organize an event where the leading scholars and practitioners want to be. For this to happen, technical quality needs to remain the central focus. Additionally, we are well aware of the importance of creating a relaxed, pleasant and collegial environment where open discussions can create the sparks of change. Good hospitality will always be important for UComms.

See you in 2024!

Figure 5. The OES VP for Workshops and Symposia hands a commemorative plaque to the UComms Organising Committee marking 10 years of successful conferences and JOE Special Issues.

IEEE MetroSea 2022

Pasquale Daponte, IEEE MetroSea2022 General Chairman,
Maurizio Migliaccio, IEEE OES Italy Chapter Chairman

IEEE MetroSea 2022 was the first edition in person after the Covid-19 editions. It was held in Milazzo, Messina, Italy, on October 3–5, 2022. For the first time this conference was endorsed by the IEEE OES Society and the IEEE OES Italy Chapter.

Milazzo, located north-east of Sicily, not far from the city of Messina, was a wonderful place to meet in person again.

The conference venue was the ancient castle of Milazzo. It is located on the summit of a hill overlooking the town, on a site first fortified in the Neolithic era. The Greeks modified it into an acropolis, and it was later enlarged into a castrum by the Romans and Byzantines. The Normans built a castle, which was further modified and enlarged during the Medieval and Early Modern periods. In Fig.1 a castle picture is shown, while in Fig.2 the view from the castle with a view of the Aeolian islands is shown. From the castle it was possible to admire the Etna volcano on one side and the Aeolian islands on the other side.

Figure 1. The Castle of Milazzo, Messina, Sicily, Italy.

The conference accepted papers were 118, with a number of international registered attendees equal to 112. All articles submitted to IEEE MetroSea 2022, that have been accepted in a peer-reviewed process, will be submitted for publication on IEEE Xplore Digital Library.

The Conference included 23 oral sessions, 1 poster session. Further, the conference schedule incorporates 3 keynote talks and 2 tutorials. The keynotes were held by the speakers: Laura Giuliano, Director of Science, CIESM—Mediterranean Science Commission; Franc Dimc, Faculty of Maritime Studies and Transport, University of Ljubljana, Slovenia; and Aimé Lay-Ekuakille, University of Salento, Italy. During the conference 2 tutorials were also held, one by Adam Gauci, University of Malta, Malta, and the other by Paolo Favali and Francesco Italiano, INGV, Istituto Nazionale di Geofisica e Vulcanologia, Italy.

The three keynotes were particularly appreciated and outstanding. Laura Giuliano, made a keynote on "Measuring Marine Life—across (and beyond) paradigms" (Fig.3), Franc Dimc, made a keynote on "Observations of vessels and human actions at Port of Koper approach" and, Aimé Lay-Ekuakille lectured on "The EU BAT constraints on the measurement systems for industrial wastewater treatments: quality and quantity for discharging into the sea."

The two tutorials were about "Satellite Derived Bathymetry," the one held by Adam Gauci (see Fig.4), and "Seafloor interdisciplinary observatories: a global vision for monitoring underwater processes, and submarine active volcanoes by technological enhancement and new scientific results," the one held by Paolo Favali and Francesco Italiano.

Because of the great success of the Conference, the three days format had to organize multiple sessions in parallel, generally four, to accommodate the oral presentations. Although

Figure 2. The view from the castle toward the Aeolian islands.

Figure 3. Laura Giuliano while lecturing.

most of the sessions were about technologies to observe the sea, e.g., satellite and drone remote sensing, in situ infrastructures, several papers were about artificial intelligence and machine learning to analyze sea measurements. Some sessions and papers were mostly focused on marine habitats and species also in connections with polluting events.

Further, some special events, jointly organized with Armed Forces Communications and Electronics Association (AFCEA), were held during the conference focusing on defense applications, see Fig.5.

In Fig.6, Ferdinando Nunziata, presenting his remote sensing contribute about satellite Synthetic Aperture Radar monitoring of sea oil spill, is shown.

In Fig.7 a session picture is also shown.

The social events were excellent and organized with great care and professionality. On 3 October, a welcome party was hosted on board the Italian Navy vessel VEGA, see Fig.8 and 9.

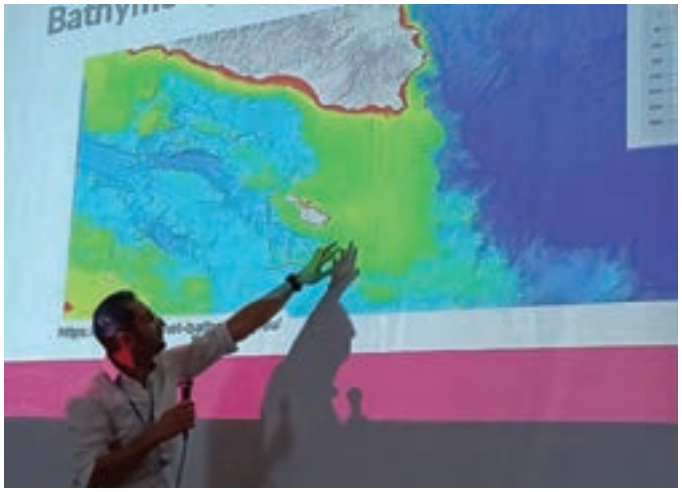


Figure 4. Adam Gauci, University of Malta, Malta, presenting his tutorial.

Figure 5. About the MetroSea 2022 sessions jointly organized with AFCEA.

Figure 6. Ferdinando Nunziata of University of Naples "Parthenope" while presenting his paper.

Figure 7. A lively session at MetroSea 2022.

Figure 8. About the welcome party on board the Italian Navy VEGA vessel.

Figure 9. A final picture with Prof. Pasquale Daponte, in the center, with Italian Air Force Gen. (r) Giovanni Savoldelli Pedrocchi, Chair of AFCEA Chapter of Naples, and some Italian Navy Officers.

Figure 10. The organizing Committee.

The gala dinner was held on 4 October at the wonderful Villa Hera.

The IEEE MetroSea 2022 was jointly organized by Pasquale Daponte, University of Sannio, Italy, Nicola Donato and Giovanni Randazzo, University of Messina, Italy, (see Fig.10). All participants must thank them for the successful effort to bring such a magnificent piece of Italy to a large, lively scientific community that had the chance to exchange their different point of views on the common interest: the sea!

Next year the IEEE MetroSea will be held in Malta, we all wait for you!

The University of Tokyo is delighted to welcome international experts for the International Symposium on Underwater Technology (UT23). UT23 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.

Conference Scope

Environmental Monitoring, Marine Robotics, Marine Mineral Resources Renewable Energy, Marine Construction, Observatory and Disaster Mitigation Fishery Engineering, Acoustics and Communications, Sensors
Special Topic: Remote Observation and Cloud Computing

Important Dates

Abstracts submission page open: April, 2022
Deadline for Abstract Submission: September 30, 2022 (extended)
Notification of Acceptance: **October 28, 2022 (revised)**
Deadline for Paper Submission: December 19, 2022 (revised)
Deadline for Early Registration: January 20, 2023
Symposium Dates: March 6 - 9, 2023

Organizers

IEEE Oceanic Engineering Society (IEEE/OES)
IEEE/OES Japan Chapter
Institute of Industrial Science (IIS), the University of Tokyo
Earthquake Research Institute (ERI), the University of Tokyo

Exhibition Opportunities

In conjunction with UT23, there will be a limited number of booths for technical exhibition. We hope you would take this opportunity to display your products at the symposium. There are also opportunities for supporting the symposium. For more information, please contact the secretariat at info@ut23.org

For more information about UT23, please contact:

UT23 Secretariat: info@ut23.org

A Blast from the Past! … Remembering Claude Brancart

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

Unfortunately, we have to again report on the passing of one of our highly involved and distinguished members—Claude Brancart. A detailed article is provided in this issue that addresses his professional and society activities. The following photos highlight some of his society activities. RIP.

OCEANS 2005 Distinguished Service Award.

OCEANS 2007 Aberdeen.

OCEANS 2005 Brest—on LaCouvrance.

OCEANS '2004 Kobe AdCom.

Dan Schwartz, Claude Brancart, John Watson & Howard Roe, OCEANS 2004 Kobe—Cheers.

Navy, NASA, NOAA Strengthen Present, Future OCEANS 22 Coastal Resilience Impact

Jeremy Roman, NSWC PCD Public Affairs

Note: The following OCEANS 2022 Hampton Roads report, including photos, is from the NSWC PCD Public Affairs.

Exhibits ribbon cutting.

VIRGINIA BEACH, Va.—Nearly 1,600 attendees, professionals, and students from more than 30 countries were treated to cutting-edge science, technology and innovation at the OCEANS 2022 Hampton Roads Conference and Exposition, Oct. 17–20.

Standing room only at the opening Plenary.

OCEANS 2022 converged technical expertise between the U.S. Navy, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA) and various professional organizations, with a region characterized for its significant federal and maritime technological activity.

The conference, entitled "Resilient Coasts: Adapting Today to Secure Tomorrow," featured plenary speakers and panels, nearly 500 technical paper presentations, a student poster competition and a global network of more than 100 exhibition booths.

U.S. Senator Tim Kaine addressed the Plenary I audience.

Plenary II Panel on Ocean Technologies.

Dr. Dan Sternlicht, Naval Surface Warfare Center Panama City Division (NSWC PCD) distinguished scientist for littoral sensing technologies, was one of the conference's general co-chairs.

"OCEANS is the premier marine technology and ocean engineering conference and since 1979, has evolved through

Conference Co-Chair Dr. Dan Sternlicht.

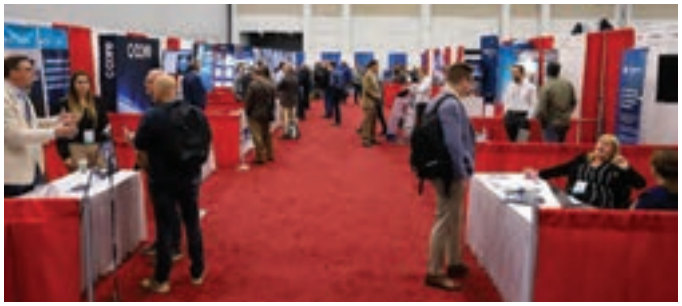
joint leadership of the Marine Technology Society and the Institute of Electrical and Electronics Engineers Oceanic Engineering Society to serve our defense, commercial, government, and academic constituents," said Sternlicht. "The growth of our young ocean science professionals is also of highest priority, with the Office of Naval Research supporting the student poster competition. This conference facilitates bringing scientific, research and development, regulatory, policy, innovation, and commercial technologies into industry and public awareness, and fosters good stewardship of the oceans and the Earth's water resources."

OCEANS 2022 was also historic as it accomplished several firsts. On Dec. 5, 2017, the United Nations proclaimed a Decade of Ocean Science for Sustainable Development, to be held from 2021 to 2030, to provide a common framework to ensure that ocean science can fully support countries' actions to sustainably manage the oceans and ensure the lasting protection of the planet and its natural resources. Serving as an international forum, OCEANS 2022 was the beginning of that support. Additionally, both the Navy and NASA helped to co-chair this conference in a combined effort with NOAA for the first time ever.

NSWC PCD played a prominent role in Navy representation by providing various support to include committee organization and coordination, providing plenary speakers and panelists, technical session chairpersons, photo support and human resources personnel to speak with the next generation of oceanic scientists and engineers.

Dr. Peter Adair, NSWC PCD technical director and one of the plenary speakers, shared why Panama City brought such a large presence. "As a Navy Lab, it's important to attend conferences like OCEANS 22 since we are all about innovation, diversity of thought and learning about different technical perspectives. We have our internationally recognized experts here so having the ability to foster relationships with our technical peers and bring that shared knowledge back to apply to our mission areas is key, while we also become better recognized as the leader in the littoral battlespace," said Adair. "Anecdotally, our representation here has some historical perspective as Panama City hosted the first OCEAN [as it was called then] conference over 50 years ago."

Technical Sessions were well attended.



Canadian Pavilion in the Exhibit Hall.

In 1970, NSWC PCD, known then as the U.S. Navy Mine Defense Laboratory, held the inaugural OCEAN conference in Panama City, Fla., where the Navy Lab's history was tied to the OCEANS legacy. Ray Toll, OCEANS 2022 co-chair, shared how the Navy impacted the entire event.

Conference Co-Chair Ray Toll.

"As a retired U.S. Navy captain, I was most proud of how the Navy engaged in this conference. Led by Dr. Marty Irvine [Executive Director, Submarine Forces and OCEANS 2022 honorary chair], Dr. Adair, and Dr. Sternlicht, this unprecedented conference brought the unique skills and intellectual capital of the Navy's ocean science professionals to Hampton Roads," said Toll. "NSWC PCD's involvement brought in the Naval Sea Systems Command network and Submarine Force Atlantic Fleet, combining that with NASA [co-chair Laura Rogers] and NOAA provided a holistic government presence. It really was quite impressive and appreciated by all, including U.S. Virginia Senator Tim Kaine."

Two OCEANS conferences are slated for 2023. OCEANS 2023 Limerick, Ireland, June 5–8, and OCEANS 2023 Gulf Coast, Miss., September 25–28.

Conference Co-Chair Laura Rogers.

The Student Poster Competition at OCEANS 2022 Hampton Roads

Dr. Shyam Madhusudhana, OES Student Poster Competition Chair
Photo credits: Jhon Bermudez and Stan Chamberlain

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

Deviating slightly from convention, the Hampton Roads Local Organizing Committee's (LOC) SPC Chairs Robert Heitsenrether and Eric Breuer bravely took on a gargantuan task of inviting a larger pool of candidates to the Competition. Out of 84 submissions received, 27 abstracts were shortlisted for the final program. Of these, 4 students participated virtually. It was very satisfying to see so many participants attend the event in-person. While we had a large faction of participants from the USA (16), there was a good spread of global participation, with 2 students from each of Australia and Portugal, and 1 each from Canada, China, Israel, Italy, Japan, Norway, and Sweden. Kudos to the LOC SPC Chairs for brilliantly managing the increased workload. The poster sessions were very well attended, and the students seemed to have enjoyed their time at the conference. We had a panel of 9 judges that generously offered their time, speaking to each participant and scoring their posters. We are grateful for their support. The awards ceremony was held prior to the exhibitors' luncheon on the final day of the conference. Participation certificates and winning prizes were handed out by the LOC OCEANS co-Chairs Ray Toll and Laura Rogers along with the sponsoring societies' Presidents Christopher Whitt (OES) and Zdenka Willis (MTS).

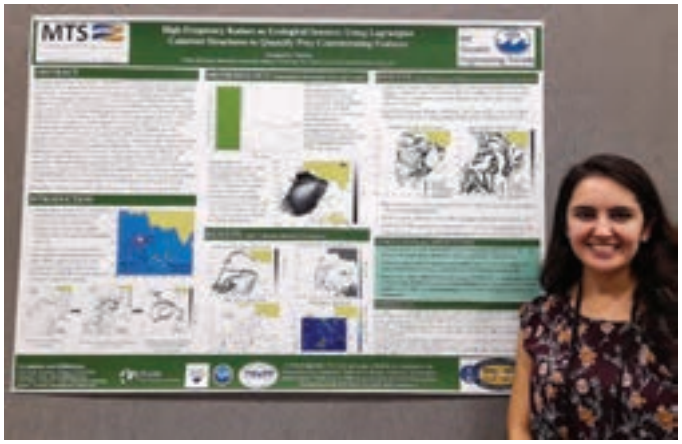
Poster sessions were well-attended on all days (top) and so was the awards ceremony (bottom).

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

At this edition of the SPC, in addition to awarding prize money to the 1st prize winner, the OES also offered to provide support for travel and registration (up to US$3000) to participate in any of the OES-sponsored conferences in 2023 (including OCEANS). This additional award is aimed to encourage the student to continue to remain engaged with OES' activities. The student would have an opportunity to contribute to the chosen conference by being a judge in the SPC, by chairing a session and/or other relevant activities identified by the conference's LOC.

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 $ 3000)
Jacquelyn Veatch, Rutgers University, USA, *High Frequency Radars as Ecological Sensors: Using Lagrangian Coherent Structures to Quantify Prey Concentrating Features*

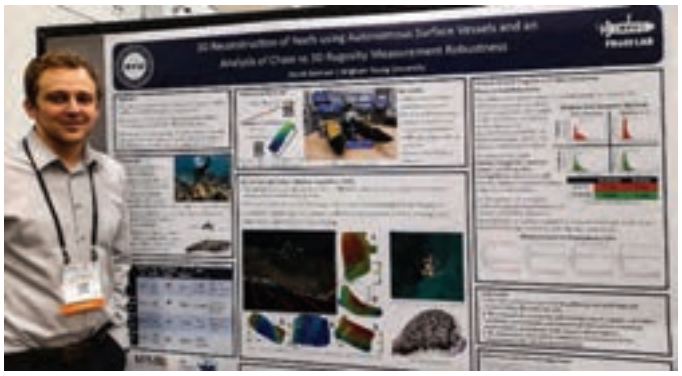


Abstract—Food resources in marine food webs are often concentrated into patches within biological hotspots, separated by large expanses of barren ocean. Inhomogeneous, or "patchy" distribution of plankton is in part due to mesoscale and submesoscale oceanographic features transporting and locally concentrating plankton. Concentrations of plankton at the base of the food web increase prey availability for intermediate and upper trophic levels creating productive regions known as biological hotspots. Submesoscale oceanographic features within coastal biological hotspots occur at spatiotemporal scales that can be resolved by coastal High Frequency Radars (HFR). To identify areas with enhanced passive particle (plankton) transport and concentration, four popular mathematical techniques known as Coherent Structure Analyses (CSA) are applied to HFR observed ocean surface currents. Each CSA technique quantifies the stretching (pulling drifters apart) and shrinking (pushing drifters together) of the flow, yet each has its own unique calculation of "stretching" and "shrinking." All four CSA have been applied to ocean datasets in previous studies, however results from the four techniques have not been compared and evaluated as valid ecological metrics in energetic coastal flows. The following study will bring clarity to what makes each type of coherent structure differ from the others when applied to plankton transport and concentration in a coastal marine ecosystem. Results show some coherent structures define boarders of transport while others define centers of attraction. The following study uses HFR observed surface currents around a known biological hotspot, Palmer Deep Antarctica to quantify prey concentrating ocean features, and describe their ecological significance by comparing them to biological observations. Transport features quantified by CSA have the potential to be transport hubs, delivering and concentrating constant supplies of plankton. Results have the potential to inform the identification of prey concentrating features in larger, more complex food webs, and expand the use of coastal HFR data.

Second Prize (Certificate and $2000)
Cameron Smith (virtual), US Naval Academy, USA, *Design and Development of a Bioinspired Lateral Line Sensor for Uncrewed Underwater Vehicle Operations*

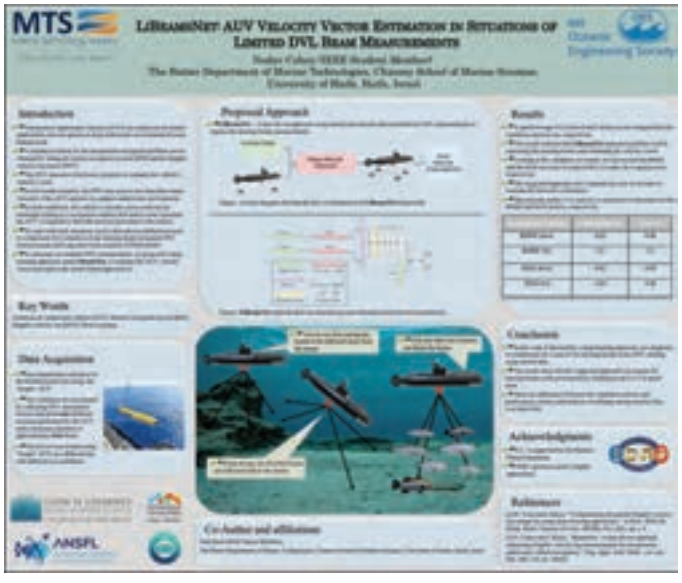
Abstract—Fish have developed unique anatomies and capabilities to thrive in a dynamic undersea environment. One such biological feature is a lateral line organ, which allows a fish to detect skin-surface pressure differences caused by the wakes of upstream objects. By understanding its incident and surrounding fluid flow-field, a fish can swim more efficiently. This paper presents the design and development of an engineered sensory system with similar capabilities to a natural lateral line. The artificial lateral line was constructed using an array of commercial off-the-shelf pressure sensors and an additively-manufactured housing. A series of experiments were performed in a recirculating water tunnel at the United States Naval Academy using a pair of upstream articulating hydrofoils, demonstrating the ability of the sensors to detect both flapping frequency and a distinct relationship between frequency and phase offset. These in-water trials broadly revealed the system's potential to characterize vortex wakes in a manner similar to fish. Ultimately, the results demonstrate the functionality of a low-cost sensory system architecture capable of being integrated into an uncrewed underwater vehicle, significantly benefiting applied biomimetic research in the undersea domain.

Third Prize (Certificate and $1000)
Derek Benham, Brigham Young University, USA, *3D Reconstruction of Reefs using Autonomous Surface Vessels and an Analysis of Chain vs 3D Rugosity Measurement Robustness*



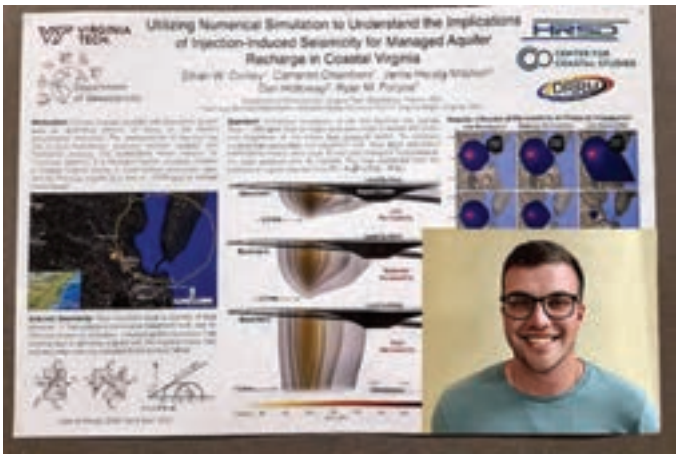
Abstract—Coral reefs are at risk. To study and minimize the impacts of global warming, pollution, or land sediment disposition on the reef, regular and accurate measurements are needed to assess the coral's health. We present a method of using surface vessels to autonomously collect GPS tagged images to be used in creating a 3D model of the reef which we tested in Molokai, Hawaii. We also discuss the shortcomings of chain rugosity measurements (the longtime standard for categorizing reef health) and how surface complexity measurements, a metric only obtained from creating 3D models from imagery are less subject to these flaws.

Nadav Cohen (virtual), University of Haifa, Israel, *LiBeamsNet: AUV Velocity Vector Estimation in Situations of Limited DVL Beam Measurements*



Abstract—Autonomous underwater vehicles (AUVs) are employed for marine applications and can operate in deep underwater environments beyond human reach. A standard solution for the autonomous navigation problem can be obtained by fusing the inertial navigation system and the Doppler velocity log sensor (DVL). The latter measures four beam velocities to estimate the vehicle's velocity vector. In real-world scenarios, the DVL may receive less than three beam velocities if the AUV operates in complex underwater environments. In such conditions, the vehicle's velocity vector could not be estimated leading to a navigation solution drift and in some situations the AUV is required to abort the mission and return to the surface. To circumvent such a situation, in this paper we propose a deep learning framework, LiBeamsNet, that utilizes the inertial data and the partial beam velocities to regress the missing beams in two missing beams scenarios. Once all the beams are obtained, the vehicle's velocity vector can be estimated. The approach performance was validated by sea experiments in the Mediterranean Sea. The results show up to 7.2 % speed error in the vehicle's velocity vector estimation in a scenario that otherwise could not provide an estimate.

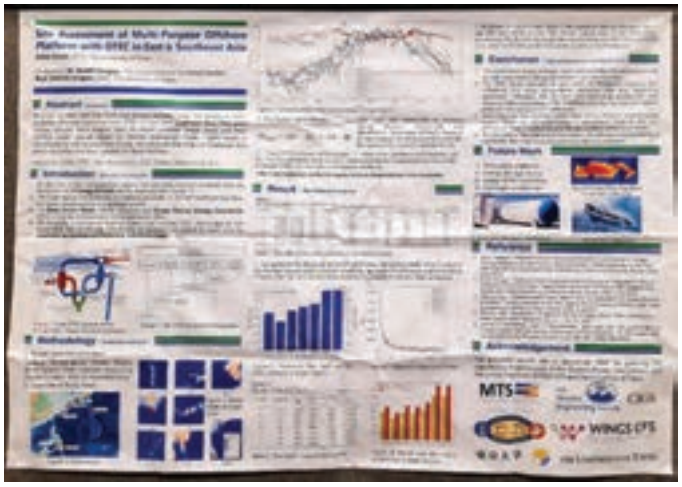
Ethan Conley, Virginia Tech, USA, *Utilizing Numerical Simulation to Understand the Implications of Injection-Induced Seismicity for Managed Aquifer Recharge in Coastal Virginia*



Abstract—As demand for freshwater increases in coastal Virginia, overpumping of the Potomac Aquifer has led to accelerating land subsidence, declining groundwater levels, and saltwater intrusion. To slow these deleterious effects, the Hampton Roads Sanitation District is developing the Sustainable Water Initiative for Tomorrow (SWIFT) project to replenish the Potomac Aquifer through a network of up to five managed aquifer recharge facilities in southeast Virginia. Large-scale fluid injections into deep geologic formations have a well-documented history of causing earthquakes, particularly in the energy sector; however, there has yet to be a demonstrable connection between managed aquifer recharge and injection-induced seismicity. Nevertheless, the SWIFT project is unique because target aquifer lies unconformably above the crystalline basement rock, where pre-existing basement faults may occur. Although the Virginia Coastal Plain does not generally experience natural earthquakes, fluid injections from large scale aquifer recharge may produce sufficient fluid pressure to induce seismicity, if critically-stressed and optimally oriented faults exist within the deep basement rock below the Virginia

Coastal Plain. While the presence of such faults remains unknown, this study is designed to estimate the extent and depth to which injection-induced pressure transients may travel during MAR injections at the James River Wastewater Treatment Plant, which is scheduled to come online in 2026. Results from numerical simulation show that (i) injection-induced pressure transients in excess of 40 kPa may reach depths of ~3 km and (ii) basement rock permeability largely imposes first-order control on the depth and extent of injection-induced fluid pressure propagation.

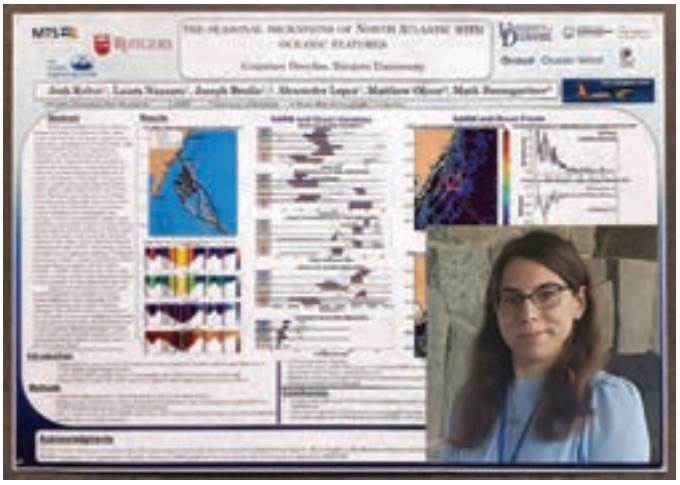
Yutian Ding, The University of Tokyo, Japan, *Site assessment of multi-purpose offshore platform with OTEC in East and Southeast Asia*



Abstract—In order to deal with the food and energy security issue, we design a multi-purpose offshore platforms with OTEC in East and Southeast Asia. This work utilizes Google Earth Engine (GEE) to assess possible target areas and then identify seven typical region for further evaluation. Triple I light index is introduced for site assessment. Finally, we conclude that tropical Southeast Asia performs better and thus suitable for these facilities.

Courtney Dreyfus, Rutgers University, USA, *Aligning the seasonal migrations of North Atlantic Right Whales with oceanic features*

Abstract—While baleen whales have been migrating through the oceans for millions of years, more recent human activity has heavily impacted their populations. The population of North Atlantic right whales (NARW) has been in rapid decline compared to other baleen whale species. To counteract this, there has been a recent push in science and conservation to understand how the ocean environment influences the behaviors of whales. The purpose of this study is to see how oceanic features factor in the migratory patterns North Atlantic right whales off the coast of New Jersey. The study was conducted in an offshore wind lease area off the south coast of New Jersey as part of the ECO-PAM Project. Autonomous vehicles equipped with oceanographic and ecological sensors simultaneously mapped whale detections in the context of physical



ocean features. Results indicate that the presence of NARW begins near the New Jersey coast in late fall, transitions offshore in the winter, with no detections between mid-spring through mid-fall. Our findings indicate that there was no significant difference in observed temperature, salinity, oxygen concentration, density and chlorophyll in regions with and without NARWs. NARWs were found more often in the vicinity of strong cceanic fronts delineating regions of large gradients in ocean temperature and color.

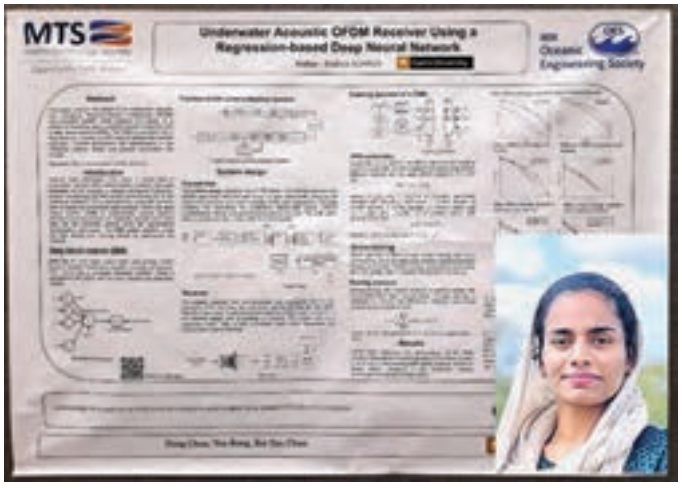
Analysis from the gliders, acoustics, and satellites highlights the potential for oceanic feature mapping to better understand NARW migration pathways and conduct mitigation strategies. This research serves as an example of the new insight gained when integrating concurrent oceanic and ecological data, and demonstrates how dynamic mapping through autonomous systems could support whale-friendly maritime activity in and around planned offshore wind lease areas in the Mid Atlantic Bight.

Elias Erstorp, KTH Royal Institute of Technology, Sweden, *Experimental Results of a k-Nearest Neighbor Power Level Controller for Flooding-based Underwater Networks*

Abstract—Systems of heterogeneous underwater vehicles and sensor platforms are being used in various applications. Although these systems are still deployed at a relatively small scale, rapid technological development is in progress, and a significant impact of these systems is approaching. To a large

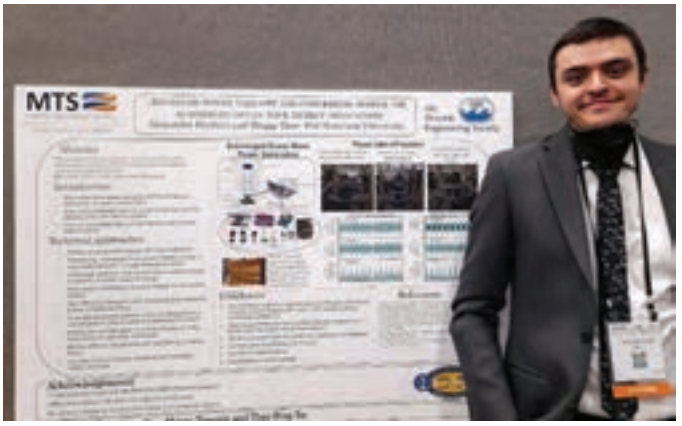
degree, this is driven by a desire to utilize the oceans for sustainable food, energy, and environmental monitoring. Vehicles and platforms in these systems communicate wirelessly using acoustic signals due to the limited range of radio signals. To form underwater networks, the systems must communicate at the same frequency range and use common network protocols. Flooding-type network protocols are easy to implement, robust, and can serve as a baseline for heterogeneous networks. Here, a transmission power controller used in conjunction with a flooding protocol is examined. Results show a great reduction in transmission power and potential for significant energy savings.

Sabna Hassan, Curtin University, Australia, *Underwater Acoustic OFDM Receiver Using a Regression-based Deep Neural Network*



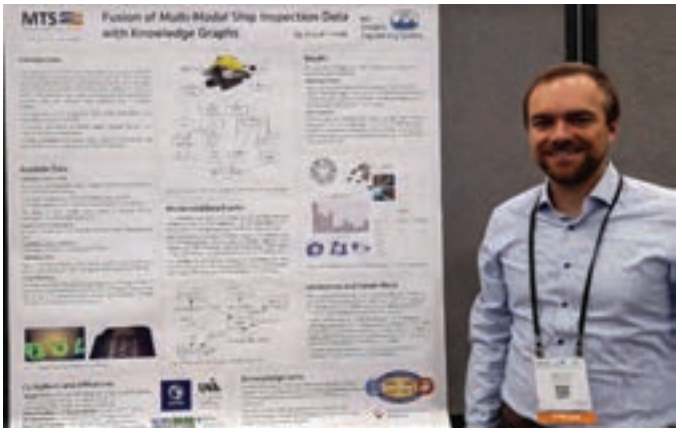
Abstract—The orthogonal frequency-division multiplexing (OFDM) technology is a promising technology for many scenarios in underwater acoustic (UA) communications. This paper presents the design of a UA OFDM communication system, which explains the design of a traditional transmitter and a modified receiver integrated with a deep neural network (DNN). The DNN is proposed to replace the channel estimation, channel equalization and demodulation in the traditional receiver design and recover transmitted bits directly. The regression-based DNN consists of a long short-term memory (LSTM) layer. The training stage of the DNN can be either offline or online. During the testing stage, the trained network is used to recover online transmitted data directly. The offline training method is performed with maximum possible channel scenarios with a large data set. Meanwhile, the online training uses a small data set with short training time. The designed regression-based DNN receiver achieves a better performance compared to previously developed DNN receivers and the traditional receiver which is implemented with the least-squares (LS) estimator.

Alexander Hatfield, Old Dominion University, USA, *Advanced Power Take-off and Conversion System for Submerged Ocean Wave Energy Convertors*



Abstract—Today, unmanned undersea vehicles (UUVs) are taking an increased number of U.S. Navy mission roles. These vehicles will most likely be launched within a large distance from its assigned mission area. At times it may be desirable for these vehicles to loiter and await tasking. One of the major limiting factors for these UUV activities is endurance. Currently, UUVs are limited to the range provided by one single battery charge. However, a reliable and renewable power resource to charge the battery trays is a big challenge issue for the U.S. Navy. Which is why the U.S. Navy is interested in developing a renewable seabed power source that will allow UUVs to charge while deployed and remain undetected. UUVs are generally far away from terrestrial power with no power source available to charge a battery. A covert, submerged, renewable power source that utilizes wave energy, wind, solar, temperature differences, etc., to charge a submerged power center is highly desirable. Working with the Navy Science Advisor, we obtained the requirements for a typical UUVs battery, which includes i) the high-charge-rate for two battery trays has about ~11 kWh, ii) takes about 7 hours to charge from 0 to 100 percent, iii) the charge voltage is 32VDC, iv) and the power charge station is preferably located on ocean bed, which is typically under 60 meters of ocean water surface.

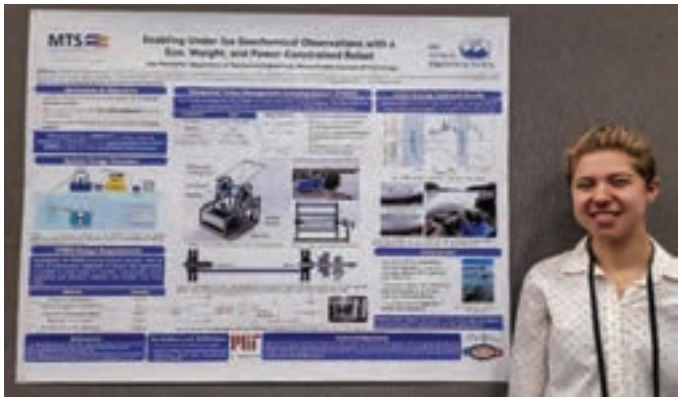
Joseph Hirsch, SINTEF AS, Norway, *Fusion of Multi-Modal Underwater Ship Inspection Data with Knowledge Graphs*



Abstract—With recent advances in underwater inspections of ships with remote sensing technologies the need for

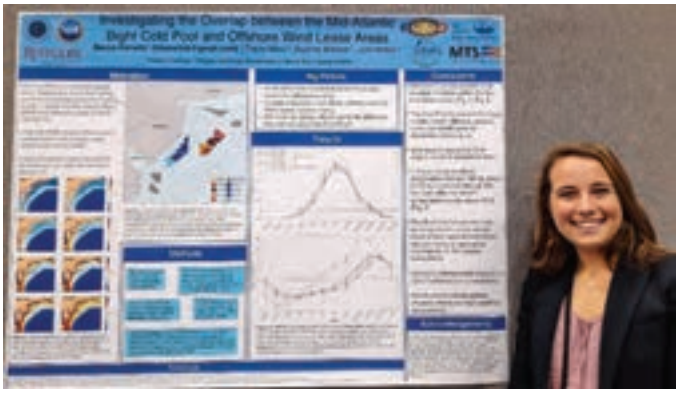
automated data annotations and analysis becomes apparent. During underwater ship inspections, various data such as video, positioning information, and other telemetry data are collected and combined with the results of computer vision models. The variability in the modalities of data makes the automatic analysis across multiple data sources challenging. We propose the use of a Knowledge Graph in combination with industry standards in the ship inspection domain for the taxonomy. This enables automated data analysis for underwater ship inspection videos which is the requirement for different downstream use cases. In this work, we demonstrate the applicability of our approach on 12 ship inspections in two downstream tasks. First, we aim at supporting a detailed ship status report generation, and second, we demonstrate big data analytics for several inspections. We use the fused data to compare different ships by identifying patterns in the findings aided by computer vision algorithms.

Jessica Horowitz, Massachusetts Institute of Technology, USA, *Enabling Under-Ice Geochemical Observations with A Size, Weight, and Power-Constrained Robot*



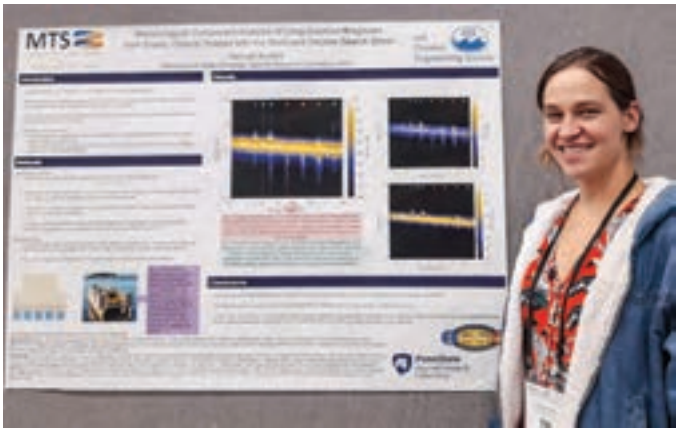
Abstract—Estimates of greenhouse gas emissions from Arctic estuarine environments are dominated by in situ summer-time ice-free dissolved gas measurements due to the logistical ease of performing field observations in these conditions. Recent evidence in coastal Arctic environments, however, has demonstrated that dissolved methane (CH_4) and carbon dioxide (CO_2) are strongly seasonally variable, and at least one significant gas ventilation event occurs during the spring freshet. Whether the Arctic serves as a source or sink of greenhouse emissions has significant implications on modeling climate change and its feedback mechanisms. To enable higher resolution spatiotemporal measurements of dissolved gases in typically undersampled conditions, remotely operated vehicles (ROVs) can be used to extract near continuous water samples below ice before and during the spring freshet. Here, we present a size, weight, and power-constrained (SWAP) underwater vehicle (UV) and novel geochemical sampling system suitable for taking under-ice geochemical observations and demonstrate the proposed system in a field-analog setting for Arctic estuarine studies.

Rebecca Horwitz, Carleton College and Rutgers University, USA, *Investigating the Overlap Between the Mid-Atlantic Bight Cold Pool and Proposed Offshore Wind Lease Areas*



Abstract—The Mid-Atlantic Cold Pool is a seasonal mass of cold bottom water that extends throughout the Mid-Atlantic Bight (MAB). The Cold Pool forms from rapid surface warming in the spring and dissipates in the fall due to mixing events such as storms. The Cold Pool supports coastal ecosystems and economically valuable commercial and recreational fisheries along the MAB. Offshore wind energy has been rapidly developing within the MAB in recent years. Studies in Europe demonstrate that existing WEAs can impact seasonal stratification; however, there is limited information on how MAB wind development will affect the Cold Pool. Seasonal overlap between the Cold Pool and wind lease areas in the Southern New York Bight along coastal New Jersey was evaluated using a data assimilative ocean model. Results highlight overlap periods as well as a thermal gradient that persists after bottom temperatures warm above the threshold typically used to identify the Cold Pool. These results also support cross-shelf variability in Cold Pool evolution. This work highlights the need for more focused ocean modeling studies and observations of the Cold Pool and MAB wind lease area overlap.

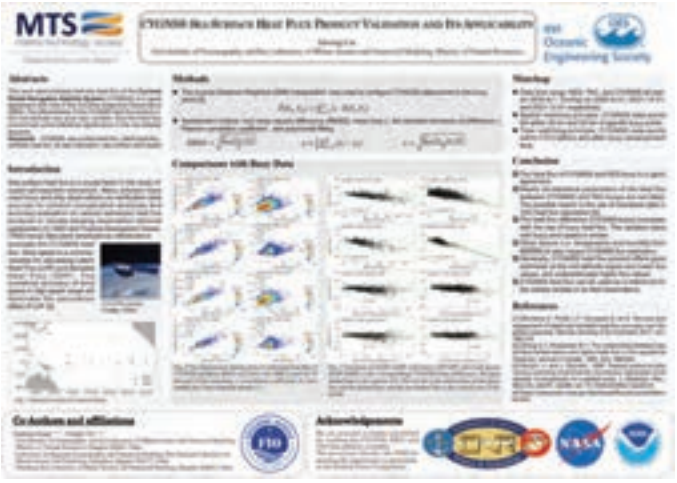
Hannah Kurdila, Penn State University, USA, *Morphological Component Analysis of Long Duration Ringdown from Elastic Objects Imaged with Sediment Volume Search Sonar*



Abstract—A common problem in signal processing is decomposing a signal comprised of several components into its constituent parts. This paper uses Morphological Component Analysis (MCA) to decompose experimentally collected Sediment Volume Search Sonar (SVSS) data into short-duration and

long-duration components. The SVSS is a synthetic aperture sonar (SAS) system designed for detection of ordnance at shallow water depths. In the implementation of MCA, Enveloped Sinusoid Parseval (ESP) frames are used to represent the signal components with sparse representations obtained via the Split Augmented Lagrangian Shrinkage Algorithm (SALSA). Ultimately, we are able to isolate late-time ringing of metallic objects both on top of and buried beneath sediment and generate sonar imagery using the two separated components to demonstrate the isolation.

Jinsong Lin (virtual), First Institute of Oceanography, China, *CYGNSS Sea Surface Heat Flux Product Validation and its Applicability*



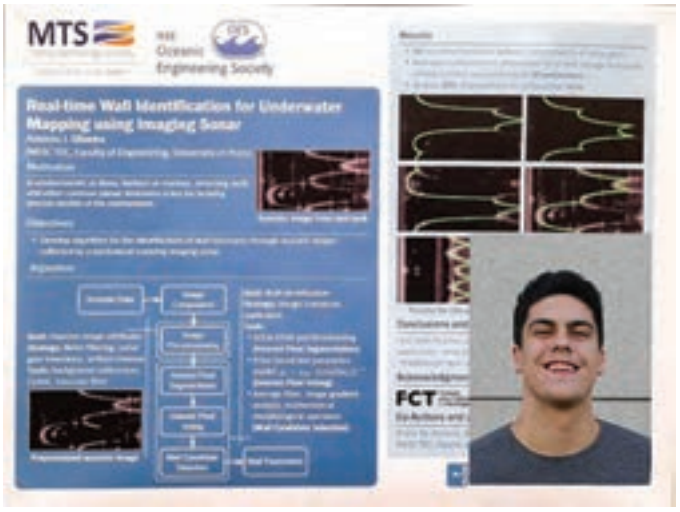
Abstract—Sea surface heat flux is an important factor for studying ocean-atmosphere interaction. The heat flux product developed based on the Cyclone Global Navigation Satellite System (CYGNSS) wind speed provides a new platform for studying sea surface heat flux under extreme sea conditions. The wind speed and heat flux measured by the Kuroshio Extension Observatory (KEO) and Tropical Atmosphere Ocean (TAO) buoys were employed as reference data to evaluate the accuracy and applicability of CYGNSS heat flux products in the northwestern and equatorial Pacific Ocean. The results show that the heat flux of CYGNSS is in good agreement with the measured heat flux of the KEO, and the correlation coefficient is up to 0.90. There is a large error and weak correlation between CYGNSS and TAO array, which may be due to the use of reanalysis data in TAO heat flux. The effect of 25 km spatial matching statistical parameters is better than that of 50 km spatial matching. The effectiveness of the CYGNSS heat flux product in the mid-latitude sea area was verified. In the absence of field observation data in the low latitude sea area, the heat flux product has a certain reference significance.

Tiago Matos, University of Minho, Portugal, *A low-cost, low-power and low-size multi-parameter station for real-time and online monitoring of the coastal area*

Abstract—The seashore is the front door to the oceans and the sustain of many societies. However, humans still seem to be

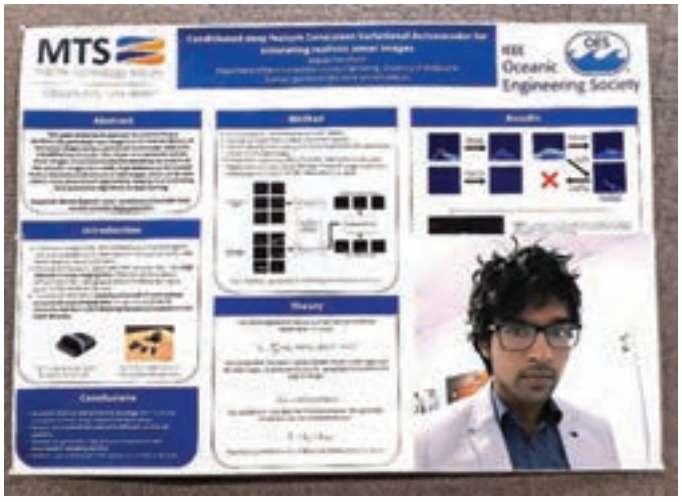
unable to unlock new paradigms to project sustainable growth of marine and coastal ecosystems. One of the reasons for this is the lack of knowledge about the natural processes that systematically change their balance. Thus, a new generation of tools is needed to gather data to validate and predict geostatistical models and protect this important resource. This manuscript reports the design and validation of a multi-parameter marine station installed in the estuary of Cávado—Portugal. For the last two years, the station has hosted several own-developed sensors to monitor water parameters, and it was designed to send the monitoring data, in real-time, to a public website so the information can be shared with the communities. So far, the monitoring station has been able to produce data about hydraulic and environmental dynamics, such as water column height or sediment displacement, as well as seasonal events and other extreme phenomena occurrences such as floods. The proposed monitoring system, built in a low-power and low-cost philosophy, aims to allow massive replication all over the coastal areas and to deliver qualitative and quantitative data for better management and planning of the littoral.

António Oliveira, Faculdade de Engenharia da Universidade do Porto, Portugal, *Real-time Wall Identification for Underwater Mapping using Imaging Sonar*



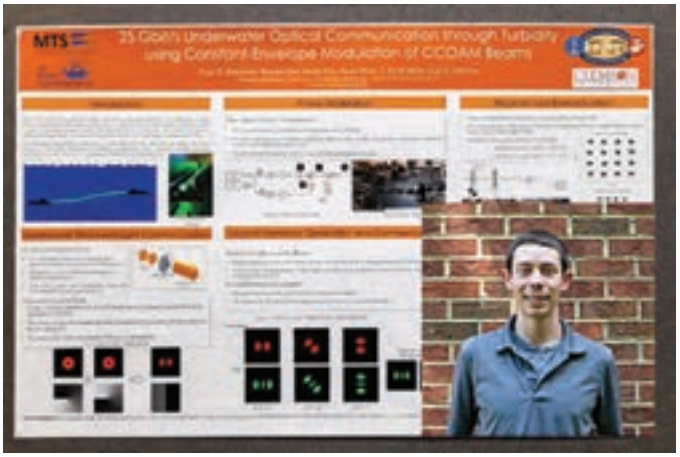
Abstract—Wall and other planar structures are common in environments as harbors, marinas, or dams. In this paper we introduce an algorithm aimed at the identification of these structures through acoustic images retrieved from an imaging sonar, building on an application of the Hough Transform algorithm. We employ a polar-based line parametric model for improved computational efficiency and further adapt the core Hough Transform blocks to the characteristics of acoustic imaging. The developed solution was subjected to experimental tests employing acoustic data acquired in a water tank, from different viewpoints and under different sonar gain configurations.

Jeygopi Panisilvam, University of Melbourne, Australia, *Conditioned deep feature consistent variational autoencoder for simulating realistic sonar images*



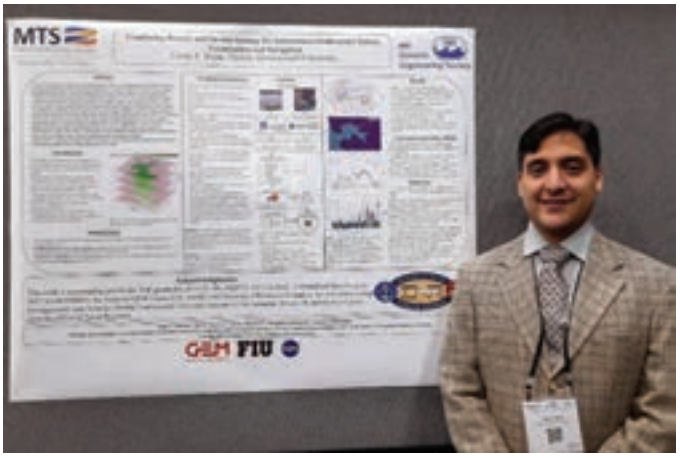
Abstract—Multibeam imaging sonar is one of the primary sensors for underwater navigation with uncrewed underwater vehicles (UUVs) due to the robustness to turbidity and variable lighting conditions that limit the applicability of standard cameras. However, the operating principles and noise models of real sensors make imaging sonar challenging to accurately simulate, and acquiring real images experimentally is difficult and costly. This paper presents an approach for transforming a synthetically generated input image into the textural domain of real sonar images using a variational autoencoder (VAE) with a modified loss function. This allows us to generate realistic sonar images of simulated scenarios emulating the texture of real acoustic images. As a result, large datasets can be created from a relatively small amount of real images, which can be later used in many downstream applications, ranging from evaluating data association algorithms to deep learning. The method was evaluated using an isolated real and simulated dataset that trained a separate convolutional neural network (CNN) to discern between images in the sonar domain and simulated images. The VAE has several advantages over a compared Cycle Consistent Generative Adversarial Network (CycleGAN) approach, including more texturally accurate generated images, and allowing for more variation in generated images.

Evan Robertson, Clemson University, USA, *25 Gbit/s Underwater Optical Communication through Turbidity using Constant-Envelope Modulation of Orbital Angular Momentum Modes*



Abstract—In this paper, we demonstrate an underwater optical communication link using an Ince-Gaussian beam which is generated by pumping a nonlinear crystal with a coherently coupled Orbital Angular Momentum (CCOAM) beam. By modulating data on the relative phase of the pump beam, a power scalable underwater communication link at 25 Gbit/s is experimentally verified for turbid coastal conditions.

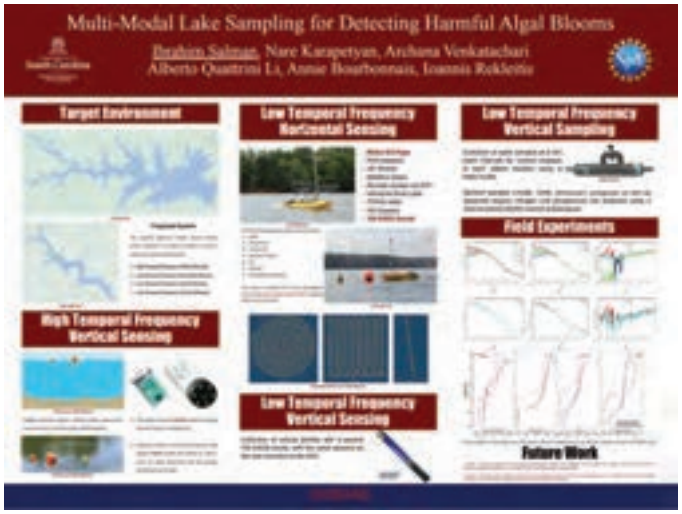
Cesar Rojas, Florida International University, USA, *Combining Remote and In-situ Sensing for Autonomous Underwater Vehicle Localization and Navigation*



Abstract—Scientists continue to study the red tide and fish-kill events happening in Florida. Machine learning applications using remote sensing data on coastal waters to monitor water quality parameters and detect harmful algal blooms are also being studied. Unmanned Surface Vehicles (USVs) and Autonomous Underwater Vehicles (AUVs) are often deployed on data collection and disaster response missions. To enhance study and mitigation efforts, robots must be able to use available data to navigate these underwater environments. In this study, we compute a satellite-derived underwater environment (SDUE)

model by implementing a supervised machine learning model where remote sensing reflectance (R_{rs}) indices are labeled with in-situ data they correlate with. The models predict bathymetry and water quality parameters given a recent remote sensing image. In our experiment, we use Sentinel-2 (S2) images and in-situ data of the Biscayne Bay to create an SDUE that can be used as a Chlorophyll-a map. The SDUE is then used in an Extended Kalman Filter (EKF) application that solves an underwater vehicle localization and navigation problem.

Ibrahim Salman, University of South Carolina, USA, *Multi-Modal Lake Sampling for Detecting Harmful Algal Blooms*

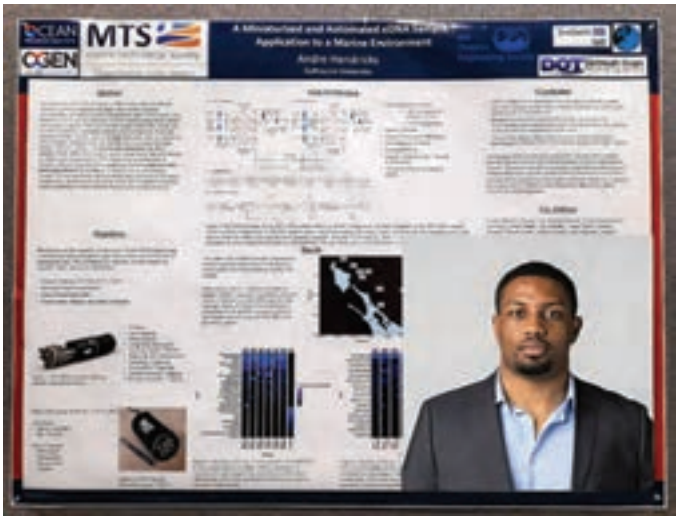


Abstract—In this paper, we present a system for measuring water quality, with a focus on detecting and predicting Harmful Cyanobacterial Blooms (HCBs). The proposed approach includes stationary multi-sensor stations, Autonomous Surface Vehicles (ASVs) collecting water quality data, and manual deployments of vertical water sampling together with vertical water quality sensor data collection, in order to monitor the health of the lake and the progress of different types of algal blooms. Traditional water monitoring is performed by manual sampling, which is limited both in the spatial and the temporal domain. The proposed method will expand the range of measurements while reducing the cost. Human sampling is still included in order to provide a base of comparison and ground truth for the automated measurements. In addition, the collected data, over multiple years, will be analyzed to infer correlations between the different measured parameters and the presence of blooms. A detailed description of the proposed system is presented together with data collected during our first sampling season.

Russell Shomberg, University of Rhode Island, USA, *Feasibility of a Near Surface Wave Powered Profiling Float for Extended Fully Submerged Autonomous Deployments*

Abstract—We propose a float capable of harvesting wave energy while fully submerged. The proposed design could theoretically operate indefinitely without ever breaching the surface. We developed and validated design guidelines for the proposed float through a combination and tank testing simulation. These design insights could be employed to build an operational float.

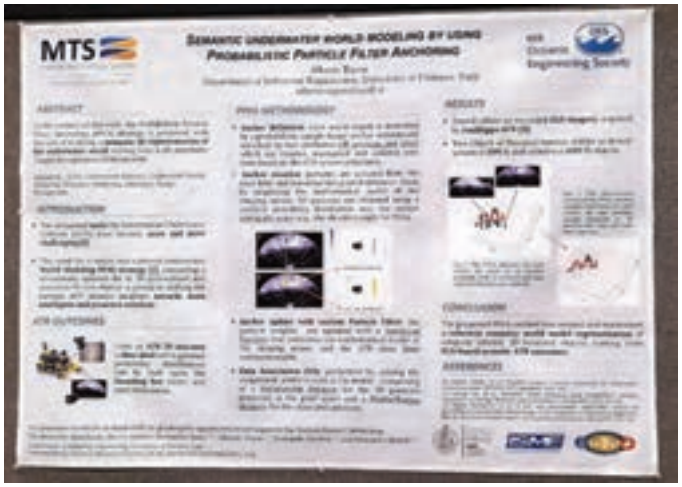
Andre Hendricks (virtual), Dalhousie University, Canada, *A Miniaturized and Automated eDNA Sampler with Fluorometer Utilization Applied to a Marine Environment*



Abstract—Environmental DNA (eDNA) analysis offers a time- and cost-efficient method to perform temporal and spatial observations of aquatic environments, providing a wealth of biodiversity data. Unfortunately, most protocols require manual collection of eDNA samples using highly skilled individuals to capture, filter and store the samples before they can be sent to a lab for analysis. Automated samplers exist to reduce this front-end collection burden, but they tend to be bulky and costly. Here we describe an eDNA sampler designed to be user-friendly and to automate the entire sample collection process. We describe and characterize our eDNA sampler, which offers multi-sample capture, preservation, and self cleaning to reduce cross contamination. DNA sequencing was performed on samples collected using the eDNA sampler as well as a traditional niskin bottle-based protocol at six stations in Bedford Basin, Nova Scotia, Canada. The two approaches showed similar algal and bacterial taxonomic compositions, demonstrating

the ability of the eDNA sampler to generate results comparable to those obtained through gold-standard protocols.

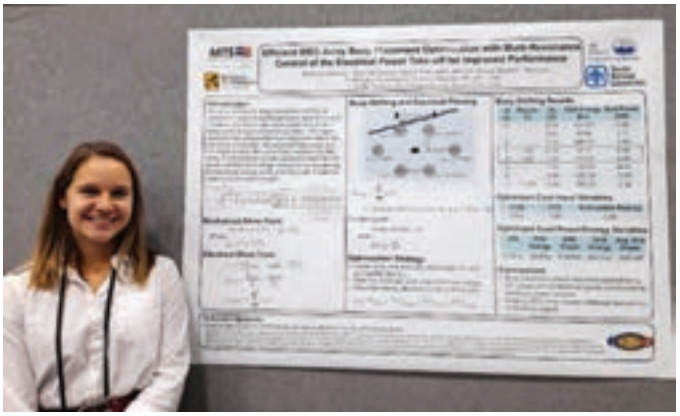
Alberto Topini, University of Florence, Italy, *Semantic underwater world modeling by using Probabilistic Particle Filter Anchoring*



Abstract—Creating an accurate world model of the scenario where an Autonomous Underwater Vehicle (AUV) is navigating can be considered a crucial stage for understanding the surrounding environment. As a result, the targets detected by a cutting-edge Automatic Target Recognition (ATR) architecture alongside their localized positions, must be handled, selected and filtered to get a symbolic representation of the underwater context. Even though the specific World Modeling (WM) architecture may vary, current WM methodologies usually rely on the 3D localization knowledge of the detected target by introducing a not-negligible constraint. Motivated by the aforementioned considerations, a novel Probabilistic Particle Filter Anchoring (PPFA) approach has been developed. Starting from ATR 2D results, the PPFA methodology aims at providing a semantic 3D representation of the subsea environment by merging the upsides of both Data Association (DA) and object tracking, handled by a custom designed Particle Filter (PF) with resampling.

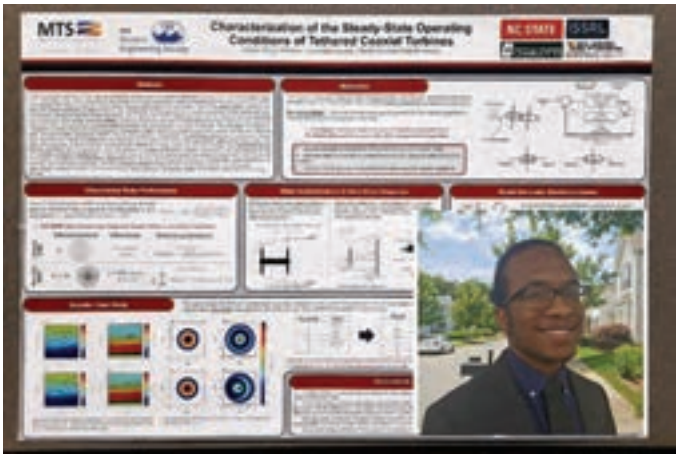
Madelyn Veurink, Michigan Technological University, USA, *Efficient WEC Array Buoy Placement Optimization with Multi-Resonance Control of the Electrical Power Take-off for Improved Performance*

Abstract—An array of Wave Energy Converters (WEC) is required to supply a significant power level to the grid. However, the control and optimization of such an array is still an open research question. This paper analyzes two aspects that have a significant impact on the power production. First the spacing of the buoys in a WEC array will be analyzed to determine the optimal shift between the buoys in an array. Then the wave force interacting with the buoys will be angled to create additional sequencing between the electrical signals. A cost function is proposed to minimize the power variation and energy storage while maximizing the



delivered energy to the onshore point of common coupling to the electrical grid.

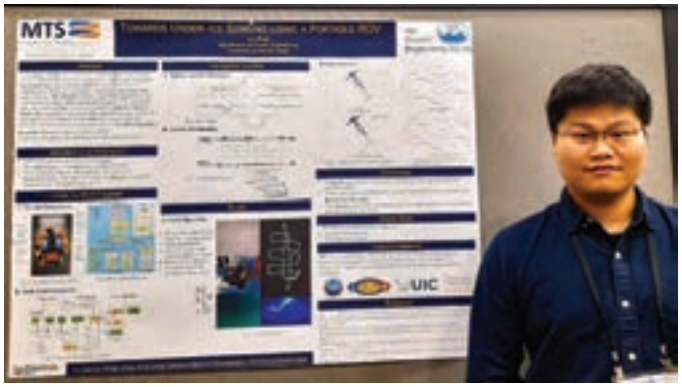
Vinson Williams, North Carolina State University, USA, *Characterization of the Steady-State Operating Conditions of Tethered Coaxial Turbines*



Abstract—Tethered coaxial turbines (TCTs) may be a feasible configuration to extract hydrokinetic energy from the Gulf Stream's flow. A TCT consists of two rotors attached to the halves of a rotary generator, which is moored to a mounting point via a tether. Flow causes the rotors to counter-rotate which induce power within the generator. The TCT's steady-state operating domain and power extraction is determined by the intersection of the hydrodynamic operating domain of the rotors and electromechanic operating domain of the generator. As a result, the TCT's operating point can be selected with an electrical load resistance, skew angle, and flow speed. Previous analytical methods for evaluating dual rotor devices have assumed ideal rotor, flow, and generator characteristics to simplify the quantification of power extraction. The proposed hydrodynamic analysis modifies traditional blade-element momentum theory (BEMT) to accept nonuniform inflow into the rotor, via a radially and azimuthally discretized BEMT method (RAD-BEMT). RAD-BEMT is leveraged alongside a momentum theory wake development factor to determine the response of the back rotor within the nonuniform wake of the front rotor. The back rotor response is determined by minimizing

the difference in mass continuity and rotor torques. Our electromechanical analysis considers an AC generator, and the effects of voltage rectification, system resistance, and capacitance on the TCT's power extraction capabilities. A case study was performed to demonstrate the ability of torque and mass continuity minimization to locate a hydrodynamic operating point, for axial and skew flow conditions. Additionally, power extraction capabilities, load resistance selection, and the qualitative effects of skew on the minimization domain are discussed.

Lin Zhao, University of Rhode Island, USA, *Towards Under-ice Sensing using a Portable ROV*



Abstract—Unmanned Underwater Vehicles (UUVs) have a promising future to explore the polar regions. In this paper, we present our progress on developing a self-contain inertial odometry for under-ice navigation. Firstly, a microcontroller-based hardware time synchronization for multiple devices is demonstrated. Moreover, we present a new IMU, Doppler Velocity Log (DVL) and Pressure dead-reckoning (DR) for state estimation and a robust initialization approach for underwater vehciels. Field trials have been conducted in Utqiagvik, Alaska in March 2022 to gather multi-sensor data under the sea ice. In this paper, we highlight the performance of our method by comparing to the robot localization algorithm, a widely used open-source localization algorithm.

Winning Poster Paper

High Frequency Radars as Ecological Sensors: Using Lagrangian Coherent Structures to Quantify Prey Concentrating Features

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***Abstract*—Food resources in marine food webs are often concentrated into patches within biological hotspots, separated by large expanses of barren ocean. Inhomogeneous, or "patchy" distribution of plankton is in part due to mesoscale and submesoscale oceanographic features transporting and locally concentrating plankton. Concentrations of plankton at the base of the food web increase prey availability for intermediate and upper trophic levels creating productive regions known as biological hotspots. Submesoscale oceanographic features within coastal biological hotspots occur at spatiotemporal scales that can be resolved by coastal High Frequency Radars (HFR). To identify areas with enhanced passive particle (plankton) transport and concentration, four popular mathematical techniques known as Coherent Structure Analyses (CSA) are applied to HFR observed ocean surface currents. Each CSA technique quantifies the stretching (pulling drifters apart) and shrinking (pushing drifters together) of the flow, yet each has its own unique calculation of "stretching" and "shrinking". All four CSA have been applied to ocean datasets in previous studies, however results from the four techniques have not been compared and evaluated as valid ecological metrics in energetic coastal flows. The following study will bring clarity to what makes each type of coherent structure differ from the others when applied to plankton transport and concentration in a coastal marine ecosystem. Results show some coherent structures define boarders of transport while others define centers of attraction. The following study uses HFR observed surface currents around a known biological hotspot, Palmer Deep Antarctica to quantify prey concentrating ocean features, and describe their ecological significance by comparing them to biological observations. Transport features quantified by CSA have the potential to be transport hubs, delivering and concentrating constant supplies of plankton. Results have the potential to inform the identification of prey concentrating features in larger, more complex food webs, and expand the use of coastal HFR data.**

***Index Terms*—Lagrangian Coherent Structures, High Frequency Radar, spatial ecology, food web focusing**

I. Introduction

Surface currents in coastal systems define features like eddies and fronts that may concentrate plankton at the base of the food web. The presence of plankton patches attracts and supports grazers, which then attract foragers, rippling the effects of the location of the plankton patch up the food web, as if grazers and foragers are visiting marine "grocery stores". Recent studies have demonstrated the importance of physical advection of plankton in the creation of patches and maintenance of biological hotspots [1] [2] [3] as well as the connectivity between neighboring systems sharing resources [4]. The processes that govern the attraction of upper trophic species to areas of concentrated plankton are defined as food web focusing [5]. However, utilizing High Frequency Radar (HFR) data to observe submesoscale transport crucial to the maintenance of coastal biological hotspots has yet to be fully explored.

Observing and understanding the role of physical mechanisms in food web focusing is especially difficult in energetic coastal systems, complicated by three-dimensional flow, tidal frequencies, and complex bathymetry. Yet, these coastal systems can be extremely productive epicenters of food web focusing. The ability to accurately observe transport and concentrating mechanisms of food web focusing in coastal systems would open the door to a wide range of analyses, bettering understanding of how coastal marine ecosystems maintain plankton resources at the base of the food web. The following study will repurpose HFR data by quantifying transport extremizers in HFR observed coastal flow and describing the relationship between transport extremizers and plankton concentrations that catalyze food web focusing.

HFR are coastal radars that use doppler-shifted radio waves backscattered off the ocean surface to deduce surface velocity [6]. Measured radial components from two or more HFRs are added together to construct magnitude and direction of surface current velocities [7]. Arrays of HFRs are a powerful tool to observe coastal flow at high spatiotemporal resolutions and have been deployed along coastlines around the world. HFR observed velocity fields provide the total horizontal current vector including ageostrophic components, which is advantageous for studying small scale oceanographic features that may exist on the same time and spatial scales of a foraging trip or patchy zooplankton swarm.

This work was supported by the National Science Foundation

II. COHERENT STRUCTURE ANALYSIS

Various coherent structure analysis (CSA) techniques have gained traction in the past decade as a tool to identify areas in a flow field that have a strong influence on nearby drifting constituents. These areas of strong influence will be referred to as coherent structures. Coherent structures can identify local extrema of repulsion, attraction, and shearing of flow. Some coherent structures will define boarders of transport while others will define centers of attraction of passive drifters in a flow field, or plankton in ocean velocity [8] [9]. Rather confusingly, despite signifying different transport extrema, they are all referred to as "coherent structures". The following study will bring some clarity to what makes each type of coherent structure differ from the others when applied to a marine ecosystem.

The power of these coherent structures lies in their ability to uncover features and transport extremizers that are not visible from studying velocity fields alone. Past studies have related coherent structures to migratory patterns of birds [10] transport of phytoplankton blooms [11] and the location of overboard passengers [12]. While each CSA technique quantifies the stretching (pulling drifters apart) and shrinking (pushing drifters together) of the flow [13] [14] [15] [16], each has its own unique classification of "stretching" and "shrinking". Following the principle of conservation of mass, the integrated stretching and the integrated shrinking in the system is conserved. This constrains implementation of coherent structure analysis given the dimensionality of the inputted velocity data. Coastal velocity data from High Frequency Radars (HFR) are unique in that they represent a two-dimensional surface slice of processes that are happening in three dimensions. It is unknown how much coherent structures of any technique are affected by vertical velocity influences on the surface HFR data. Some initial studies show promising results of coherent structures in HFR data indicating borders and attracting centers of phytoplankton patches [17] [18].

Past studies have used two-dimensional ocean velocity data to identify coherent structures. Such analysis assumes no vertical velocity in the system. Two-dimensional surface flow has been shown to be a good assumption in open ocean regions dominated by geostrophic flows [11] [19] [20] [21] [22]. Coastal regions, on the other hand, have more complex dynamics sometimes influenced significantly by vertical flow. It is unknown how well coherent structures calculated with any CSA technique capture transport in coastal systems or how results from different techniques differ in coastal systems. Three-dimensional coherent structure analyses have been done, [8] but are computationally expensive, and many ocean velocity datasets loose resolution in the vertical dimension. This study will calculate two-dimensional coherent structures from HFR observed surface current data.

The four coherent structures tested have all been applied to ocean datasets: Finite Time Lyapunov Exponents (FTLE), Finite Size Lyapunov Exponents (FSLE), Transient Attracting Profiles (TrAP), and Relative Particle Density (RPD) [2] [8] [23] [12]. Each of these CSA techniques detect coherent structures isolate the root causes of flow coherence, however "stretching" and "shrinking" features within velocity fields are defined differently by each technique. Following the principle of conservation of mass, the integrated stretching and the integrated shrinking in the system is conserved. This constrains implementation of coherent structure analysis given the dimensionality of the inputted velocity data.

A. Finite Time Lyapunov Exponents

Finite Time Lyapunov Exponents assign scalar values to points on a gridded velocity field that characterize the amount of length separation between two drifters about a point over a defined time interval. From particle trajectories in a velocity field, FTLE will define stretching as the integrated separation rate between two particles (Figure 1). FTLE differs from instantaneous separation rate [24] [25] by integrating over trajectories, providing a more realistic interpretation of transport in the velocity field. When applied to a discrete set of velocity data, FTLE will vary over space and time. FTLE calculations begin with a velocity field over some selected time. Finite differencing is then used over a defined auxiliary grid to numerically compute the derivative of the flow map. Next, the Cauchy-Green strain tensor field is computed from the derivative of the flow map as well as its eigenvalue field and eigenvector field. Then, the "stretching" of the field is computed as in (1), where $S(x_0)$ is the maximum stretching at point x_0, λ_i is the eigenvector field, and C is the Cauchy-Green strain tensor.

$$S(x_0) = [max_{i=1:N}\lambda_i(C(x_0))]^{\frac{1}{2}} \tag{1}$$

FTLE is then computed with (2) over a finite time T. [18, 44, 45].

$$FTLE(x_0, t_0, T) = \frac{1}{T}\ln(S(x_0)) \tag{2}$$

FTLE calculations were performed using a software toolbox [26] that was modified for use on HFR data (Figure 5A).

B. Finite Size Lyapunov Exponents

Finite Size Lyapunov Exponents assign scalar values to points on a gridded velocity field that characterize the amount of time it takes for two drifters to separate from a starting distance to a defined final distance. Together with FTLEs, FSLEs are sometimes referred to as "Local Lyapunov Exponents". From particle trajectories, FSLE will define stretching as the amount of time is takes for two particles to separate a finite distance. FSLEs isolate different oceanic regimes based on different length scale of oceanic flow, whereas FTLE will isolate regimes of different time scales. FSLEs have been shown to work particularly well in closed systems [27], but have been applied to a wide variety of oceanic datasets [28] [29] [30] [10]. Similarly to FTLE, when applied to a discrete set of velocity data, FSLE will vary over space and time. If appropriate time and length integration scales are used in FTLE and FSLE conditions, their results should converge to

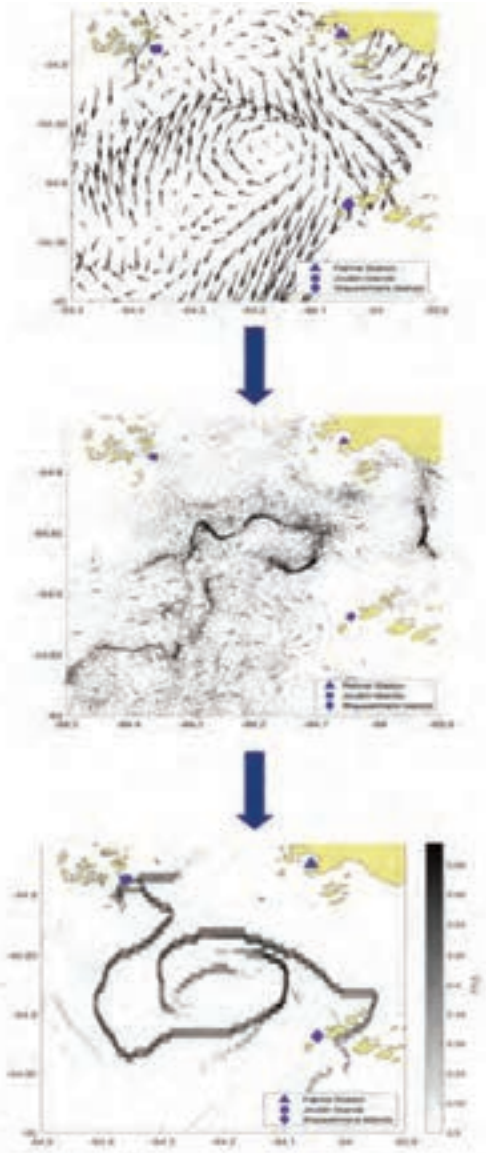

Fig. 1. Turning Observed Surface Currents into Transport Extremizers. From top to bottom, (1) HFR observed surface currents (2) Particles released and advected in surface currents (3) Attractive coherent structures calculated from particle trajectories. Blue polygons indicate locations of HFR stations.

the same mapped coherent structures. From the trajectories of particles, a τ will be calculated as the time it takes for two particles around a point with coordinates (x,y) to separate from an initial distance (δ_0) at time t, to a final distance (δ_f). The scalar value of the FSLE around that point will be evaluated as in (3).

$$FSLE(x, y, t, \delta_0, \delta_f) = \frac{1}{\tau} \ln(\frac{\delta_f}{\delta_0}) \tag{3}$$

Ideally, τ would be calculated between every pair of particles in the flow field starting at δ_0 from the basis point (x,y). However, when the velocity field is nicely gridded, past studies have only considered a few of the closest particles to the basis point. This approach will be used. δ_0 will be the size of the inter-grid spacing of the output FSLE field (1km) (Figure 5B).

C. Transient Attractive Profiles

Transient Attractive Profiles identify collection zones of drifters from Eulerian, instantaneous snapshots of velocity data. TrAPs fall under the larger umbrella of "Objective Eulerian Coherent Structures" [31]. Results will produce mapped locations of TrAPs on top of a scalar field of attraction rate for each time stamp. Mapped TrAPS consist of an attracting core and a line of attraction protruding from the core like a tail (Figure). Attraction rate (shrinking) is defined by the smallest eigen value of the rate-of-strain tensor of the flow snapshot [12] [31]. TrAP calculations begin with the Jacobian of the velocity field v with respect to position, denoted as ∇v. Next, the rate-of-strain tensor will be computed with (4).

$$S(x, y, t) = \frac{1}{2}(\nabla v + (\nabla v)^T) \tag{4}$$

Here, ^{T} denotes matrix transposition. From this tensor, the smallest eigenvalue field, $s_1(x, y, t) \leq s_2(x, y, t)$ and the unit eigenvector field $e_2(x, y, t)$ of $S(x, y, t)$ associated to $s_2(x, y, t)$ will be calculated. Negative local minima of $s_1(x, y, t)$ will be computed as $S_m(t)$. The TrAPs are then the solution of the Ordinary Differential Equation in (5).

$$r^1(\tau) = sign < e_2(r(\tau)), r^1(\tau - \Delta) > e_2(r(\tau)) \tag{5}$$

where $r(0) \in S_m$. Here, τ is a preset arclength parameter and ^{1} is differentiation with respect to τ. Δ is the arclength increments between two nearby points on the TrAP structures. TrAP calculations have been performed based on personal communication with authors from [12] (Figure 5C).

D. Relative Particle Density

Relative Particle Density provides the normalized density of drifters within each gridded bin of the study system. Starting with particles released in the velocity field, RPD reports the normalized number of drifters present in each gridded bin at each timestamp. Two dimensional RPD assumes that no particles are lost from the surface layer due to vertical velocity, meaning that the integrated surface divergence in the x-y plane is assumed to be zero. "Stretching" of the field is divergence, where bins are sparse of particles, and "shrinking" of the field is convergence, where bins have lots of particles. Relative Particle Density calculations begin with tracking virtual particles through a velocity field. Particles are released over a regular grid. After the particles have advected in the velocity field long enough to lose the memory of the release grid, 6 hours, RPD is calculated by summing and normalizing the number of drifters in each grid box. Grid boxes with large amounts of drifters are attractive features, and grid boxes with few drifters are dispersive features. In the following analysis, new particles were released in a regular grid every three hours. Particles were no longer counted when they were advected out of the HFR domain, or after they

became three days old. The three-day threshold was chosen to coordinate with the time a phytoplankton will spend in the surface layer. These methodologies follow closely with those performed in a previous study conducted in Palmer Deep, Antarctica [2] (Figure 5D).

The use of each of these techniques on the same ocean velocity data is a novel approach. This study will compare the results of each technique to the others, and to high resolution observed phytoplankton abundance.

III. PALMER DEEP AS AN ECOLOGICAL LABORATORY

Recent observations in Palmer Deep have shown the importance of two-dimensional advection and the lack of vertical transport of nutrient rich Upper Circumpolar Deep Water to the photic zone [32] [3]. These findings suggest that increased food availability in Palmer Deep compared to neighboring regions could be due to transport rather than local nutrient supply.

HFR observed surface currents provide a two-dimensional snapshot of flow that is occurring in three dimensions. Therefore, when CSA is applied to an HFR dataset, the effects of a layered system and bathymetry are not negated. LCS results from the HFR over Palmer Deep show surface transport extremizers that are affected by a three-dimensional system, but it is assumed that particles (plankton) remain in the surface layer.

LCS acting as plankton concentrating features have the potential to increase prey availability for the penguin and seal colonies and whale pods that feed in Palmer Deep, allowing this region to provide for marine animals over ecological time. The relatively short and tightly-coupled food web of Palmer Deep makes this an ample ecosystem to observe food web focusing. A previous study has shown a relationship between surface transport features and penguin foraging behavior [2].

IV. METHODOLOGY

A. Data Collection

The data used in this study are collected from Palmer Deep, Antarctica in the late austral summer of 2020 as part of a NSF funded project, SWARM. These data provide coincident biological observations through each level of the food web with well resolved dynamic surface current maps and underlying hydrography over an entire season. Observations conducted in project SWARM included three High Frequency Radars, three Slocum gliders, and twice-weekly ACROBAT towed surveys between January and March 2020, as well as tagged penguin data spanning the whole season (Figure 2).

The three HFR sites collected hourly measurements of ocean surface current component vectors over known penguin foraging areas, covering about 1,500 square kilometers more than 80% of the time (Figure 8). HFR hourly surface currents will be used to derive coherent structures. Gaps in HFR data were filled to create a constant domain of coverage for each hourly measurement. The filling methodology followed was rigorous and HFR-specific, outlined in this reference [33].

Twice weekly ACROBAT surveys were conducted along transects on either side of the canyon (Figure 8) between January and March 2020. The ACROBAT instrument was towed behind a small boat (RHIB) at 6 knots (about 3.087 m/s) as the instrument used tilted wing angles to undulate continuously between just below the surface and about 50 meters. The ACROBAT was equipped with a fast-sampling (16 Hz) Seabird FastCAT CTD and a Wetlabs Ecopuck (chlorophyll-a, backscatter, and CDOM). A total of 17 surveys were conducted.

Penguin foraging behavior was tracked using GPS archival tags. The tags provide location data with a small error of about five meters. Penguin data collection was conducted by Polar Oceans Research Group as part of project SWARM.

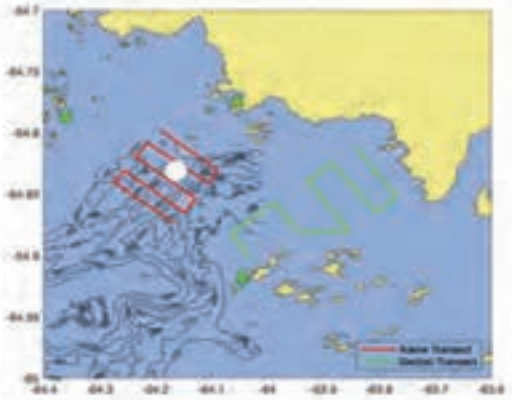

Fig. 2. Green polygons indicate locations of HFR Stations. Bathymetry is contoured in black with 200m isobars. White circle indicates stationary glider at the head of Palmer Deep Canyon. The Adéle and Gentoo Transects were completed by twice-weekly ACROBAT towed surveys. The transects are named after known foraging areas of the respective penguin species they are named after.

B. Determining Integration Time and Length

In the computation of FTLE and FSLE results, integration time and length were chosen carefully as varying integration time and lengths will identify different scales of transport features. As if fine tuning a microscope, transport features of a certain scale will come into focus as integration scales are adjusted. This study is interested in prey concentrating features at the base of the food web, and therefore time and integration scales were determined by observed phytoplankton abundance from twice-weekly ACROBAT towed surveys.

The ACROBAT undulated between the surface 60 meters depth completing a profile about every 300 meters, collecting hydrographic and optical measurements. Given that the composition of surface particles is dominated by phytoplankton in this region, particle backscatter was used as a proxy for phytoplankton abundance instead of chlorophyll fluorescence to negate the effects of nonphotochemical quenching. Mixed layer particle backscatter was integrated using a trapezoidal integration. Profiled mixed layer particle backscatter data was then smoothed using a sliding bin average of three profiles,

resulting in a resolution similar to that of the HFR surface current data (1km).

Profiles were determined to be part of a phytoplankton "patch" (high levels of phytoplankton) if they were 5% above the median integrated mixed layer particle backscatter within a transect line from a singular survey (Figure) [cite thomalla]. Profiles with integrated mixed layer particle backscatter that did not meet this threshold were considered non-patch profiles (low levels of phytoplankton). This analysis was also completed with optical backscatter data from a glider that held station at the head of Palmer Deep Canyon (Figure 2).

The ACROBAT data was used to determine the length of the phytoplankton patches during the austral summer of 2020 from the average length of consecutively measured profiles that met the criteria of a phytoplankton "patch". The average length of a phytoplankton patch was 3.56 km. Using the profiled data from the station keeping glider, the time scale of a phytoplankton patch was calculated as the average time of consecutive profiles that met the "patch" criteria (5% above daily median integrated mixed layer particle backscatter). The average residence time of a phytoplankton patch was 6 hours.

The length and time scales of the HFR observed surface currents were also computed. The time scale was determined as the point where the autocorrelation function averaged over all grid points, passes the e-fold (Figure 3). The spatial decorrelation for the HFR observed surface currents was also computed (Figure 4).

V. Results and Discussion

The time scale of the phytoplankton patches is very close to that of the HFR observed surface currents (Figure 3). The temporal scale of the phytoplankton patches reaches to the e-fold of the temporal autocorrelation function of surface currents (0.36), where the surface currents are considered no longer correlated with themselves. Surface currents and phytoplankton patches existing on similar timescales suggests that they are influenced by similar features or are influencing each other. Surface currents may be shaping phytoplankton patches, giving phytoplankton patches a similar timescale through advection. This is evidence that patch structure could be described by the advective transport quantified by CSA. The six hour timescale of both the surface currents and phytoplankton patches could also be a reflection of how tidally influenced this system is. Palmer Deep has a mixed semi-diurnal tidal pattern that has been shown to influence penguin foraging behavior [34]. Tidal patterns may be influencing the lifespan of coherent structures and therefore the lifespan of phytoplankton patches.

The spatial scale of phytoplankton is more sensitive to spatial decorrelation than temporal decorrelation. The average length of a phytoplankton patch (3.56 km) reaches only to about the 0.85 decorrelation of the surface currents (Figure 4). A possible explanation for this is the long, filament like shape of the coherent structures (Figure 1, 5), elongating the phytoplankton patches in one dimension (larger spatial scale) and not the other (smaller spatial scale).

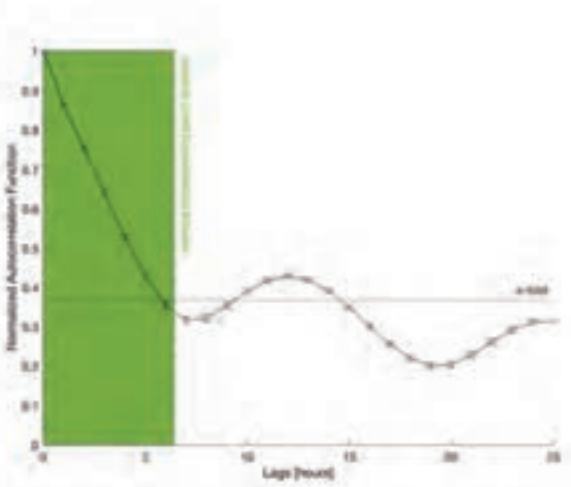

Fig. 3. Time scales of phytoplankton patches were determined from a station-keeping glider (green shading), and time scales of surface currents were determined by an autocorrelation function averaged from all surface current grid points.

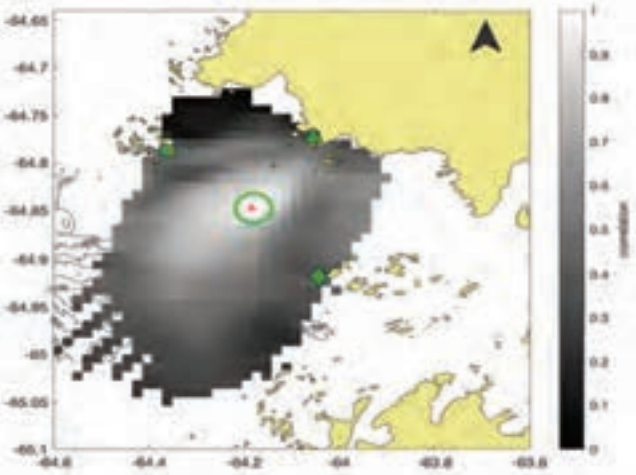

Fig. 4. Spatial scales of phytoplankton patches were determined from towed ACROBAT surveys (one dimensional diameter, 3.56 km, green circle). Spatial scales of surface currents were determined by a complex correlation at each surface current grid point. Shown here is the spatial decorrelation from the grid point where the station-keeping glider from temporal scale analysis was.

Coherent structures from all four techniques show long, filament like structures. Results from the same timestamp are usually oriented in the same direction and identify similar regions as concentrating transport (Figure 5). Note that Figure 4B is at a different timestamp than the three other coherent structure maps. This analysis is still in preparation. Between the FTLE, TrAP, and RPD results, similar areas are identified as coherent structures by all three metrics such as the region just west of the HFR station denoted by a diamond shape. The coherent structures in this region are of varying lengths and are in slightly different positions, however they are all oriented in about the same direction.

Some differences between the four techniques are worth

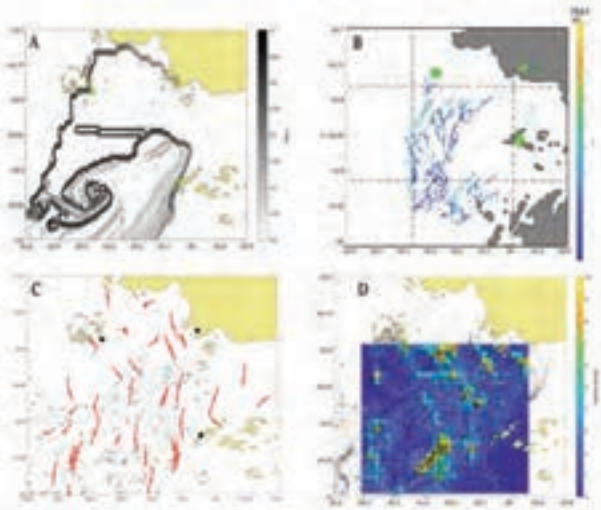

Fig. 5. Four coherent structure analyses (A) Attracting FTLE, Mar 01 2020 00:00 (B) Attracting FSLE, Jan 26 2020 00:00:00 (C) TrAP, Mar 01 2020 00:00 (D) RPD, Mar 01 2020 00:00. Green and and black polygons denote HFR stations.

noting. FTLE identify "ridges" in the flow field that seem to collocate with the edges of phytoplankton patches where the RPD appear to identify the centers of phytoplankton patches. In Figure 6A, a high particle density structure (attractive RPD) is oriented in the middle of several profiles the ACROBAT towed survey observed as a phtyoplankton patch (high phytoplankton). At the same timestamp, strong FTLE derived coherent structures border either side of the same phtyoplankton patch in Figure 6B. This may be an important distinction when quantifying the relationship between CSA results and bioactivity. Future work will produce a statistical relationship between observed phytoplankton patches and coherent structure results from all four CSA techniques.

Initial results show foraging Adélie penguins selecting for high particle density structures, similar to the results in [2] (Figure 7). If phytoplankton, zooplankton, and penguin presence are correlated with CSA results, it can be concluded that CSA are able to identify areas of food web focusing. Future work will use acoustic data from the SWARM field season to map backscattering zooplankton abundences onto CSA results, linking the phtyoplankton and penguin's positions in the food web together.

VI. Conclusion

Examples of successful CSA detection of phytoplankton patches and penguin activity are shown here (Figure 6, 7), however there are instances when phytoplankton patches are observed in the absence of strong coherent structures. Initial results suggest that there are some days where many phytoplankton patches are collocated with strong coherent structures and some days when they are not. Quantification of these trends is in preparation. Some possible explanations are that (1) days when phytoplankton patches are not collocated with

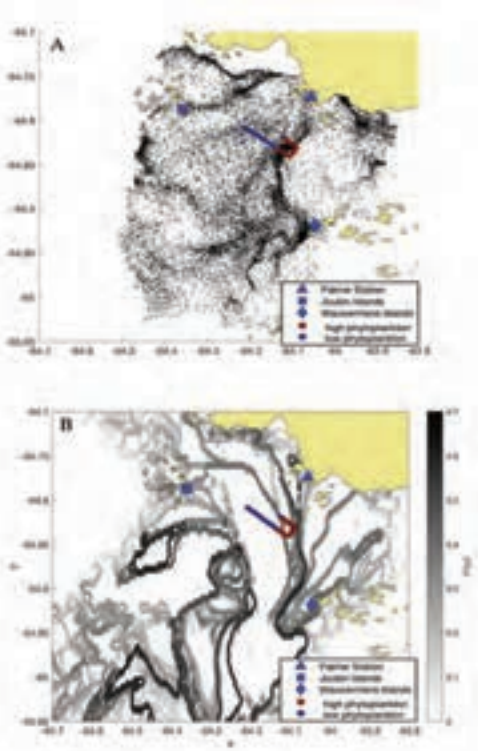

Fig. 6. High and low chloeophyll profiles observed by ACROBAT towed survey plotted over (A) particles advected by HFR observed surface currents (B) attractive FTLE both on 7 Feb 13:00

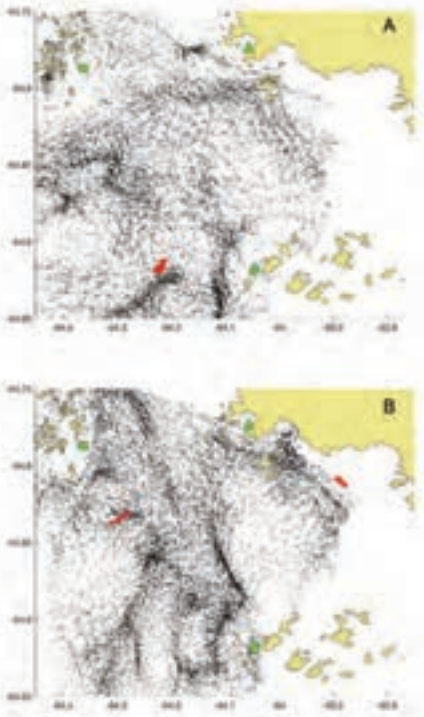

Fig. 7. Foraging Penguins Selecting for high particle density structures in HFR observed surface current data plotted with tagged penguin data (red dots) during (A) January 18th 12:00 and (B) January 19th 18:00 local time. Green polygons denote locations of HFR stations.

coherent structures have more vertical flows which the two-dimensional CSA cannot account for or (2) large zooplankton swarms grazed the phytoplankton that were concentrated in the strong coherent structures.

Our analysis indicates that these HFR derived CSA metrics can be used to identify concentrating mechanisms in coastal biological hotspots with complex submesoscale flows. The presence of consistent, strong concentrating mechanisms identified by CSA could sustain the Palmer Deep hotspot, concentrating enough phytoplankton biomass to feed large populations of Antarctic krill compared to surrounding regions, allowing central place foragers to nest and migratory species to feed in Palmer Deep annually. Further investigation of CSA applied to coastal biological hotspots could inform ecosystem models by predicting bioactivity from ocean currents. Findings will also expand the use of HFR data to locate areas of food web focusing, identify regions of increased marine animal presence for nearby boaters, and further our understanding of how coastal biological hotspots are maintained.

VII. ACKNOWLEDGMENTS

This work supported by the National Science Foundation as part of project SWARM. Thank you to Matthew Oliver, Hank Statscewich, Kim Bernard, Bill Fraser, Katherine Hudson, Ashley Hann, and the rest of the SWARM team for their work during our field season collecting data and for many helpful discussions. This work would not be possible without Polar Oceans Research Group, the PAL-LTER field teams who aided in data collection, and the Palmer Station and Laurence M. Gould personnel who provided logistical support. Thank you to Rutgers University for providing student support. Thank you to ONR for providing funds for the student poster competition at the MTS/IEEE OCEANS 2022 conference.

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Save the dates for **OCEANS 2023, June 5-8** and join us in Limerick, Ireland.

The OCEANS conference is the flagship event of the IEEE Oceanic Engineering Society (OES) and the Marine Technology Society (MTS). The event is recognized as the premier forum for the international marine community to meet and discuss technical innovations and current trends in the marine technology sector. OCEANS brings together engineers, industry practitioners, government officials, public-sector executives, researchers and academics from all aspects of the oceanic spectrum.

OCEANS 2023 will be hosted at the beautiful University of Limerick campus, located on the outskirts of Limerick City. It is the first time that OCEANS will be held in Ireland. The event will feature all aspects of oceanic engineering, science and technology. The conference theme is "Blue Ocean Planet Earth".

Key highlights:

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Who's Who in the IEEE OES

Jim Collins, OES AdCom, IEEE Millennium Medal 2000, IEEE OES 2002 Distinguished Service Awards

I am a native of Halifax, Nova Scotia, where I graduated from Dalhousie University with a BSc, followed by a BEng and MEng in Electrical Engineering in 1966. In 1965 I joined Bell Northern Research in the magnetic device development group in Ottawa. I next attended the University of Washington, and in 1973 received a PhD in Electrical Engineering. My wife, Faith, and I were so taken by the wonderful ambiance of the west coast of Canada that we decided to return to Victoria.

In 1973 I took employment as a computer consultant for the Ministry of Health of British Columbia to lead the implementation of computers in the hospital clinical laboratories of the province's public health system.

The province eventually took direct responsibility for the hospital lab systems and in the fall of 1979, I joined the Engineering Department of Royal Roads Military College (RRMC). In addition to teaching responsibilities, I represented the College in updating its computer resources especially in the Engineering laboratory area.

Further at RRMC I started a research project which would fit in with a marine bias that the College was attempting to promote. The research area I selected was acoustic communication for autonomous underwater vehicles (AUVs). This soon led to my involvement with the OES. I gave my first paper on the topic at OCEANS '83 in San Francisco. My research led to development of an acoustical sensitive mechanical mount for optimizing the pointing of narrow beam transducers suitable for communication use on AUVs. The device is featured in the 1993 IEEE Robotics and Automation Conference Video Proceedings.

My administrative roles with IEEE began about 1984 when I was elected Section Chair for Victoria. This was the year of the first Sections Congress in Boston, which I attended. Over lunch one day I was seated with Koji Kobayashi and Michiuki Uenohara, respectively the President and Senior Vice President of Nippon Electric in Tokyo. This chance meeting fostered my interest in what was happening in other regions of the IEEE around the world. Consequently, when my first sabbatical came, in 1984–85, I included a visit to Japan to view AUV related research and IEEE activity as well (see Fig.1).

By 1996 interest had grown in Japan in an OES Chapter and supporting an ocean related OES technical meeting. This resulted in discussions at the University of Tokyo (see Fig.2) where plans were made to hold such a technical meeting the following year. This became known as the Underwater Technology (UT) Symposium, which is held biannually at a location in or near Japan.

During my second sabbatical in 1993, I had the honor to be General Chair of the IEEE OCEANS '93 Conference held in Victoria. Two hundred eighty Papers were given. Booth sales,

Figure 1. Japanese National Defence Academy on 25 March 1986, Mr. Tsuneo Harada (Canadian Embassy), Prof. Kiyoshi Okazaki (Vice President, NDA), Mr. Kuniyasu Tsuchida (President, NDA), Prof. James S Collins, Lt Gen Soichi Nakamata (Vice President, NDA), Prof. Takayoshi Nakazato (NDA) (L to R).

Figure 2. University of Tokyo (IIS) July 1996, Yasuyoshi Ishii, James Collins, Tamaki Ura, Joseph Vadus, Teruo Fujii (L to R).

attendance and an effective management team resulted in a surplus of C$99,600.

I have used the opportunities afforded by travel to meet other present and future members of the OES who became instrumental in promoting the society. I met with P R S Pillai in Cochin, India, during a cruise that stopped there for a day and discovered that he had been organizing the biannual SYMPOL meeting in Cochin. OES became a co-sponsor of this meeting and the association eventually led to the offering of the UT Symposium in Chennai, followed by OCEANS'21. These two were Chaired by Dr. M. A. Atmanand, currently an OES AdCom member. Another opportunity to spread the influence of OES arose at the OES booth at OCEANS'01 Hawaii where my discussions with Brian Ferguson led to his Chairing the OCEANS'10 Sydney Conference in Australia. I also had discussions with personnel at the United Kingdom booth at an Offshore Technology Conference in Houston about 2001. These discussions perhaps planted the seed for the two Aberdeen OCEANS in 2007 and 2017.

One very important association for me was as an Adjunct Professor at the University of Victoria for 38 years until 2021. This position gave me access to additional research funding and to the opportunity to associate with the larger number of engineering faculty there. Many of these faculty were signatories on the petition resulting in the formation of the OES Victoria Chapter in 1984.

I think that a Who's Who is not complete without mentioning family details. My wife, Faith, and I married in Ottawa in 1966. Wanting to further our graduate education, we moved to Seattle. I joined the Electrical Engineering Department at the University of Washington where I completed a Ph.D. in 1973. Our two children, Beth and James, were born in Seattle. On our return to Canada, we chose to settle in Victoria, British Columbia.

Faith had a rewarding and long (41 years) career at the University of Victoria as an administrator of health programs. In her retirement she volunteers in the facilitation of refugees coming to Canada.

Our daughter, Beth, lives in Seattle and recently joined DexCom, Inc. where she is promoting technology that improve the lives of people with diabetes (more than therapeutics in some cases!). Her husband Sean works at Microsoft and has a biotech hobby of sorts known as homebrew, which benefits all who enjoy beer.

Our son, James, lives in Vancouver, and is the father of our four grandchildren. He is the Manager of Occupational Health and Safety Officer for a private company serving international shipping travelling the west coast of Canada and the USA. He is an avid soccer player and youth soccer coach. His wife, Dolores, is a school teacher. (see Fig.3).

Figure 3. Picture of Jim's family.

Request for OES AdCom Nominations

Nominees for the Term 1 January 2024–31 December 2026

Jerry Carroll, Chair of IEEE/OES Nominations and Appointments Committees, SrPastPresident@ieeeoes.org

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

This year, the Nominations and Appointments Committee is chaired by the Past President. The committee is charged with proposing a slate of nominees each year. For this election, twelve members of the OES will be nominated to fill six positions on the AdCom for the three-year term 1 January 2024–31 December 2026.

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

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

- Their views of the opportunities and challenges facing the Society

- Steps to be taken to advance the IEEE Oceanographic Engineering Society, including Ideas for potential initiatives and projects
- How they plan to contribute to standing and ad hoc committees

Elected Ad Com members should expect:
- To participate in administrative activities required to run the society (tasks will be assigned, including participation in standing, and/or ad hoc committees)
- To spend on average 5 to 10 hours per week on communications (email, phone, virtual meetings) which may not be evenly distributed throughout the year
- To travel to at least 1 in person AdCom meeting per year

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

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

Please submit nominations to the undersigned starting 1 January 2023. Please do not delay your efforts in finding and nominating qualified candidates. Send your nominations to:
*Jerry Carroll
*Chair of IEEE/OES Nominations and Appointments Committees
SrPastPresident@ieeeoes.org

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Wayne A Nickols
Candice Patton
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A DREAM COME TRUE—A New OES Student Chapter, Escuela Tecnológica Instituto Técnico Central (ETITC) in Bogotá, Colombia

Francisco Lugo, Professor ETITC, OES Member

OES ETITC student members and volunteers.

In coherence with the investigative spirit and the social commitment of the student branch IEEE ETITC (Escuela Tecnológica Instituto Técnico Central) located in the city of Bogotá, Colombia. Active members at the membership and volunteer level made the decision to create the first group in Colombia to contribute different initiatives from the R9 IEEE in the Oceanic Engineering Society (OES).

After the inconveniences caused by COVID 19, the community in general, and in particular the academic community, has changed its way of thinking about what should definitely be more important for human beings and sustainability. This affirmation for the year 2022 has been taking shape for the IEEE ETITC branch, and this is how it has been channeling and resuming the academic and research exercise with a growing participation that has exceeded 70 students in the ETITC, which historically in its eight years of operation (created in 2013 with a year of inactivity in 2016) does not refer to any similar precedent.

It should be noted that there, under the structure of a university group seedbed called ECOS (Experience, Knowledge and Solidarity), different chapters have been presented and reinforced with engineers in training in the areas of computer science, mechatronics, electromechanics, processes and mechanics. In September, a new interdisciplinary group made up of ten young researchers was formalized: Jeisson Giraldo, Anderson Bermúdez, Astrid Peña, Jenni Rojas, Ricardo López, Juan Rueda, Bryan Rojas, Natalia de Dios, Miguel Olivos, German, Estiven Torres accompanied by professors Francisco Lugo and Sergio Ramírez; whose proposal is to advance technological application projects with a wide deployment of teamwork as a premise to achieve effective and efficient results in work aimed at caring for the environment with an emphasis on responding to the growing concern for the preservation of the ecosystem, the protection of masses of water and the care of the oceans.

The vision of student branch OES ETITC will be to provide solutions in different scenarios, in order to reduce the negative impact that is progressively affecting nature due to the lack of awareness of the inhabitants of the globe.

First meeting of the OES ETITC SBC.

Integration activity and project planning OES ETITC.

IEEE OES UNIZG SBC Activities at Breaking the Surface 2022, et al.

Anja Babić, Ivan Lončar, Nadir Kapetanović, Igor Kvasić, Allan Badian, Fran Penić, Matej Fabijanić

The IEEE OES University of Zagreb SBC had yet another fruitful trimester, with members participating and presenting their recent research results in OCEANS 2022 Hampton Roads conference, IFAC CAMS 2022 in Denmark, organizing a hackaton in marine robotics simulation, and finally culminating in our yearly flagship event—the 14th edition of Breaking the Surface workshop in Biograd na Moru, Croatia.

This edition of BtS—an interdisciplinary field workshop on maritime robotics and applications—managed to get back to its pre-pandemic figures and gather almost 200 experts from the fields of maritime robotics, marine biology, maritime archaeology, maritime security, and marine geology. Although online events served us well to some extent, we are pleased to notice that our international guests could not wait to make up for all the missed opportunities to interact in person and socialize, resulting in an audience coming from 23 world countries. The workshop spanned over seven days with 15 lectures, 8 tutorials, and 6 demos in 4 different programme tracks.

The mornings during the week were reserved for plenary talks, briefly interrupted by a coffee break and networking opportunity, while the afternoons were filled with hands-on tutorials, demos, and presentations from companies in the field of marine robotics and its applications. The evenings are when the ever-so-popular social events took place, putting an emphasis on socializing and interaction in a more casual atmosphere. The IEEE OES International Night, Women in Blue, an ocean sciences themed Pub Quiz and Karaoke Night were just some of the evening events participants could take part in. In combination with its highly interdisciplinary nature, it is exactly the many networking opportunities that make this event so special.

The workshop was closed at a gala dinner on Friday, with ceremonial awarding of lecturers and contributors led by the BtS Program Chair and our SBC advisor prof. Nikola Mišković.

IEEE OES UniZg Student Branch Chapter leadership at the social event at BtS.

IEEE OES "International Night" on Monday.

Saturday was reserved for the traditional field trip to one of the local natural attractions, this year taking place in the beautiful city of Zadar.

As co-organizers of this official IEEE OES event, we are proud to say that we had the chance to bring over and engage many of our student members and volunteers in a multitude of activities that enriched the comprehensive week-long programme. One of our new student members, Allan Badian, who previously did an internship at the LABUST UniZG lab, was of great help with both organization and working on research projects as part of his thesis and was happy to share his view of the whole BtS experience.

As every year, IEEE OES UniZg Student Branch Chapter organized the social event on Monday, this year themed as "International Night," where attendees were invited to bring local food or drinks to best represent their home countries. It was a great way to start the week and for participants to get to know each other. A novel addition to this year's event was the Acoustic Localization Challenge, a competition in finding the best position estimate of a submerged acoustic pinger. More about that and much more in the rest of this article!

Breaking the Surface 2022 Workshop—Testimonial by Allan Badian, Student Member

This year BtS was my first participation in an international conference, and it was awesome! The lectures were inspiring

and the mood during this week was perfect. The demos were the best way to show systems and discuss science and robotics with interesting engineers or researchers. It allowed me to discuss my work and to get some new ideas, with a different approach.

Allan helping prepare the lecture room for the BTS opening.

Allan with Vladimir and Luka preparing a marine platform for experiments in Biograd and with Igor at the BtS closing night gala dinner.

I met a lot of people from all around the world in a fun way during the social events we did in the evenings. The field trip in Zadar was that great that I want to return over there on vacation (thanks to the guide)!

I want to thank again IEEE OES University of Zagreb SBC for the invitation and the amazing organization. I think this experience will stay for a while in my mind. So this is how my Croatian journey ends, hope to see you soon!

BtS field trip to Zadar on Saturday.

BtS 2022 Acoustic Localization Challenge

For the first time this year as part of Breaking the Surface workshop our members organized the Acoustic Localization Challenge. The participants of this year's workshop had a chance to participate in the challenge where they competed in teams in finding the best estimate for the location of an acoustic pinger hidden offshore.

Localization challenge teams collecting data at sea.

The idea of the challenge was to have an underwater acoustic pinger positioned at a secret location, transmitting a periodic signal every 28 seconds at 69 kHz, similar to ones that can be found in airplane black boxes or gliders. The participants were given up to three acoustic recorders from ThelmaBiotel, recording frequencies in the range of 63–77 kHz and a Garmin hand-held GPS receiver to record their positions and trajectories.

The activities of the challenge spanned throughout the whole week, starting with a lecture on Monday titled "The Role of Acoustics in Underwater Robotics," which gave theoretical background on the propagation of acoustic waves underwater and its use in underwater communication and localization. On Tuesday a tutorial titled "Underwater Localization of Acoustic Sources—Principles and Approaches" served to provide foundation material that will be explored during the hands-on

acoustic data processing and implementation of localization methods. On Wednesday, participants attended a lecture on localization techniques and a hands-on demo with the equipment that they had at their disposal given by prof. Roee Diamant from the University of Haifa. The tutorial was given in small groups with one-to-one feedback so participants could already discuss their ideas of locating the hidden pinger. Thursday was an action-packed day for all the teams that applied as they were each given an hour and a half time slot on a fast boat to go offshore and collect data they would later use to localize the hidden pinger.

Teams presenting their final results in front of the audience and panel of expert judges.

The data collection was particularly interesting as for some of the participants it was their first offshore field work experience and a chance to taste the charm of working in underwater robotics. After collecting the data, the teams had just around 24 hours to analyze and process the data and implement their localization solutions. On Friday, the five competing teams presented the approach they used, the methodology and finally their localization results in front of the audience and panel of expert judges composed of Nuno Alexandre Cruz and Bruno Ferreira from INESC TEC, Jeff Neasham from Newcastle University, and Roee Diamant from the University of Haifa who served as mentors throughout the week. Although all of the teams were given symbolic awards and certificates for their original approaches to the problem, the overall winners were chosen based on Euclidean distance to the original pinger location. The winning team had a triangulation approach and got an excellent position result within 30 m from the actual pinger position and were awarded a valuable prize—free registrations for all team members at the next year's Breaking the Surface workshop! Many thanks to all of the participants for their great effort and especially the mentors who were always there to help them!

The winning team, with the judging panel awarded, at the closing gala dinner.

Marine Robotics Hackathon

As a part of the "Marine Robotics" master's course at the Faculty of Electrical Engineering and Computing, we organized a hackathon for student applicants. The goal of the hackathon was to introduce our students to MARUS (https://github.com/MARUSimulator), an open-source marine robotics simulator we developed at LABUST. The goal was to familiarize our students with the simulator and to teach them how to utilize it to solve given challenges. The first tasks were implementing a position filter, which will improve performance of GNSS using an IMU, and implementing a line following controller. The next task was to implement a detector algorithm, which would count boats in a given image. The last task was the most challenging - previous solutions needed to be combined to explore a virtual marina full of boats and count occupied mooring spaces. Two teams participated in the challenge and the winning team won a trip to Breaking the Surface 2022 workshop where they got a chance to participate in various lectures, tutorials and challenges.

Winning hackathon team @ BTS 2022 tutorial.

IEEE OES Members at 14th IFAC CAMS

Our SBC members Igor, Nadir, and Ivan participated in the 14th IFAC Conference on Control Applications in Marine Systems, Robotics and Vehicles (CAMS). This year's edition of the conference was organized and hosted by the Technical University of Denmark and took place on September 14–16, 2022, in Kongens Lyngby, just outside Copenhagen. They were joined by their mentor prof. Nikola Mišković who was also the International Programme Committee Chair of the conference.

Igor, Nadir, and Ivan at the opening ceremony of the IFAC CAMS 2022 conference.

Igor presented a paper titled "Aided Diver Navigation Using Autonomous Vehicles in Simulated Underwater Environment" on Wednesday, September 14th during the afternoon session named Maritime Robotics (underwater, Surface, Aerial). The paper is co-authored by him, Đula Nađ, Ivan Lončar, Luka Mandić, Natko Kraševac, Juraj Obradović, and Nikola Mišković. At the end of the same session, Nadir presented a paper named "Landing Platform for Autonomous Inspection Missions in Mariculture Using an ASV and a UAV" co-authored by him, Martin Oreč, Nikola Mišković, and Fausto Ferreira.

On Thursday, September 15th, Ivan chaired the afternoon session named "Towards More Resilient Autonomous Operations for Maritime Vessels" that he also co-organized. Nadir

Igor presenting his paper named "Aided Diver Navigation Using Autonomous Vehicles in Simulated Underwater Environment".

Nadir presenting his paper titled "Landing Platform for Autonomous Inspection Missions in Mariculture Using an ASV and a UAV".

presented his second paper named "Tether Management System for Autonomous Inspection Missions in Mariculture Using an ASV and an ROV" during the "Automation of Ship's Systems" session he also co-chaired. The paper is co-authored by himself, Kristijan Krčmar, Nikola Mišković, and Đula Nađ.

On the last day of the conference, on Friday, September 16th, Ivan also presented his paper titled "Maximum Likelihood Based Underwater Localization Algorithm Aided with Depth Measurements" in the scope of the thread "Guidance, Navigation and Control (GNC) of Unmanned Marine Vehicles (surface and Underwater)" session, that he and Nikola Mišković co-authored.

Ivan presenting his paper "Maximum Likelihood Based Underwater Localization Algorithm Aided with Depth Measurements".

Our members used this conference not only as a chance to present their research results, but also to network with experts from the field of marine robotics. All conference attendees were invited for a dinner at the famous Michelin star-awarded Søllerød Kro restaurant on Thursday, September 15th.

Furthermore, after the conference wrap up on Friday, September 16th, they used the afternoon before returning to Zagreb for sightseeing. Their first stop was the world-famous Tivoli theme park in Copenhagen city center. They couldn't resist the

Ivan, Igor, and Nadir in the garden of Michelin star-awarded restaurant Søllerød Kro.

adrenaline rush and went for a free fall experience at the Golden Tower as well as the Dæmonen rollercoaster.

Igor, Ivan, Nadir, and Nikola at Tivoli park and the Dæmonen rollercoaster.

The team exploring Copenhagen's many sights; Nyhavn, Kastellet and the Little Mermaid.

The Copenhagen experience would not have been complete without riding around the city on a bicycle, so we rented a few of many available rent bikes and visited the hip neighborhood of Nyhavn where famous writer H. C. Andersen lived in the 19th century, as well as the statue of The Little Mermaid made in honor of his book character.

OCEANS 2022 Hampton Roads

Zagreb SBC members Nadir, Ivan, Natko, Juraj and Matej participated in the OCEANS 2022 conference, as is tradition, which took place in Hampton Roads, USA. The conference was co-organized by the The Marine Technology Society and the IEEE Oceanic Engineering Society and was held on October 17–20, 2022. The Zagreb SBC team was joined by prof. Fausto Ferreira who is a senior researcher at the Department of Control and Computer Engineering, and their mentor prof. Nikola Mišković. Sadly, only Fausto was able to go to the USA and attend the conference in-person and others joined online.

Fausto presented two papers he co-authored. "LIDAR-based USV close approach to vessels for manipulation purposes" by Ferreira, F., Kraševac, N., Obradović, J., Milijaš, R., Lončar, I., Bogdan, S. & Mišković, N. The second paper was titled "Operating drones at sea—maritime law implications" by Ferreira, F., Mišković, N.

Two more papers were accepted from PhD and Master students of Zagreb's Faculty of Electrical Engineering and Computing as virtual on-demand presentations: "MARUS—A Marine Robotic Simulator" by Lončar I., and "Biofouling Estimation in Mariculture" by Fabijanić, M., Kapetanović, N. & Mišković, N.

Matej Fabijanić, our graduate student, shared his experience of attending OCEANS 2022:

As a virtual attendee I had access to livestreams of plenary sessions with many interesting topics presented by esteemed researchers in the field of marine and ocean engineering. The online portal also provides access to a plethora of this year's papers and accompanying video-presentations from many different areas such as automatic control, data visualization, vehicle design, etc.

It was a great experience to see what people all around the world are doing in the field of marine robotics, what kind of equipment they are developing or working with, and for what purpose.

Fausto in the bottom row, third from the right with other attendees of the conference.

Team: HIT-Robotics Challenges to SAUVC 22

Jonghyun Ahn, Shoun Masuda, Kakeru Nishizaka, Koki Tokiyasu (Hiroshima Institute of Technology)

Hiroshima Institute of Technology undergraduate students challenged at Singapore AUV Challenge 2022 for the first time with the support of OES Japan Chapter. Please enjoy our story!

1. Introduction

The Singapore AUV Challenge 2022 (SAUVC 22) was held at Singapore Polytechnic on 23–26 September 2022. This event has been held every year since 2013, except during 2020 and 2021 when the damage was severe due to the COVID-19 pandemic. We have been preparing for SAUVC since 2020. This report introduces our team, and activities for SAUVC 22.

2. Introduction of HIT-Robotics

HIT-Robotics was formed in 2019 as a student robotics team of the Hiroshima Institute of Technology, and is developing various robots such as legged robots, marine robots, and agricultural robots, and challenging robot competitions. In activities of marine robotics, we developed 5 robots to participate in marine robotics competitions. The developed marine robots are shown in Fig.1.

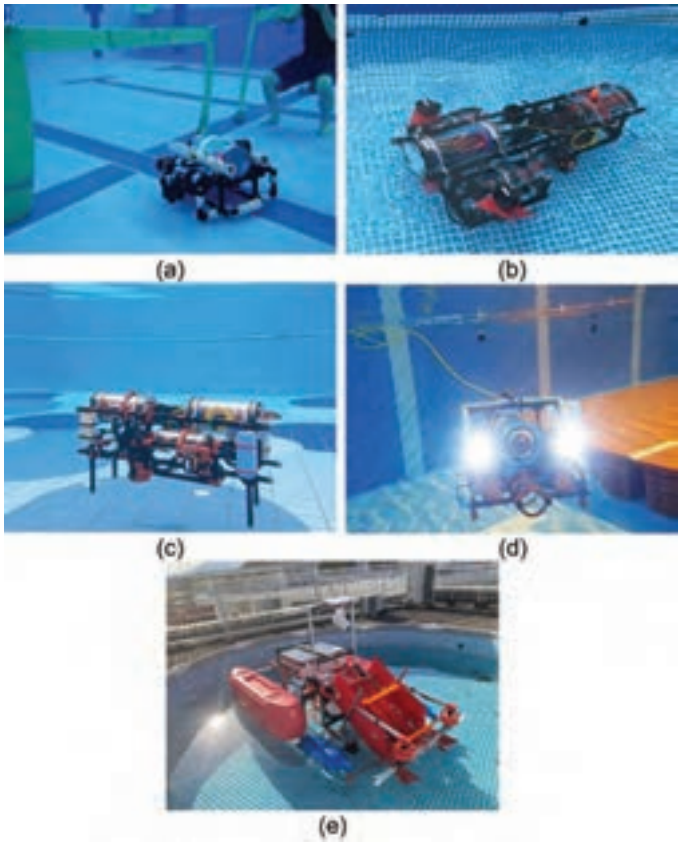

Figure 1. Developed marine robots by HIT-Robotics.

(a), (b) and (c) in Fig.1 are the developed Autonomous Underwater Vehicles (AUVs). (a), that is called HIT-AUV, participated in the underwater robot festival 2019, which was held at Fukuoka, Japan. HIT-AUV was equipped with 4 thrusters, camera, depth sensor and IMU. And the size was 500 × 680 × 330 [mm], the weight was 15.2 [kg]. In the underwater robot festival 2019, HIT-AUV carried out various tasks such as gate, buoy, and landing. (b) is called HIT-AUV 2, was equipped with 6 thrusters, 3 cameras, depth sensor, IMU, altitude sensor and kill switch. HIT-AUV 2, with 1100 × 700 × 320 [mm] dimensions and 28 [kg], participated in the underwater robot festival 2022, which was held at Yamaguchi, Japan. HIT-AUV 2 carried out gate task and buoy task in this competition. (c), is called Marine Gear, was developed to participate in SAUVC 22. Marine Gear is equipped with 5 thrusters, ball dropper, 3 cameras, depth sensor, IMU and kill switch. The detail of Marine Gear will be described in chapter 3. (d), is called JENOS, was developed to participate in free-style section of the underwater robotics competition in Okinawa 2021. JENOS was developed as remotely operated vehicle, and it is equipped with 8 thrusters, camera, depth sensor and IMU. (e), is called MIROCA, was developed as an unmanned surface vehicle to collect ocean debris. MIROCA also participated in free-style section of the underwater robotics competition in Okinawa 2021, and it showed the performance of collecting ocean debris.

3. Marine Gear and its Transportation

Marine Gear was developed to participate in SAUVC 22. Therefore, it was designed to be easily disassembled and reassembled, considering transportation using an airplane. The appearance of Marine Gear is shown in Fig.2.

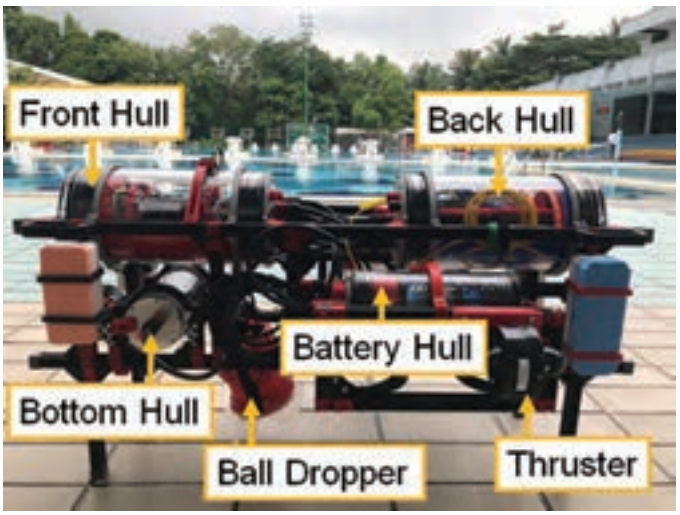

Figure 2. Appearance of AUV Marine Gear.

Marine Gear is composed with 5 hulls, such as front hull, back hull, bottom hull and 2 battery hulls, ball dropper and 5 thrusters. In the front hull, computer, Arduino, motor drivers, front camera, IMU, Wi-Fi module, kill switch were mounted. Arduino, back camera, depth sensor, USB-Ethernet modem and optical media converter were mounted in the back hull. The bottom hull contained the bottom camera, with a ball dropper mounted right behind. 14.8 [V] Li-Po batteries and voltmeters were mounted in the battery hulls, and each battery provides power to the computer and thrusters. In order to prevent damage during transportation, each hull, which was made by acrylic pipes, was transported in suitcases that can be carried inside the airplane. We loaded the suitcases on the airplane and carefully stored them during the flight. Figure 3 shows a scene of how the parts of the Marine Gear were transported from Japan to Singapore.

Figure 3 was taken in MRT station of the Changi airport. We carefully carried the suitcases in Fig.3 to the venue of SAUVC 22, then the disassembled Marine Gear was reassembled at the venue. A scene of reassemble Marine Gear is shown in Fig.4.

As shown in Fig.4, we could take each part out of the suitcases and assemble Marine Gear's frame and fix each hull to reassemble the Marine Gear within 3 hours.

4. Introduction of SAUVC 22 and Our Strategy

SAUVC 22 had three rounds such as video audition, qualification round, and final round. Each team uploaded a short video to show their AUV actually works, including a safety device to stop motion, which is called the kill switch, in the video audition. This year, video audition was conducted around March 2022. 93 teams registered, and 42 teams passed this round. The next round was the qualification round. In this round, each team tried to make their AUV pass the gate 10 [m] apart. The teams were ranked by the time to pass the gate. This year, the top 16 teams, including our team, passed this round. The final round had the following 4 tasks, such as navigation, target acquisition, target reacquisition and localization. The main arena of SAUVC 22 for each task is shown in Fig.5.

Figure 3. Marine Gear transport scene from Japan to Singapore.

Figure 4. Marine Gear reassemble scene at Venue of SAUVC 22.

In the final round, the starting zone in Fig.5 is a 1.4 × 1.4 [m] area marked on the surface of the water. Each team has to start their AUV from this area. The team may only place the AUV at the water surface, it must autonomously submerge before leaving the starting zone. And then, the navigation task is mandatory and must be completed before attempting any other task. The other tasks can be attempted in any order. Surfacing at any point signifies end of the attempt. The details of each task are described below.

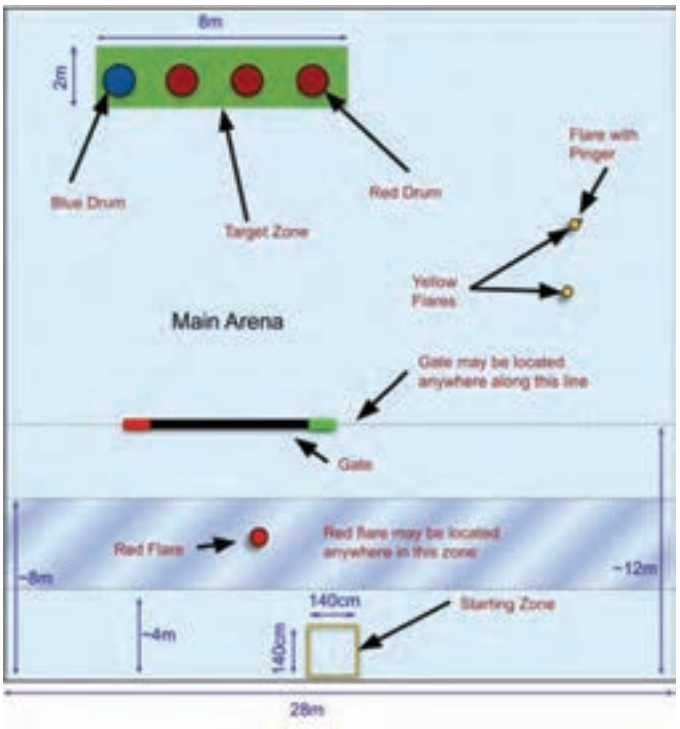

Figure 5. Main arena of SAUVC 22 for final round (https://sauvc.org/rulebook).

4. 1 Navigation Task

The aim of the navigation task is to swim, avoid an obstacle called the red flare, and then through a gate placed at the bottom of the pool. The red flare may be located anywhere in a rectangular zone 4 [m]–8 [m] from the side of the arena (in Fig.5), before the gate. The AUV has to avoid touching the red flare. And the gate may be located anywhere on a horizontal line, parallel to the side of the swimming pool, approximately 12 [m] away from the starting zone. The AUV has to swim through the 1.5 [m] tall gate without touching the gate. If the AUV successfully passes through the gate, 15 points will be awarded.

4. 2 Target Acquisition and Reacquisition Task

The aim of target acquisition is to detect and acquire a target among a series of drums at the bottom of the pool, in the target zone. A target zone is defined by a green colored mat laid out on the floor of the pool. The mat is 8 × 2 [m] in size. Fig.5 shows the location of the mat with respect to the arena. There are 4 colored drums in the arena. All of them are on the mat. One of the drums, chosen at random, will be blue in color, while the rest are red in color. One of the red drums, chosen at random, will contain an acoustic pinger. The AUV needs to drop a ball in one of the drums to successfully complete this task. Points will be awarded based on which drum the ball is dropped into. In the event of multiple balls being dropped, only the first ball is taken into consideration. Points will be awarded as follows.

Drop the ball in the blue drum: 30 Points
Drop the ball in the red drum with the pinger: 50 Points
Dropping the ball in any other red drum: 10 Points

In the target reacquisition, after the task of Target Acquisition is completed, the AUV can try to pick up the ball in the drum. If the AUV successfully picks up the ball and holds onto it till the end of the attempt, 60 Points will be awarded.

4. 3 Localization Task

The aim of this task is to localize on a yellow flare. There are two yellow flares in the arena, only one yellow flare is marked with an acoustic pinger. These flares could be located anywhere within the main arena. The AUV should locate and bump a flare causing the golf ball on the flare to drop out. The flares will be yellow in color. Only the first flare that is successfully bumped by the AUV is taken into consideration. Points would be awarded as follows. If the AUV successfully causes the ball to drop from:

Flare with the pinger: 40 Points
Flare without the pinger: 20 Points

4. 4 Our Strategy for Final Round

In the SAUVC 22, our team tried 2 tasks such as navigation and target acquisition. In our strategy, AUV Marine Gear avoids the red flare, passes the gate that has red and green color, and moves toward the blue drum on the green colored mat. Then, the AUV will try to drop an orange-colored golf ball into the blue drum. For the move toward the blue drum, the AUV will recognize red flare, gate, green mat and blue drum, using the front camera and bottom camera. For realization of our strategy, we practiced in the pool that set up each task. The scene of practice in the pool is shown in Fig. 6.

As shown in Fig. 6, a gate and a red flare were prepared and programmed to be recognized by the AUV for the navigation task. Then, we tested the developed ball dropper for the target acquisition task. Operating scenes of developed ball dropper are shown in Fig.7.

Figure 6. Scene of practice in the pool.

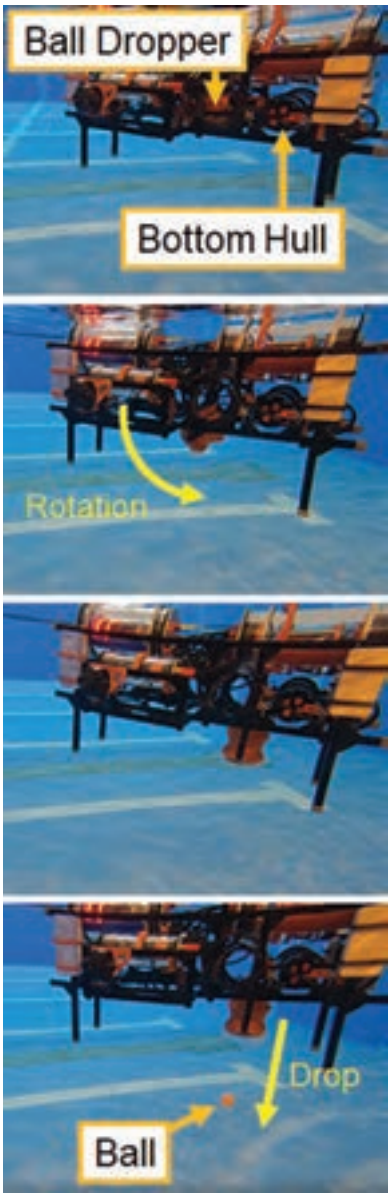

Figure 7. Operating scenes of developed ball dropper.

As shown in Fig.7, the ball dropper was rotated to be perpendicular to the pool floor, and then the device was operated to drop the ball.

5. Our Struggle in SAUVC 22

5. 1 Preparation Day

The first day of SAUVC 22 had short guidance, team AUV presentation and preparation for qualification and final round. After a short presentation on our AUV to the judges, we checked our AUV and moved to pool side. Two students, excluding the operator, put the AUV into the pool and checked its operation (Fig.8). Through the number of trials, we found the problem that the IMU was not working sometimes. We tried to detect the cause, but we could not.

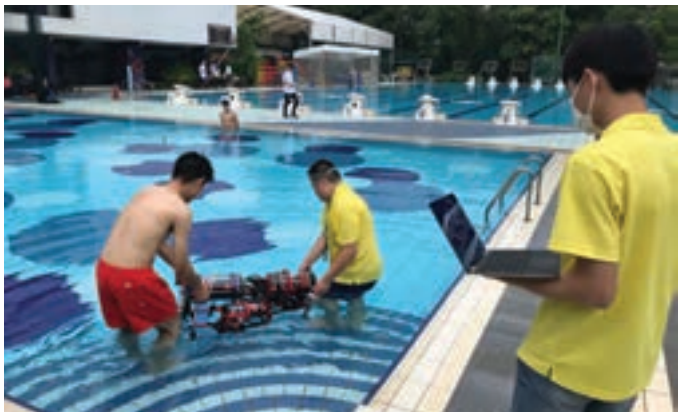

Figure 7. A scene of preparation day.

5. 2 Qualification Round and Final Round

The qualification round for our team was set to start at 11:55. In the qualification round, AUV Marine Gear was able to pass through the qualification gate and our qualifiers rank was 9th. In the final round (Fig. 8), we tried to operate the AUV according to our strategy. However, the AUV could not get heading data from the IMU, then the AUV could not pass the gate, therefore our final rank was 14th.

Figure 8. A scene of final round.

6. Conclusion

We learned a lot from SAUVC 22, although our AUV could not pass the gate in the final round. We were able to interact with many students from other countries (Fig,9), then we got the friendship and a lot of ideas for development of our AUV system. If possible, we would like to participate next year, and try again on tasks that we could not achieve this year.

Also, we hope more students join the world of underwater robotics with amazing experience in SAUVC (Fig,10).

Figure 9. Exchange with students from other countries.

Figure 10. A scene of after prize presentation ceremony.

Acknowledgments

This project was supported by Youngster Robocon Support Program 2022 offered by IEEE OES Japan Chapter. We would like to express our sincere appreciation to the organization for strong support.

wARIEL, the AUV Won First Place in Underwater Robot Convention in JAMSTEC 2022!

Amane Toriyama, Masaki Ohashi, Hiroki Yokohata, The University of Tokyo

Introduction

On August 27 and 28, students and enthusiasts gathered online to take part in the Underwater Robot Convention in JAMSTEC 2022. The event, hosted by NPO Japan Underwater Robot Network, serves as a forum for participants to exchange technical ideas and build networks through presentations and the competition of underwater robots. The overview of this year's event can be found in the convention's website [1] (in Japanese), and the events in previous years are described in [2], [3], [4], and [5].

We, the authors, are masters course students in Prof. Maki's laboratory at the University of Tokyo. We participated in the Free-style division as team "UT Maki Lab." [Figure 1]. Our primary aim was to accumulate basic knowledge and skills related to underwater robotics in preparation for future research work. We also learned how to collaborate as a team, which is a crucial aspect in developing and operating underwater robots.

Rules

In the Free-style division, the event organizers called for "high quality" robots that set an objective to solve real-world problems. Each team uploaded a poster and two videos of five minutes each, one to present their robot configuration and software system, and another to demonstrate its capability. The judges evaluated the overall performance based on the two criteria listed in table 1.

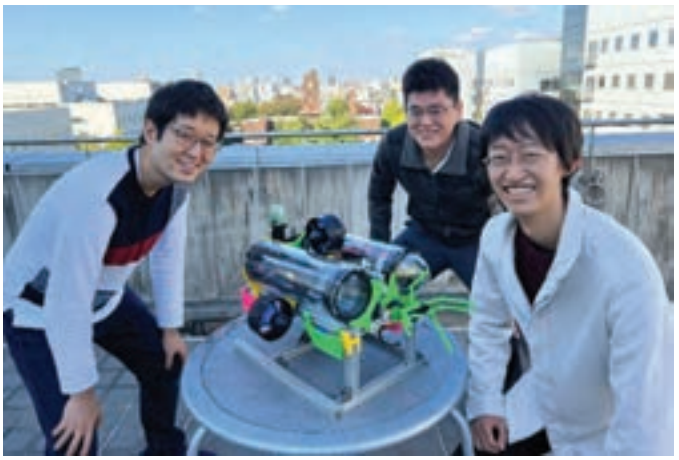

Figure 1. The group photo of "UT Maki lab" Team and the AUV, wARIEL.

Table 1. Criteria for Free-style division

Presentation	Competition points	Total
50	50	100

Mission

We set the mission to break a balloon in the water with an AUV as a demonstration to set an objective to solve a real-world problem and to prove a high level of perfection.

The rules for underwater balloon splitting are as follows Red, yellow, green, and blue balloons are placed at a depth determined for each color. Points are earned by breaking the balloons, and the points earned are different for each balloon color. Red is 30 points, yellow is 20 points, green is 40 points, and blue is 10 points. The placement of the balloons is random. The only tool that can be used to break the balloons is a push pin. The game was supposed to be held offline, but due to the spread of the coronavirus, it was decided to hold the game online. Therefore, red and yellow balloons were randomly placed at a depth of 40 cm in a water tank 3 m wide, 4 m long, and 1 m deep at the Institute of Industrial Science, University of Tokyo. The starting position of the robot was also set randomly [Figure 2].

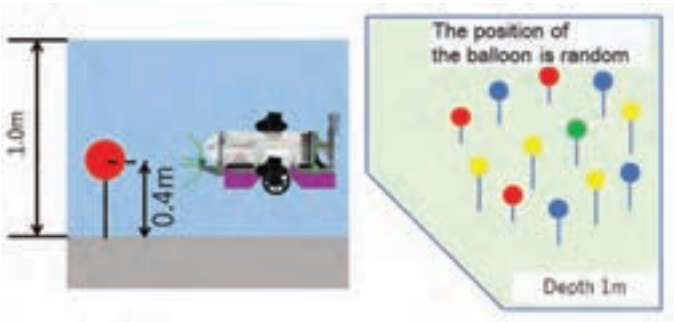

Figure 2. Overview of rules.

Strategy

Our mission was to recognize and break a balloon underwater with an AUV. The robot would recognize the balloon underwater with its camera, detect the relative distance between the balloon and the AUV, and push a push pin attached to the robot to break the balloon. This mission was divided into two tasks: balloon search and approach [Figure 3]. During the balloon search task, the robot hovered and rotated slowly in the YAW direction to search for balloons using a CV algorithm. If the balloon on the camera is red or yellow, the robot decides to move on to the next task, the approach task. During the approach task, the robot approaches the balloon, adjusting its position so that the balloon is in the middle of the aircraft. When the balloon is close enough that it is no longer recognized, the robot determines that the balloon is broken. After the balloon is broken, the robot returns to the balloon search task and searches for the remaining balloons. If no balloons are recognized after a 360 degree YAW rotation during the search,

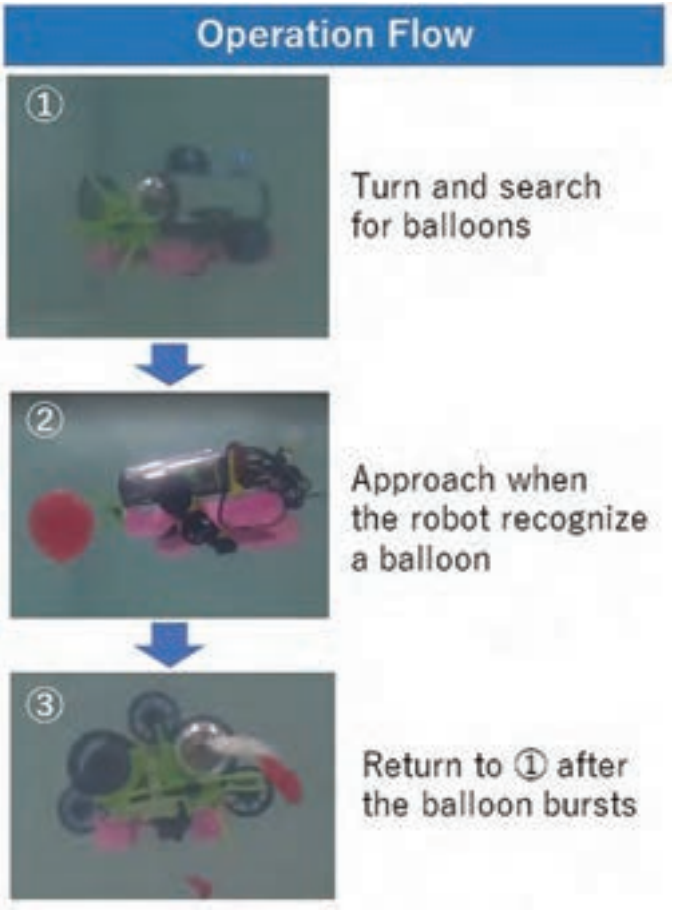

Figure 3. Operation Flow of AUV.

or if the 4 minutes mission time expires, the robot completes the mission and ascends to the surface.

AUV

To demonstrate our mission, we have developed a hovering type autonomous underwater vehicle named "wARIEL" [Figure 4, Figure 5]. wARIEL estimates its depth using a depth sensor that measures water pressure. It is equipped with a camera in the hull to recognize balloons in the water. In addition, a mechanism that swings the camera up and down allows for a wider search area for balloons [Figure 6]. The camera is also lightweight and maneuverable, as it is necessary to increase the surge speed in order to break the balloons. Since the push pin must be pressed against the balloon from the front in order to break the balloon, a guide is attached around the push pin to guide the center of the balloon toward the push pin.

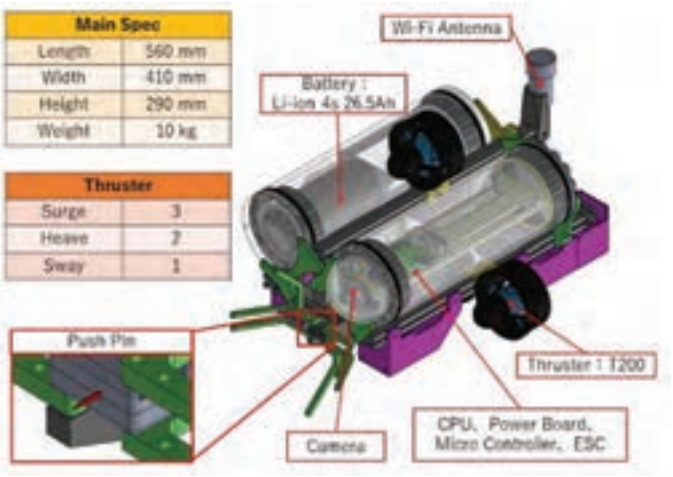

Figure 4. General arrangement of AUV wARIEL.

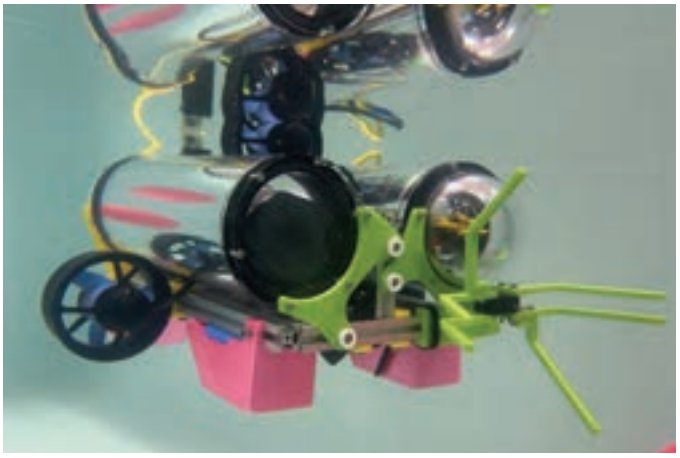

Figure 5. The hovering type autonomous underwater vehicle for balloon splitting named wARIEL.

wARIEL controls itself using a Raspberry Pi microcontroller and Teensy drivers. We implemented the software application of wARIEL using the ROS, an open-source library and tools commonly used to develop robotics applications. The ROS is a powerful tool for parallel distributed processes such as sensor and actuator signal handling. wARIEL uses Hough Gradient Method to perform circle detection. wARIEL rewrites

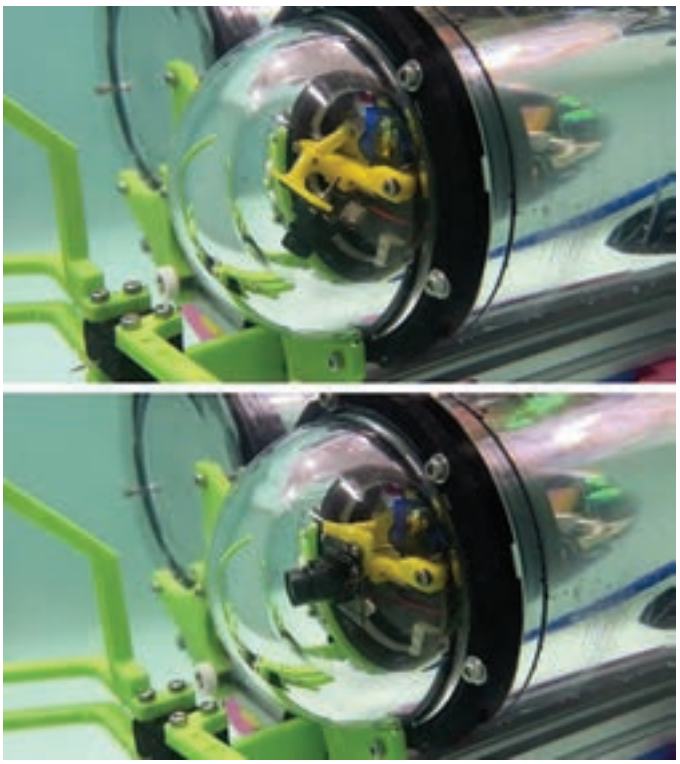

Figure 6. The camera servo system.

images gotten from the camera into HSV format. It then acquires the color inside the circle and recognizes the color of the balloon [Figure 7]. Hough Gradient Method is easy to tune. As parameters, thresholds or a channel, changed, this method is adaptable for different environments. For example, green axis in RGB is fit to determine balloon shapes and colors in our water tank. In JAMSTEC pool, we had a plan to use an axis on CIE-Lab (from red to green) and a water color recovery system. Analyzing the YouTube movie [6], this system detected balloons almost correctly. These shows hough gradient method is useful to detect colors if the environment changes.

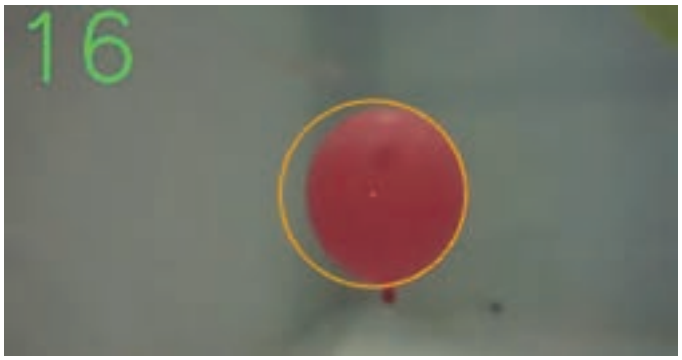

Figure 7. The system in wARIEL detecting a balloon using a downward looking camera.

The relative position of the camera and the balloon is estimated from the size and position of the balloon as seen by the camera. We set the balloons diameter at about 20 cm, so the distance from AUV camera to balloons can be calculated as following formula (1), (2), (3) with focal length and compressed size. It then estimates the relative distance between the AUV and the balloon, taking into account the relative angle between the aircraft and the camera and the roll and pitch angle of the AUV [Figures 8 and 9]. The formulas are below (4), (5), (6). This software program runs quickly and accurately on the Raspberry Pi despite its limited computing power; wARIEL completes its mission accurately by transitioning to the appropriate mode depending on the recognition results from the camera.

$$x_{\mathrm{diff}} = \frac{r \cdot f}{2 r_{\mathrm{detect}} \mu c} \tag{1}$$

$$y_{\mathrm{diff}} = \frac{x_{\mathrm{diff}}}{f}(y_{\mathrm{pixel}} - y_{\mathrm{pixelcenter}})\mu \tag{2}$$

$$z_{\mathrm{diff}} = \frac{x_{\mathrm{diff}}}{f}(z_{\mathrm{pixel}} - z_{\mathrm{pixelcenter}})\mu \tag{3}$$

$$\begin{pmatrix} r : the\ radius\ of\ set\ balloons\ (cm) \\ f : focallength\ (cm) \\ r_{\mathrm{detect}} : the\ circle\ radius\ detected \\ \mu : pixceltocm\ constant \\ c : compression\ ratio\ of\ pixeltocm \\ y_{\mathrm{pixel}} : detected\ location\ y\ in\ image \\ y_{\mathrm{pixelcenter}} : center\ location\ y\ in\ image \\ z_{\mathrm{pixel}} : detected\ location\ z\ in\ image \\ z_{\mathrm{pixelcenter}} : center\ location\ z\ in\ image \end{pmatrix}$$

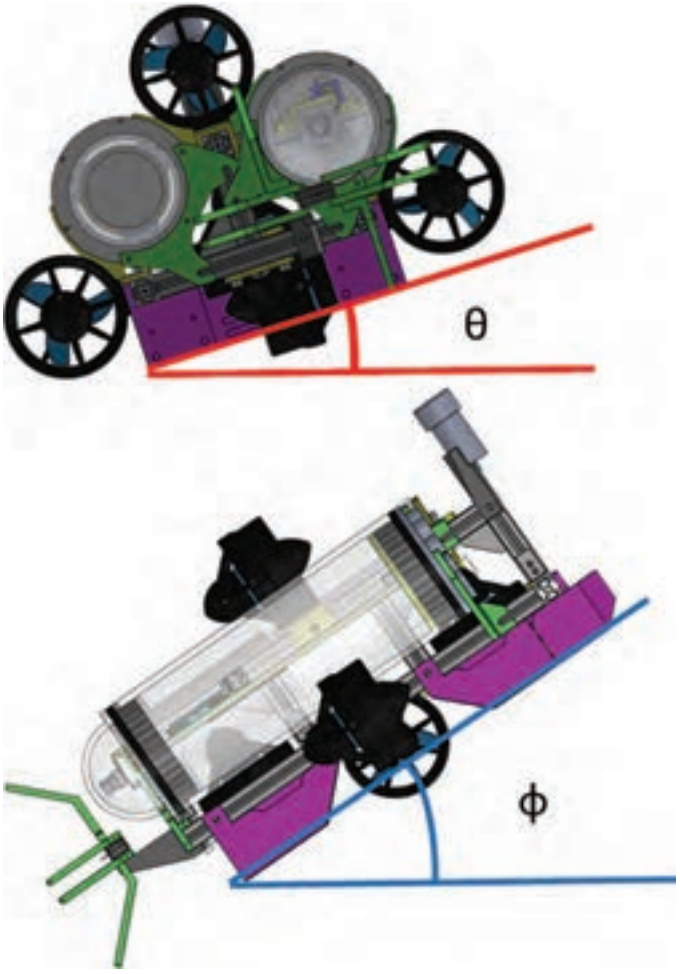

Figure 8. The case of changes, roll or pitch.

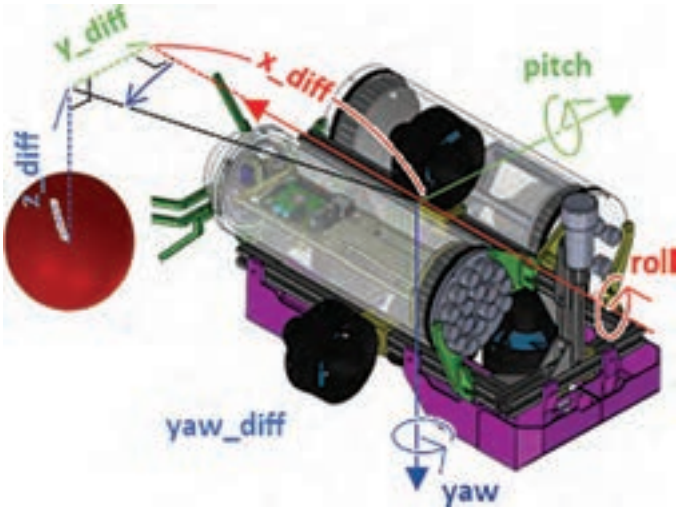

Figure 9. Calculate the position of the balloon considering the attitude of the AUV.

$$x = x_{\mathrm{diff}} \cos\phi + y_{\mathrm{diff}} \sin\theta \sin\phi + z_{\mathrm{diff}} \cos\theta \sin\phi \tag{4}$$

$$y = x_{\mathrm{diff}} \cos\theta - z_{\mathrm{diff}} \sin\theta \tag{5}$$

$$z = -x_{\text{diff}} \sin\phi + y_{\text{diff}} \sin\theta \cos\phi + z_{\text{diff}} \cos\theta \cos\phi \quad (6)$$

We started working on it in earnest in June 2022, with less than three months left before the August 23 submission date, so we needed to be efficient. We divided the wARIEL development process into three subprojects: hardware, airframe control algorithms, and balloon detection algorithms, and divided the subprojects into conquered. Each process was carried out in parallel by appointing a person in charge of each part. While completing each task, it was also important to collaborate and exchange opinions. in July, the hardware was completed to some extent, making it possible to operate wARIEL under manual control. In early august, the system and AI, which were underway simultaneously, were combined with the hardware and a prototype of wARIEL was completed by combining the hardware with the system and AI that were being developed at the same time.

Starting in August, we tested and adjusted wARIEL in the tank. The center of buoyancy and center of gravity were adjusted, PID parameters were adjusted, and parameters for the balloon recognition system were set. Prior to the submission date, wARIEL was completed as an autonomous underwater robot, recognizing balloons underwater and performing approach movements to balloons [Figures 7 and 8]. wARIEL succeeded 14 out of 20 attempts, representing a 70% mission success rate.

Result

On the first day of the event, each team shared their presentation video and answered questions online; on the second day, each team did the same, sharing their demo video and finally the awards ceremony. Our video can be found on the NPO Japan Underwater Robonet's YouTube channel [6], and our final score is shown in Table 2: with an impressive score of 85.8 points, we placed first out of all 12 teams.

Looking back, the Underwater Robotics Convention made us realize the difficulty of developing an underwater robot, the importance of collaboration, and connected us with people in the related industry. We have no doubt that the experiences gained throughout the intense three months of development, and the event, will be of great strength for us in future research work.

Comments

Finally, we will close this article with a short comment from each member.

Amane Toriyama: Building a robot is hard work, but I gained a lot by working with my colleagues to complete the project. I would like to thank all of my teammates and everyone in the Maki lab for their advice and support.

Masaki Ohashi: Studying ROS system and the knowledge of AUVs were really tough. I can overcome it because my team members worked enthusiastically and staffs, students, teachers in the laboratory give us helpful advice. I appreciate it for them.

Hiroki Yokohata: Thanks to the help of the members in the Maki lab we were able to achieve the result of winning the competition. In fact, I will participate in next year's competition and continue to do my best to win.

Acknowledgment

The Underwater Robot Convention in JAMSTEC in 2022 was supported by The Japan Society of Naval Architects and Ocean Engineers, IEEE/OES Japan Chapter, MTS Japan Section, Techno-Ocean Network, Kanagawa Prefecture, Yokosuka City, Tokyo University of Marine Sciences and Technologies, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Center for Integrated Underwater Observation Technology at Institute of Industrial Science, the University of Tokyo, Sea challenge Co., Ltd., FullDepth Co., Ltd., ARAV Co., Ltd., Space One Co., Ltd., Japan Branch of Robotiz,Inc, Matsuyama Industry Co., Ltd., Aqua Modelers Meeting, and Matsuyama Industry Co., Ltd., Misago Co., Ltd., Japan Underwater Drone Association. We would like to express our sincere appreciation to the sponsors for their strong support and cooperation in realizing this event.

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