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Newsletter of the 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.

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From the President

How many OCEANS conferences have you attended?

A year ago we celebrated the 60th OCEANS conference [1] during OCEANS 2017 Aberdeen, co-sponsored with the Marine Technology Society (MTS). We cannot thank enough the Aberdeen local organizing committee, led by Prof. John Watson, Brian Horsburgh, and Nikki Pearce, for rising to the occasion and creating a very successful marine science and ocean engineering forum attended by over 780 delegates from 31 countries. Attendees appreciated the professional networking opportunities that are the hallmark of OCEANS conferences, and the local hospitality delivered with proper Scottish decorum, bracing dampness, commemorative single malt Scotch whisky bottled for the occasion, and more [2].

During OCEANS 2017 Aberdeen, MTS and OES established a joint OCEANS Steering Committee (OSC) responsible for OCEANS strategy and oversight. This vast program began with the long-overdue revision of the venerable joint OCEANS conference operating agreement signed by the Societies on July 31, 1995, when there was a single annual OCEANS conference—and life seemed easier for some of us.

I am pleased to report that as of June 25, 2018, the Societies have ratified a new binding agreement for joint operation, in equal shares, of the OCEANS conference series. Why should you care? A few reasons:

- For the foreseeable future, the Societies are committed to co-sponsoring two OCEANS conferences per year: one held annually in North America in September-October, and the other held in May-June in Europe in odd numbered years and Asia-Pacific in even numbered years. Mark your calendars (http://www.oceansconference.org/).

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From the OES BEACON Editors

Harumi Sugimatsu and Robert Wernli

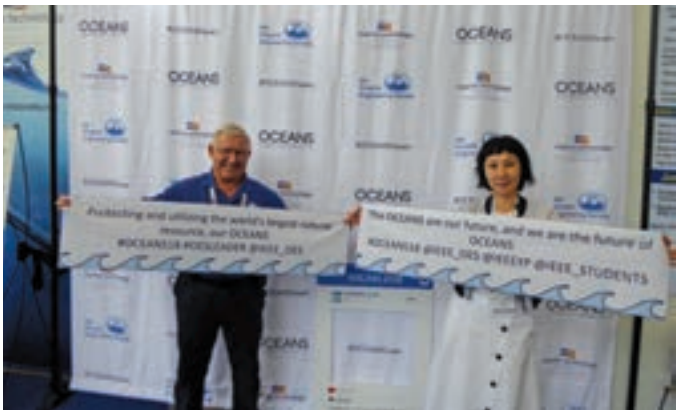
Welcome to the September 2018 issue of the Beacon. And, once again, we'd like to thank all of the contributors to our quarterly newsletter. As you can see by the content, this is your newsletter, and we try to cover all aspects of the society activities from our workshops, symposia and conferences to what our individual members, chapters and committees are up to. And, don't forget, all issues of the Beacon are available on the OES website.

Our last issue featured reports from many of our elected officials, introduced our YP-BOOST winners (see their reports on OCEANS'18 Kobe in this issue), AUV competition results, upcoming events and a large number of member, committee and chapter reports. And this issue will continue providing you with the latest OES activities and opportunities for our members, including our newly elected AdCom members. Want to get involved? Consider running for an AdCom position in 2019 or get involved in supporting our social media initiatives.

First of all, we'd like to welcome aboard our two newest Associate Editors, Katsunori Mizuno and Takeshi Nakatani, who are introduced in this issue.

Of particular interest in this issue are the reports from the President and also our VP of OCEANS that address the many changes within the society to enhance the efficiency of identifying OCEANS venues and increasing the operation of the conferences so that we provide our exhibitors and attendees with exactly what they expected . . . and more!

A significant event at the OCEANS conferences is the Student Poster Competition. Enjoy the article on all the participants and winners, along with the winning paper. Also included is a report from our VP for Technical Committees with the latest on the new committee structure.



Your editors in front of the OCEANS social media banner in Kobe.

Chapter activity continues to accelerate as reported by the Australia, Victoria, B.C., and Japan chapters. Besides our many ads that provide details on upcoming conferences and events, we include a report on the very successful OCEANS'18 MTS/IEEE Kobe / Techno-Ocean 2018 (OTO'18) conference. Also included are reports on our two successful OTC conferences and the 7th IEEE/OES Baltic Symposium. Your OES Journal editor provides the latest, including recently released technical papers.

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. There are also many opportunities for students and Young Professionals. It's your society and it is here to help you reach your professional goals. Enjoy.

Introduction of Beacon Associate Editors, July 2018

From Beacon Associate Editors

As the editors of the OES Beacon, we want to ensure that everyone knows the depth of support by our team of Associate Editors. And, the high level of technical expertise that they bring to our excellent publication. There are some changes to the members list of Associate Editors from July 2018. We thank the outgoing member "Katsuyoshi Kawaguchi", and welcome new members, "Takeshi Nakatani" and "Katsunori Mizuno" with their graphical sketches that follow.

Katsunori Mizuno

Katsunori Mizuno received B.E., M.S., and Dr. Eng. degrees in Doshisha University, Kyoro, Japan, in 2006, 2008, and 2012, respectively. From 2008 to 2012, he was an engineer at the image sensor business unit, Panasonic corporation. From 2012 to 2017, he was a projective research associate at Institute of Industrial Science, The University of Tokyo, where he joined several national projects and developed various types of sonar systems. In 2017, he moved to the Graduate School of Frontier Sciences, The University of Tokyo as an assistant professor. Now he is currently

involved in development of a new underwater sensing system for the monitoring of the underwater environment and its applications, and has twin boys.

Takeshi Nakatani

Takeshi Nakatani is a research scientist at Japan Agency for Marine-Earth Science and Technology (JAMSTEC). His research background is underwater robotics, especially software design, control and sensing. He received the B.E. degree, the M.S. degree, and the Ph.D. degree in ocean engineering from the University of Tokyo, in 2004, 2006, and 2009, respectively. From 2009 to 2011, he was a researcher at the University of Tokyo. In 2011, he became a research scientist at JAMSTEC. He had been involved in the development of seafloor observation systems and applications using AUV and ASV. He has participated in an international competition "Shell Ocean Discovery XPRIZE" as the team leader of Team KUROSHIO, which is a Japanese team with young Japanese engineers and researchers.

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VPTA Report

Malcolm Heron, OES Vice President for Technical Activities

The Technology Committees are at the very foundation of the Oceanic Engineering Society. They define the activities covered and provide a reference for our Conferences, Workshops and Symposia. During the past year a group of people have been busy reviewing the Technology Committees to weed out the overlaps where committees were competing with each other on the same topics. And some gaps were identified where the coverage of the Technology Committees did not quite include all areas of activity in the Society. We started with the philosophy that Technology Committees should each have a clearly defined area of technology as their basis, and then have a scope that includes development of the technology and its applications, and expresses some idea about how their technology benefits humanity. This totem pole going from the foundations in technology to the benefits to humanity sets IEEE-OES apart from many of the ocean-related societies like science-focused AGU on one hand and the technologically focused MTS on the other. We should value and promote this holistic structure.

The Technology Committees (TC) look new and refreshed, mostly with different names and keywords as well as revised scopes. Chairs will have three-year terms that are renewable, but not forever. Some TCs have merged and some have disappeared. I think that there are still some gaps, but I am not going to talk about them here: I want you to write to the VPTA if you see a gap where we should have a TC. Once these are approved by AdCom all of the details will go onto the OES Web Site and OES members (i.e. you) will be invited to affiliate with one or more of the Technology Committees. Several of the TCs are

planning workshops and/or tracks in conferences; all are involved in reviewing abstracts for conferences and symposia; and there is a wide range of other activities that TCs are involved in, like robot competitions for students, and multi-society working groups. TC chairs are being asked to nominate OES members for the OES Distinguished Lecturer Program. The TCs as a group are the engine-room of OES and will now be more visible in the activities of the Society.

The 13 new Technology Committees will be:

- Autonomous Maritime Systems (AMS);
- Current, Wave and Turbulence Measurement and Applications (CWTMA);
- Data Analytics, Integration and Modeling (DAIM);
- Ocean Observation and Environmental Sustainability (OOSES);
- Ocean Remote Sensing (ORS);
- Ocean Sustainable Energy Systems (OSES);
- Polar Oceans;
- Standards;
- Subsea Optics and Vision;
- Underwater Acoustics;
- Underwater Cables and Connectors;
- Underwater Communication, Navigation and Positioning (UNCP).

OCEAN of Change

Diane DiMassa, Ph.D., Vice President for OCEANS

"The times they are a-changin'." Bob Dylan

"Never doubt that a small group of thoughtful, committed, citizens can change the world. Indeed, it is the only thing that ever has." Margaret Mead

Well, we may not be changing the "world," but we are changing OCEANS, and what we do, learn, and experience at OCEANS can in fact change our world—what we know about it, how we interact with it, and how we protect it. A small group of thoughtful committed OES (and MTS) members worked together to change a number of things related to our flagship conference. First, and at the highest level, OCEANS is a joint venture between the OES and the Marine Technology Society (MTS) and is governed by the OCEANS Steering Committee, which is made up of members from both societies and led by the society presidents—currently Christian deMoustier for OES and Donna Kocak for MTS. President deMoustier led the charge to update the Memorandum of Agreement between the societies so that it more accurately reflects current OCEANS activities and provides administrative and legal guidelines for conference contracts, branding, etc., as well as establishes a review period to ensure that the agreement remains current.

From the Luxuriant Flowing Hair Club for Scientist.

Second, internally OES changed its leadership structure to provide more continuity for the conference. Now, all aspects of the OCEANS conference fall under the purview of a single OES Vice President, namely the Vice President for OCEANS. This change in OES leadership structure will enable better continuity for OCEANS volunteers, as there is one "funnel" for all undertakings. It is a big job, but the VP OCEANS does not go it alone. There are two significant committees, made up of both OES and MTS members, whose functions are 1) to search out and determine the best locations for OCEANS and 2) to ensure conference planning and operations are successful. The RECON committee does just that—reconnaissance on potential future sites for the conference. With OCEANS taking place every year in North America and on alternate years in Europe and Asia/Pacific, the RECON committee is always in discussion with OES and MTS members worldwide regarding the possibility of bringing the conference to a hotbed of marine-related activity. Once a site is chosen, the Joint OCEANS Administrative Board (JOAB) works closely with the local teams to ensure that all aspects of the conference are properly planned and executed.

Third, although conference leadership is made up of volunteers, all OCEANS conferences employ a professional conference organizer (PCO). We are pleased to announce that MCI is our new PCO for upcoming conferences and will be supporting OCEANS 2018 Charleston and OCEANS 2019 Seattle through their Strategic Events, Meetings, and Incentives office in the U.S., as well as OCEANS 2019 Marseille through the Management Board of their France office. MCI is a highly experienced global organization with a focus on state-of-the-art conference management that provides a fresh and vibrant energy to the event.

Next, on the conference level, we have upgraded both our branding and website for OCEANS. The unified OCEANS brand logo has created an improved and centralized image for the conference, while maintaining the conference venue logo still allows for each conference to be unique in its own way. The website redesign has given OCEANS a great new contemporary look and made it not only easier to garner information about upcoming OCEANS conferences, but also to maintain details of past events, and provide specifics for future meetings.

OCEANS 2018 Charleston will take a new approach to showcasing exhibitors through Exhibitor Presentations in the Exhibit Theater located in the center of the exposition hall. A new conference app is under development, a broader student poster session will incorporate more students, and the interactive plenaries will provide an energetic start to what will be a great week of networking and sharing information.

There is yet one more change that will come shortly. As per the OES By Laws, it is time for new leadership in this position. This is my last article as your VP OCEANS. I feel privileged to have played a part in the changes outlined above, and I promise to contribute to a smooth transition to my successor. I look forward to great experiences at future OCEANS conferences. "Sea" you all there!

"I alone cannot change the world, but I can cast a stone across the waters to create many ripples." Mother Teresa.

From the Journal Editor's Desk: Sharing Research Findings, and More...

Mandar Chitre, Journal Editor-in Chief

We share knowledge. We learn from each other. That's how we progress. "Standing on the shoulders of giants", as Bernard of Chartres or Isaac Newton said. The Journal is all about sharing what we discover as we go about doing whatever we do in Ocean Engineering. Traditionally, authors focus on sharing their motivations, methods, results, findings and thoughts. But why stop at that? Most papers are based on data and code to analyze that data, and perhaps code to implement some algorithms. Why not also share that data and the associated code? That'll not only allow others to understand the paper better, but also build on top of the work presented in the paper. We'll progress faster as a community.

The idea of sharing data or code is not new. In communities like robotics, image processing and machine learning, sharing is very common. It has helped them grow and advance rapidly. Some researchers worry about losing competitive advantage if they share their code or data. However, experience from communities where sharing is common has shown that authors benefit immensely from synergies with other researchers and are able to advance the field more rapidly. Authors who share data and code that others use and build on become de facto thought leaders and well-known researchers in their fields.

In the latest issue of the Journal, I wrote an Editorial "On Writing Reproducible and Interactive Papers," where I discuss reproducibility of results and sharing of code and data in more depth. With the help of modern tools such as Jupyter and Python, and services such as CodeOcean, I show how to seamlessly blend code, data, text and results into a single document that can be published.

I've recently been to the IEEE Panel of Editors meeting that was held in April in Hollywood, CA. While many issues were discussed there, I'm glad to note that reproducibility of papers and sharing of code and data were also discussed extensively. IEEE is trying to put in place data repositories and code sharing services so that authors who wish to share code and data can do so easily. At the Journal, we may adopt some of the same services as other IEEE Journals, and some different ones, but the philosophy of sharing is certainly something we want to encourage our authors to embrace.

Finally, as with previous messages, I will conclude with a list of papers that were published as Early Access papers on IEEE Xplore and will appear in regular issues soon. You'll find these papers now:

- "On the Accuracy of Quartz Pressure Sensor in the Seafloor Affected by Transport Condition," by Y. Machida, E. Araki, S. Nishida, T. Kimura, H. Matsumoto
- "Composite Underwater Noise Footprint of a Shallow Arctic Exploration Drilling Project," by J.E. Quijano, D.E. Hannay, M.E. Austin
- "Very-High-Frequency Single-Input-Multiple-Output Acoustic Communication in Shallow Water," by J.Rudander, P.A. van Walree, T. Husøy, P. Orten
- "An Airgun Array Source Model Accounting for High-Frequency Sound Emissions During Firing--Solutions to the IAMW Source Test Cases," by A.O. MacGillivray
- "Floating Hemispherical Helical Antenna for Ocean Sensor Networks," by Z.M. Loni, H.G. Espinosa, D.V. Thiel

- "Grouped Packet Coding: A Method for Reliable Communication Over Fading Channels With Long Delays," by R. Ahmed, M. Stojanovic
- "Coherent Matched-Filter Reflection Loss From a Moving Rough Surface as a Function of Pulse Duration and Ensonified Extent," by D.A. Abraham
- "Deterministic and Bayestian Sparse Signal Processing Algorithms for Coherent Multipath Directions-of-Arrival (DOAs) Estimation," by A. Das
- "Response of GPS-Tracked Drifters to Wind and Water Currents in a Tidal Estuary," by K.A. Suara, H. Wang, H. Chanson, B. Gibbes, R.J. Brown
- "Continuous Active Sonars for Littoral Undersea Surveillance," by A.Munafò, G. Canepa, K.D. LePage
- "Fuzzy Gain Scheduled PI-Based Airflow Control of an Oscillating Water Column in Wave Power Generation Plants," by F. M'zoughi, S. Bouallègue, A.J. Garrido, I. Garrido, M. Ayadi
- "Measurement of Pier Deformation Patterns by Ground-Based SAR Interferometry: Application to a Bollard Pull Trial," by G. Nico, G. Cifarelli, G. Miccoli, F. Soccodato, W. Feng, M. Sato, S. Miliziano, M. Marini
- "A Steganographic Approach to Sonar Tracking," by J.D. Park, J.F. Doherty
- "Energy Minimization With One Dot Fuzzy Initialization for Marine Oil Spill Segmentation," by P. Ren, M. Xu, Y. Yu, F. Chen, X. Jiang, E. Yang
- "UKF-Based Navigation System for AUVs: Online Experimental Validation," by R. Costanzi, F. Fanelli, E. Meli, A. Ridolfi, A. Caiti, B. Allotta
- "Portable Data Acquisition System for Offshore Applications," by L. Ulvgård, T. Kamf, A. Risberg, M. Leijon
- "Underwater Unexploded Ordnance (UXO) Classification Using a Matched Subspace Classifier With Adaptive Dictionaries," by J.J. Hall, M.R. Azimi-Sadjadi, S.G. Kargl, Y. Zhao, K.L. Williams
- "DeepCaustics: Classification and Removal of Caustics From Underwater Imagery," by T. Forbes, M. Goldsmith, S. Mudur, C. Poullis
- "A Navigation Solution Using a MEMS IMU, Model-Based Dead-Reckoning, and One-Way-Travel-Time Acoustic Range Measurements for Autonomous Underwater Vehicles," by J.H. Kepper IV, B.C. Claus, J.C. Kinsey
- "Assessing Solar Power for Globally Migrating Marine and Submarine Systems," by G.G. Hahn, L.A. Adoram-Kershner, H.P. Cantin, M.W. Shafer
- "Optimized Design for Sparse Cross Arrays in Both Near-Field and Far-Field," by D. Zhao, X. Liu, W. Chen, Y. Chen
- "Classification and Localization of Naval Mines with Super-ellipse Active Contours," by D. Köhntopp, B. Lehmann, D. Kraus, A. Birk
- "Attitude-Trajectory Estimation for Forward-Looking Multibeam Sonar Based on Acoustic Image Registration," by B.T. Henson, Y.V. Zakharov
- "Unsupervised Online System Identification for Underwater Robotic Vehicles," by G.C. Karras, P. Marantos, C.P. Bechlioulis, K.J. Kyriakopoulos
- "Measurement of Sounds Emitted by Certain High-Resolution Geophysical Survey Systems," by S.E. Crocker, F.D. Fratantonio, P.E. Hart, D.S. Foster, T.F. O'Brien, S. Labak
- "Segmentation of Sidescan Sonar Imagery Using Markov Random Fields and Extreme Learning Machine," by Y. Song, B. He, Y. Zhao, G. Li, Q. Sha, Y. Shen, T. Yan, R. Nian, A. Lendasse
- "Design and Analysis of an Innovative Concept for Submerging Open-Sea Aquaculture System," by M. Milich, N. Drimer
- "Implementation and Validation of the ISMAR High-Frequency Coastal Radar Network in the Gulf of Manfredonia (Mediterranean Sea)," by L.P. Corgnati, C. Mantovani, A. Griffa, M. Berta, P. Penna, P. Celentano, L. Bellomo, D.F. Carlson, R. D'Adamo Adaptive Second-Order Fast Nonsingular Terminal Sliding Mode Tracking Control for Fully Actuated
- "Autonomous Underwater Vehicles," by L. Qiao, W. Zhang
- "Incorporating Ocean Wave Spectrum Information in Short-Term Free-Surface Elevation Forecasting," by A. Mérigaud, J.V. Ringwood
- "Optical Underwater Communication: The Potential of Using Converted Green LEDs in Coastal Waters," by J. Sticklus, P.A. Hoeher, R. Röttgers
- "Distributed Traversability Analysis of Flow Field Under Communication Constraints," by S. Liu, J. Sun, J. Yu, A. Zhang, F. Zhang
- "At-Sea Evaluation of an Underwater Vehicle Behavior for Passive Target Tracking," by A.Wolek, B.R. Dzilowicz, J. McMahon, B.H. Houston
- "Development and Performance Validation of a Cylindrical Buoy for Deep-Ocean Tsunami Monitoring," by R. Venkatesan, S.A. Sannasiraj, M.V. Ramanamurthy, P. Senthilkumar, G. Dhinesh
- "Strong Scattering Targets Separation Based on Fractional Fourier Transformation in Pulse-to-Pulse Coherent Acoustical Doppler Current Profilers," by J. Cui, Z. Li, Q. Li
- "A Low-Complexity Mosaicing Algorithm for Stock Assessment of Seabed-Burrowing Species," by D. Corrigan, K. Sooknanan, J. Doyle, C. Lordan, A. Kokaram
- "On the Doppler Bias of Hyperbolic Frequency Modulation Matched Filter Time of Arrival Estimates," by J. J. Murray
- "Track-Before-Detect Bearings-Only Localization Performance in Complex Passive Sonar Scenarios: A Case Study," by T. Northardt, S.C. Nardone
- "Gaussian Sum Shifted Rayleigh Filter for Underwater Bearings-Only Target Tracking Problems," by R. Radhakrishnan, S. Bhaumik, N.K. Tomar
- "Analysis of Optimal Diagonal Loading for MPDR-Based Spatial Power Estimators in the Snapshop Deficient Regime," by M. Pajovic, J.C. Preisig, A.B. Baggeroer

OCEANS 2019 MTS/IEEE Marseille, France 17–20 June 2019

Philippe Courmontagne, Chair of OCEANS 2019 Marseille

15 years after the last edition in France of the OCEANS Conference (OCEANS 2005 Brest), the historical and scenic city of Marseille in the South of France will welcome an innovative and dynamic edition: OCEANS 2019 Marseille.

OCEANS 2019 Marseille will be a fantastic place for information sharing and networking, with an exhibition, several tutorials on special interest topics, hundreds of technical presentations and a student poster program. Moreover, for the first time in the OCEANS series, a day will be fully dedicated to the Exhibition, with on-site demonstrations, round tables, symposiums, ministerial delegations … more than a simple exhibition, OCEANS 2019 Marseille will offer a world leading forum, where industry, academia and government organizations will share knowledge and connect with marine science and ocean technology communities.

Furthermore, the theme of the conference, "**Let's sea our future together**," reflects our concern to understand the future of our oceans in terms of the preservation of marine, animal or plant life, as well as the exploitation of new energies.

The Special Marseille Topics will focus on the question of oceans being a keynote of the climate change and will tackle this issue through the following themes:

- Marine observatories
- Renewable energies
- Ocean noise evolution
- Marine life transformation
- Marine pollution

The conference will be hosted in the Marseille Chanot Exhibition & Convention Centre located in the city centre, in close proximity to nice hotels, great restaurants, and of course to the Vieux Port of Marseille (old port) and scenic coastline.

Who could have imagined such a nice city, such a sunny and warm spot, such a place full of history, to host this prestigious event in France? At the gates of Provence and the French Riviera, founded in 600 BC by the Greeks from Phocaea, Marseille is the oldest city in France and the second largest in France after Paris, largest French city on the Mediterranean coast and largest commercial port.

Marseille has much to offer its locals and tourists: an incredible coastline and 300 days of sunshine every year! Marseille has an impressive natural heritage with numerous lush parks in the heart of the city, offering refreshing havens when the sun is beating down. Just a few kilometers from the Vieux-Port lies the Calanques National Park, which is the perfect spot for year-round outdoor activities. The famous Calanques cover 20 kilometers with untamed creeks to explore and clear blue water to enjoy.

As you stroll around this Mediterranean city you will see its impressive heritage for yourself. Marseille is brimming with hidden gems from the old town of Panier to the Second Empire buildings and the Roman churches.

Nearby, the city of Toulon, the fourth-largest French city on the Mediterranean coast, is the first French military port, home of the French Navy aircraft carrier Charles De Gaulle and its battle group. The presence of these two major ports, in the Provence-Alpes-Côte-d'Azur region, has generated the development of a large number of institutions (industries, companies and laboratories) dedicated to the exploitation and exploration of the sea.

Marseille old port.

One of the Calanques (Envau).

Casa Delauze, nestled at the foot of Fort Ganteaume, by the old port.

The Local Organizing Committee is making continuing efforts to offer to participants a memorable experience and has the pleasure to announce that the Conference Gala Dinner will take place in a unique place, accessible to a few privileged people only and highly representative of the efforts of our community in understanding the oceans: the Casa Delauze, the private house of Henri-Germain Delauze, grand industry leader, diver and passionate about the seabed. He founded the COMEX in 1961, today one of the most famous and important companies specialized in ocean engineering, marine and underwater technologies.

Visit the OCEANS 2019 Marseille website (https://www.oceans19mtsieeemarseille.org) to find out more information about the conference and to keep updated on the latest news.

Do not miss the OCEANS 2019 Marseille key dates:

- Abstract submission opening: 8 November 2018
- Opening of registration and hotel booking: 7 January 2019
- Deadline for abstract submission: 15 January 2019
- Deadline for early bird registration fee: 1 May 2019

We are waiting for you in Marseille!

EXHIBITION & PARTNERSHIP

Many Exhibition, Partnership and Marketing opportunities are available for industrial and institutional partners to join actively OCEANS 2019 Marseille.

5 GOOD REASONS TO JOIN OCEANS 2019 MARSEILLE

1. **To meet face to face with more than 1000 experts** from the community of oceanic engineering and marine technology
2. **To enhance your knowledge** about the latest scientific and technical advances in the fields
3. **To strenghten your network and create new partnerships**
4. **To promote your latest technics and services** in a favourable and supportive environment
5. **To keep up with your competitors and create a network** with future leading experts

Please contact partnership@oceans19mtsieeemarseille.org to receive more information and the Partnership Brochure.

Conference office OCEANS 2019 Marseille c/o MCI France - 9, rue Gustave Ricard - 13006 Marseille - France
Telephone: +33 (0)1 70 39 35 64 - **Fax:** +33 (0)1 53 85 82 83 - info@oceans19mtsieeemarseille.org

See you in Marseille in 2019 ! **www.oceans19mtsieeemarseille.org**

YP-BOOST at OCEANS'18 MTS/IEEE Kobe

Fausto Ferreira, IEEE OES Young Professionals Boost Program Member

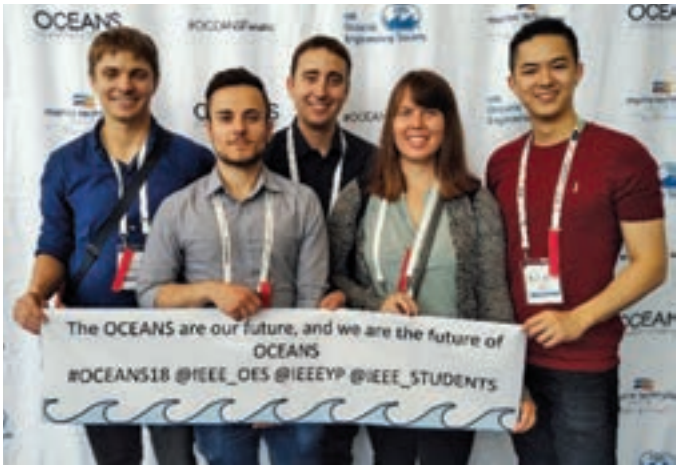
I have attended several OCEANS conferences before both as a regular author and as a student competing in the Student Posters Competition (SPC). But the experience at OCEANS'18 MTS/IEEE Kobe as a member of the Young Professionals (YP) BOOST program was new. As an author, you are able to attend most of the sessions, tour around the exhibition area and network during the social events. As a student, your focus is on presenting your poster to all the attendees that stop by your poster, impress the SPC judges, meet new people and exchange experiences with the other students. As a YP-BOOST program member, the experience is even more intense and interesting.

The program gives you the excellent possibility of attending the OES AdCom and be in touch with how the society works currently. This deeper involvement allows you to understand better OES and its relevant work for the community and also to make your task of volunteering for OES as YP-BOOST easier. By attending the meetings, you can learn more about the decision-making of the society, the future trends and the strategic thinking. This gives you an overview and serves as input for your own thinking about the future of our society. As a YP-BOOST you should bring new ideas and help in shaping the way the society will work. Seeing how it works now is essential for that.

Another moment I enjoyed particularly was the Young Professionals meeting. In this case, I had the chance of speaking to other Young Professionals (YPs) and students that will become YPs soon, exchange experiences and present the YP-BOOST Program to future candidates. It was an opportunity for networking with people at a similar career stage, to discuss several ideas and get feedback from current and future YPs.

But OCEANS'18 MTS/IEEE Kobe was more than attending meetings. One of the jobs I performed as a YP-BOOST program member was to participate in the social media initiative brilliantly led by Brandy Armstrong. I had a lot of fun doing it and the excellent team we had led to a lot of posts and constant updates in all social networks. We had a great time and discussed how it could be even improved for the next OCEANS in Charleston. Some ideas are now consolidating and hopefully we will have some surprises in Charleston!

Last, but not the least, one of the most relevant functions we had as YP-BOOST was to participate as a judge in the Student Poster Competition (SPC). Being myself an ex-student that participated in a previous SPC, it was a pleasure to be part of the competition again seeing it "from the other side." I have been previously a reviewer for the SPC several times. While that role gives you a wide view of what currently students are capable of, judging the selected ones at OCEANS gives an extra thrill to the experience. I was very glad to be able to share my experience with the students as a previous SPC participant and to mingle with all of them since the Student's



Some of the SPC students at the photo booth.

The two YP-BOOST Program members.

Mixer until the Award Ceremony at the Gala Dinner. The students were very bright and there was a nice atmosphere since the beginning. Reading the papers before getting to Kobe, I

knew there were some very high quality works, but the interaction with the students during their poster presentations is the best part. For a judge it might clarify some doubts, for a student it is an opportunity to grow professionally and show their value. Nonetheless, knowing that the students are typically stressed, the judges tried to highlight that they should also enjoy the SPC. I believe that in the end the students were happy, new friendships were born and the judges were also happy with their performance.

Personally, it was a great pleasure to work with Prof. John Watson and the Local Organizing Committee of the SPC to make it successful and I hope I will be given the same opportunity to serve the society in future SPCs. Volunteering is essential to keep our society alive. If you can have fun while doing it, then it becomes a pleasure and that was certainly the case for the SPC.

In the middle of such an interesting and intense experience as YP-BOOST, I still found the time to present one paper in Kobe. I hope I will manage to present two in Charleston but I am very willing to be again part of the YP-BOOST program and contribute to the OES mission as I can. See you in Charleston!

A Decade Later …

Shyam Madhusudhana, IEEE OES Young Professionals BOOST Program Member

My tryst with IEEE OES and the OCEANS conferences began in 2008, when I had attended OCEANS'08 MTS/IEEE TECHNO-OCEAN '08 (OTO'08) in Kobe, Japan as a participant in the student poster competition (SPC). What followed was a sequence of fortunate events that ensued my continued engagement with OES—another participation (and another award) in the SPC at OCEANS'09 Bremen, Germany, serendipitous opportunities to serve as the Secretary/Treasurer of the San Diego chapter of OES, as the SPC chair at OCEANS'13 San Diego, as the Secretary of the Australian chapter of OES, and most recently, getting selected to serve as the Technology Committees (TC) Coordinator. It felt great to have had the pleasure to return to Kobe for another OCEANS conference, a decade later, this time having been selected for the inaugural YP BOOST program.

My activities as part of the YP BOOST program started off with the AdCom meeting on the first day of the conference. Given the privilege of being a non-voting member of the AdCom, the opportunity to witness an AdCom meeting, my first, provided a valuable learning experience. What I had previously imagined to manifest as an apprehensive affair, being in a room full of stalwarts, eased rather quickly when I noticed a few familiar faces. Over the following days, my activities included serving as a judge on the SPC program (thanks to Harumi Sugimatsu for the opportunity) and participation in deliberations on social media reporting with the YP/Student Activities team (thanks to Brandy Armstrong). As the TC coordinator, I also chaired the meeting of the TC chairs. I am grateful for the many opportunities that were there, throughout the conference, for having stimulating interactions with the movers and shakers in the field of oceanic engineering. I am also grateful for the camaraderie with Fausto Ferreira, the other selectee on the YP BOOST program, for the memorable interactions—from the insightful exchanges during SPC judging to the lighter moments while sipping Japanese sake.

My prior visit to Japan had given me an intriguing glimpse into the Japanese culture and way of life, and I was overly keen to return to experience more. Though there were a few perceivable changes (presence of English signboards, vegetarian-friendly menus at restaurants, the apparent diminished sense of surprise among the locals upon seeing a non-Japanese wandering the streets) since my last visit, their sense of duty, respect for others and the warmth in their greetings, which were all significant aspects of my picture of Japanese culture, had remained unchanged. I am grateful to the conference organizers for providing an opportunity, during the gala, to experience a traditional Japanese tea ceremony. A big shout out to Christopher Whitt, my new friend and impromptu travel buddy, for the fun moments we shared exploring Kobe and Osaka.

During a leisurely hike around the Osaka Castle.

YP Experiences, OCEANS'18 Kobe

Farheen Fauziya, Research Scholar, Bharti School of Telecommunication Technology & Management Indian Institute of Technology Delhi

Participating in OCEANS'18 Kobe as a Young Professional was a very enriching experience for me. It provided me with the opportunity to interact with the brightest minds in the area of Ocean Engineering research. It broadened my horizons and also helped crystallize ideas in the area of underwater acoustic communications. Specifically, interacting with the stalwarts in the area was very motivating, an opportunity that I got because of being a social media volunteer. One of the responsibilities was to interview senior researchers in the area and present their view. In the process, I got insights into what makes them tick and also understood what needs to be done to take research output to the next level. It also helped create opportunity to do collaborative work with them and further my skills and knowledge as a researcher.

My interactions with other young professionals helped me network with researchers from all over the globe. I learnt what drives research in their part of the world and how they go about addressing the issues facing them. It helped me accept my struggles, and fueled me to work harder on the research challenges.

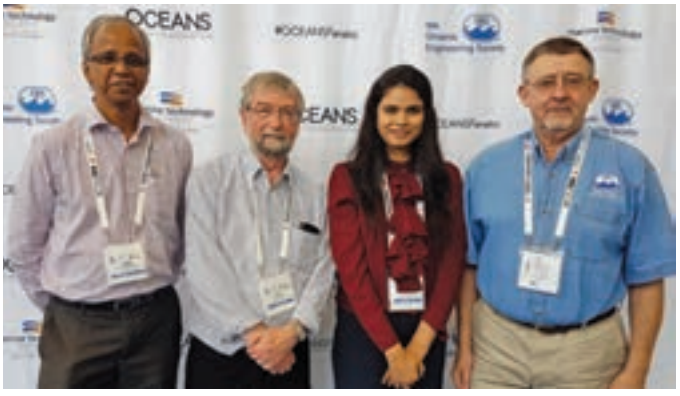
At a different level, participation in the conference helped me understand the importance of bodies such as the Oceanic Engineering Society and how they are instrumental in the growth of research and development. The volunteering that I did for the conference has spurred me to make larger contributions to the activities of OES. I am actively looking for a larger role in the activities of the society.

Another forum that had an impact was the Women in Engineering. It is heartening to note the increasing contribution that women are making to research in general and Ocean Engineering research in particular. I look forward to an even larger contribution by women and I, for my part, will do all I can for this trend to continue and gain pace.

Overall, the conference and responsibilities as a social media volunteer allowed me to become better equipped for handling research. I made a lot of connections both at a personal and professional level, my motivation levels are higher and I am looking forward to a larger role and more responsibility in the future.

At the Student Mixer.

With Brandy Armstrong.



With OCEANS banner (Venugopalan Pallayil, John Watson, Farheen and Bill Kirkwood) (L to R).

2018 IEEE OES Autonomous Underwater Vehicle

Rectorate Building, Porto University, Porto, Portugal

Every two years the IEEE Oceanic Engineering Society (IEEE OES) sponsors a collaborative symposium to bring together those working in the field of autonomous underwater vehicles.
In 2018 this diverse group from around the world will meet in Porto, Portugal, at the University of Porto for AUV 2018.

Topics

AUV2018 invites the authors to submit contributions in the following (but not limited to) topics:

- Vehicle Design
- Vehicle Navigation
- Sensor Fusion
- Vehicle Control
- Vehicle Planning and Execution
- Control
- Multi Vehicle Systems
- Vehicle Applications
- Open Source Robotics

Important Dates

Abstract Submission	**Closed**
Notification for Authors	**September 10, 2018**
Deadline for Full-paper Submission	**October 10, 2018**

Student Poster Competition "AUV conceptual design challenge"

Students are invited to submit proposals to address the AUV conceptual design challenge: **"AUV system for data collection in the water column"**.

A prize will be awarded to the best Student Poster! The announcement will be made during the Symposium.

Poster submission is also closed!

Organizers

IEEE Oceanic Engineering Society | IEEE / OES Portugal Chapter

IEEE Oceanic Engineering Society

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For Inquiries, please contact AUV2018 Secretariat: **auv2018@lsts.pt**

auv2018.lsts.pt

Chapter News

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

Australia Chapter

Reported by Mal Heron

OES was Technical Co-Sponsor of the 27th International Symposium on Industrial Electronics (ISIE) in Cairns, 12–16 June 2018, in a partnership with the IEEE Industrial Electronics Society. On behalf of the Society, the OES Australia Chapter organized a track on Marine Electronics. Marine-related papers were presented on Autonomous Marine Vehicles, Energy Storage and Regulation, and Navigation in High Traffic Areas. The intention of this Technical Co-Sponsorship was not so much to form an ongoing partnership between the two Societies, but to create an opportunity for local OES members in Australia to participate in an international event.

One innovation at ISIE was the Interactive Session where poster presenters were each given a 3-minute time slot to summarize their poster during an extended coffee break. It was very informal and some people did not listen; but many did. It was held in the foyer where the coffee was served with people coming and going. I thought it was an excellent feature without imposing on the schedule. Afterwards I went back to look more carefully at a couple of the posters.

Santha Jayasinghe from the Australian Maritime College talking about Hybrid Electric Ships.

Mal Heron acknowledges applause for his ability to hold a didgeridoo.

Thomas Olwal from South Africa gives his 3-minute talk while the Session Chairs scramble to organize the next speaker. The person on the left is paying attention while another in the background is busy organizing coffee.

Victoria Chapter Technical Meeting

Reported by Nick Hall-Patch

On 17 April 2018, at the University of Victoria, Dr. Jean Rasson, a scientist with the Royal Meteorological Institute of Belgium's Centre de Physique du Globe, gave a presentation that he had co-authored with Alexandre Gonsette and François Humbled. It was titled "Seafloor Magnetic Observatories: Why and How?", and was sponsored by the Ocean Engineering Society's Victoria Chapter.

The earth's magnetic field varies somewhat with time, and these variations affect the accuracy of modern navigation systems. Dr. Rasson described the network of magnetic observatories. maintained by various countries, as having an objective of establishing a "magnetic atlas" that records variations in the geomagnetic field. These observatories are land-based internationally, and must be accessible due to frequent recalibration. There are no true magnetic observatories located under the ocean at this time, so a comprehensive picture of the magnetic field over the Earth is not currently observable.

Dr. Rasson addresses a question from the audience.

Dr. Rasson then described the set of instruments used in land based magnetic observatories, which includes a variometer to measure changes occurring along the three axes of the magnetic field, and a proton magnetometer, providing the modulus of the magnetic field. Additionally, there is a non-magnetic theodolite which provides the bearing of the field relative to true north, as well as its inclination with respect to the vertical.

Electronic package for underwater magnetic observatory.

Although he pointed out that there are presently magnetic observatories on small islands around the world, in addition to those on the continents, Dr. Rasson presented a rationale for placing additional observatories on the ocean floor. Scientific research would benefit from the resultant quantity and quality of magnetic field data, particularly at high latitudes where geomagnetic field variations are more intense. Improved magnetic field modeling could lead to greater understanding of the physics of the deep Earth, as well as of such phenomena as the south Atlantic anomaly, in an area of the world where the strength of the magnetic field is considerably lower than elsewhere.

Dr. Rasson also discussed how tsunamis and underwater earthquakes create perturbations in the Earth's magnetic field. These pertubations could be identified by ocean-based observatories and provide earlier warnings to the public about these events.

Finally, greater accuracy in geomagnetic field observations provided by ocean floor-based observatories could benefit industry, by integrating acquired data into the products employing magnetic declination for compass correction. Dr. Rasson pointed out, as an example, that more accurate local geomagnetic field information could ensure more precise positioning for drilling undersea oil wells.

There are some notable obstacles associated with deploying present magnetic observatory sensors under the ocean. In addition to the standard concerns associated with placing instrumentation on the sea floor, such as power, communications, corrosion, extreme water pressure, et al, there are other issues for the observatories. These include the need to be in a non-magnetic environment, to have an autonomous ability to derive the direction of true north, and to perform self-leveling. Unlike surface observatories, all orientation of the instrumentation needs to be automated.

Dr. Rasson continued by describing some technical solutions to the problems associated with creating underwater magnetic observatories. The use of a fluxgate variometer provides low-noise measurements of the magnetic field vector changes with a high sampling rate. Together with a proton magnetometer, this provides the absolute measurement of the field's modulus. A non-magnetic theodolite, equipped with a fluxgate and a fiber optic gyro, provide an indication of true and magnetic North as well as magnetic inclination. The levelling of the system is accomplished with software rather than by using motorized leveling screws.

The use of commercial products in the design of the underwater observatory required some modifications in order to meet desired specifications. The total resulting package was low powered enough to be suitable for battery operation, and could communicate via an acoustic modem.

A question and answer time followed the presentation. Among the issues discussed were the impact of ocean currents and underwater electrical cables on the observed magnetic fields.

The Distinguished Lecturer Program in Japan

Hayato Kondo and Katsunori Mizuno, OES Japan Chapter

IEEE OES Japan Chapter organized the Distinguished Lecture (DL) program in June 2018 after the OCEANS'18 MTS/IEEE Kobe / Techno-Ocean 2018 as fellows.

Ocean Acoustic Signal Processing: A Bayesian Approach by Dr. James V. Candy

Reported by Hayato Kondo, OES Japan Chapter, TC Member

On the 4th of June, 2018, a Distinguished Lecturer, Dr. James V. Candy, gave a lecture titled "Ocean Acoustic Signal Processing: A Bayesian Approach" at the Etchujima Campus of the Tokyo University of Marine Science and Technology (TUMSAT). This DL program was planned as a post event of the OCEANS'18 MTS/IEEE Kobe/Techno-Ocean 2018. Eleven participants from university, research institution and company enjoyed his thought-provoking lecture.

According to Jim, "The application of Bayesian methods to complex ocean acoustic processing problems, especially in shallow water, has evolved from well-known probability distributions like Gaussian leading to model-based, Kalman filtering solutions to nonparametric representations driven by the uncertain ocean environment leading to sequential Monte Carlo or equivalently particle filtering solutions. In this lecture, an overview of particle filtering methods coupled to a shallow ocean modal tracking application motivated by the nonlinear nature of underlying ocean acoustic phenomenology is presented. Beginning with a brief overview of Bayesian inference leading to sequential processors, the Bayesian paradigm is established. Simulation-based methods using sampling theory and sequential Monte Carlo realizations are discussed. Here the usual limitations of nonlinear approximations and non-gaussian processes prevalent in classical algorithms (e.g. Kalman filters) are no longer a restriction to perform Bayesian processing. It is shown how the underlying state variables are easily assimilated into this sequential Bayesian construct. With this in mind, the idea of a particle filter, which is a discrete nonparametric representation of a probability distribution, is developed and shown how it can be implemented using sequential methods. Finally, an oceanic application of this approach is discussed comparing the performance of the particle filter designs with that of the classical unscented Kalman filter."

The lecture was comprehensive and high-leveled, it was well-arranged for beginners of Bayesian methods to easily understand from basics to applications by giving not only theories but also real data obtained at sea tests.

After the lecture, participants were invited to take a short-tour of the university campus. There is a Meiji-maru, a national important cultural property. She was an iron ship planned to be used as a lighthouse patrol ship, ordered by the Meiji Government from a British shipbuilder, Napier, located in Glasgow and built in 1874. The ship was a state-of-the-art ship equipped

Bayesian methods were discussed at the lecture.

Audience in a lecture room of TUMSAT.

Jim Candy gave a powerful lecture.

Post-lecture tour to the Meiji-maru, a national important cultural property, and the Centennial museum in Etchujima campus of TUMSAT.

Alumnus explaining its uniqueness of the Meiji-maru at her saloon.

Group photo taken on the fore-deck of the Meiji-maru.

with special rooms and saloons and, in addition to patrolling lighthouses, it also served as a royal ship. (https://www.kaiyodai.ac.jp/english/overview/facilities/meijimaru.html)

Acoustics in Fisheries Research: Evolving Technology and New Opportunities to Solve Old Problems by Dr. Kenneth G. Foote

Reported by Katsunori Mizuno, OES Japan Chapter, Beacon Associate Editor

Dr. Kenneth G. Foote, who is a Senior Scientist, Applied Ocean Physics & Engineering, Woods Hole Oceanographic Institution, was invited as a distinguished lecturer and talked about the acoustic technologies in fisheries research. The title of the lecture was "Acoustics in fisheries research: evolving technology and new opportunities to solve old problems." A total of 21 participants, including academian, business people, and students, attended his lecture. Most of the audience are concerned with the fisheries acoustic through their research and business, therefore, the lecture was filled with the excitement and seemed to be meaningful.

The lecture was started from the introduction about Dr. Foote's achievements by Dr. Koichi Sawada, who was a group leader, National Research Institute of Fisheries Engineering,

Dr. Kenneth G. Foote.

Discussion with Dr. Koichi Sawada during the lecture.

Group photo after the lecture.

FRA. Dr. Sawada said "The greatest effort of Ken-san is a finding of the "linearity" between the backscatter strength and the abundance of fish school." The author was really impressed because the finding was one of the most important ideas in fisheries acoustic. Dr. Sawada continued, "However, the specialty of Ken-san is "non-linear" acoustics." It was really interesting because the expert of non-linear acoustics found the most important linear dependence!

Dr. Foote introduced broad topics of technologies in sonar and applications in fisheries research. The basic sonar performances, e.g., bandwidth, sensitivity, dynamic range, and beamforming, are still important, and consistently improved by novel powerful signal processors and platforms for the sonar. He also said the steady development may solve the general problems in fisheries research that involve detection, localization, classification, and quantification. The recent case studies related to the problems were briefly explained with the introduction of several types of sonars. These practical talks strongly attracted the participants. After the lecture, the author recalled the famous word "温故知新 (onkochishin)," which means "developing new ideas based on study of the past learning from the past".

From the President *(continued from page 3)*

- The Societies have established a business plan to continue a conference remodeling process started at OCEANS 2016 Monterey. Feel free at any time to send us your suggestions for improving the conference.
- The Societies are working on a strategic plan to expand the reach of the OCEANS conference series (e.g. South America, Africa). Again, all suggestions are welcome.
- The conference series is now called OCEANS, with individual OCEANS conferences in the series identified by the four-digit year and the name of the host city: "OCEANS YYYY City". This seemingly trivial matter became a priority after countless professional conference organizers highlighted our lack of recognizable brand, as beautifully illustrated in [1] where conference naming creativity shines over 60 iterations.

If you have not yet registered for OCEANS 2018 Charleston [3], South Carolina, there is still time to do so at the discounted rate through September 7, 2018. Otherwise, do consider OCEANS 2019 Marseille [4], France in June of next year.

I look forward to meeting you at one of these future OCEANS conferences.

References

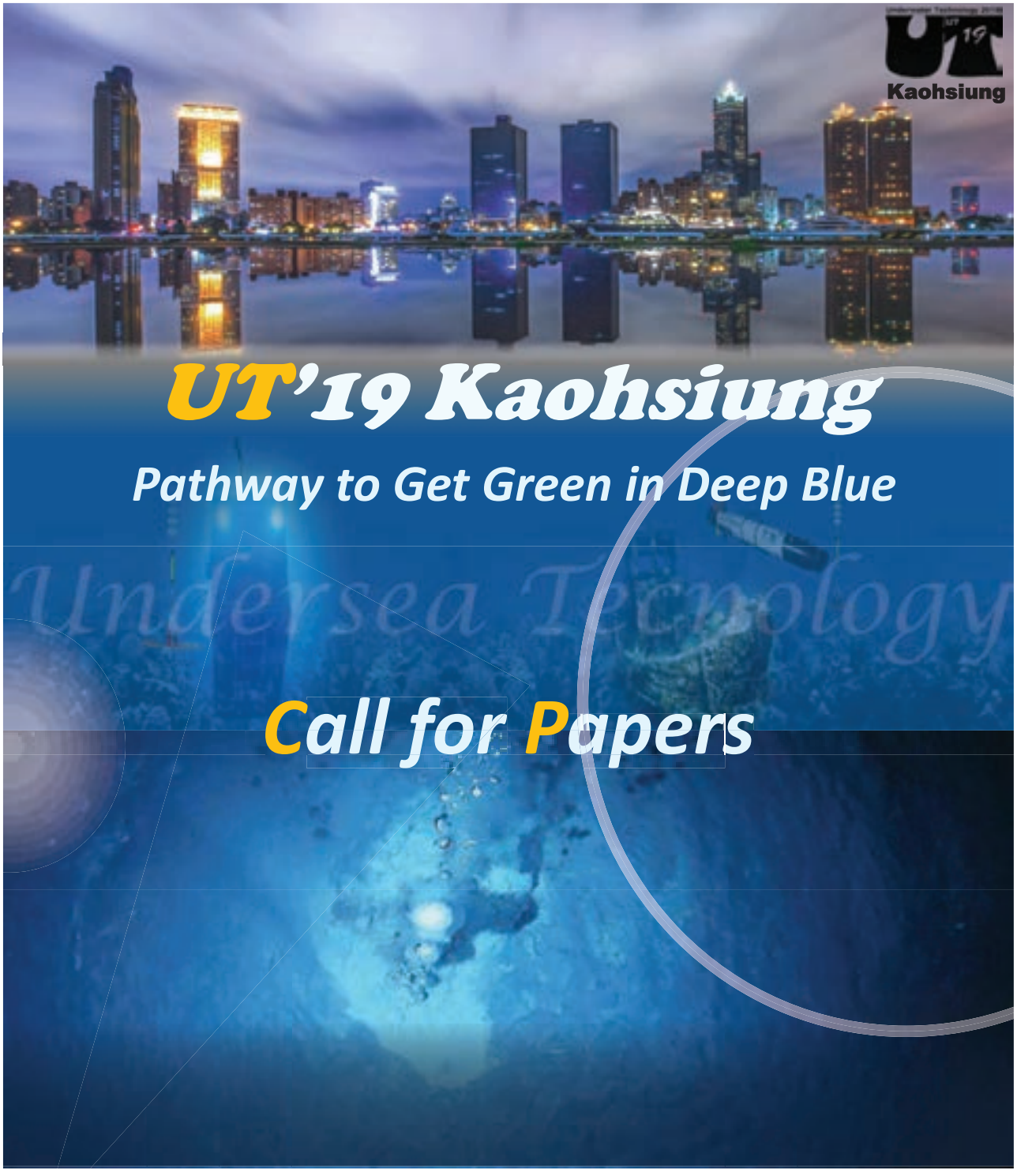
[1] IEEE Oceanic Engineering Society, and Marine Technology Society, "The OCEANS conference—Sixty and Counting", 48 pp., 2017, ISBN-13: 978-1-5386-4052-4; Proc. OCEANS 2017 Aberdeen, e-ISBN: 978-1-5090-5278-3 http://www.ieeeoes.org/history/oceans/OCEANS-Conference-Sixty-and-Counting.pdf

[2] http://aberdeen17.oceansconference.org/

[3] http://charleston18.oceansconference.org/

[4] http://www.oceans19mtsieeemarseille.org/

Christian de Moustier,
OES President



Dates April 16 Tue. ~19 Fri. , 2019

Venue International Building
National Sun Yat-sen University
Kaohsiung, Taiwan

Organizers

IEEE Oceanic Engineering Society (IEEE/OES) | IEEE/OES Japan Chapter
IEEE/OES Taipei, Taiwan Chapter | Taiwan Ocean Research Institute (TORI)
National Sun Yat-sen University (NSYSU)

UT'19 Kaohsiung

Pathway to Get Green in Deep Blue

UT'19 Kaohsiung

April 16-19, 2019, NSYSU in Kaohsiung, Taiwan

Call for Papers

INVITATION

We are pleased to invite you to participate UT'19 Kaohsiung, which will be hosted by five organizers and institutes, IEEE Oceanic Engineering Society (IEEE/OES), IEEE/OES Japan Chapter, IEEE/OES Taipei, Taiwan Chapter, Taiwan Ocean Research Institute, and National Sun Yat-sen University. The symposium will be held from 16-19 April 2019 at National Sun Yat-sen University (NSYSU) in Kaohsiung, the third largest city in Taiwan.

NSYSU is known for the natural fortress in the campus. Sitting along the side of Kaohsiung Harbor, the NSYSU is surrounded by mountains and faces the crystal blue water of Taiwan Strait. The beautiful Sizihwan beach in the campus makes NSYSU to be one of most valuable universities to visit in Taiwan.

We cordially invite researchers from all participating countries to attend our upcoming UT symposium and look forward to welcoming you in Taiwan in April 2019!

IMPORTANT DATES

July 16, 2018	Call for Papers
August 1, 2018	Abstract Submission Open
November 16, 2018	Abstract Submission Due
December 17, 2018	Notification of Acceptance
December 17, 2018	Registration Open
February 15, 2019	Early Bird Registration
February 15, 2019	Full Paper Submission Due

UT'19 KAOHSIUNG TOPICS

- Offshore Structure and Technology
- ROV/AUV/USV/Glider/Manned Submersible
- Underwater Acoustics and Acoustic Oceanography
- Underwater Optics
- Ocean Observatory
- Underwater Sensing and Communication
- Earthquake and Tsunami
- Coastal Engineering

IEEE Oceanic Engineering Society (OES) | IEEE / OES Japan Chapter | IEEE / OES Taipei, Taiwan Chapter | TORI 台灣海洋科技研究中心

For further information about UT'19 Kaohsiung please contact:
Email: info_ut19@narlabs.org.tw
http://ut19.tori.org.tw/

UT'19 Kaohsiung

Pathway to Get Green in Deep Blue

Dear Sir/Madam,

We are pleased to invite you to participate UT'19 Kaohsiung, which will be hosted by five organizers and institutes, IEEE Oceanic Engineering Society (IEEE/OES), IEEE/OES Japan Chapter, IEEE/OES Taipei, Taiwan Chapter, Taiwan Ocean Research Institute, and National Sun Yat-sen University. The symposium will be held from 16-19 April 2019 at National Sun Yat-sen University (NSYSU) in Kaohsiung, the third largest city in Taiwan.

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Sincerely,

UT'19 Kaohsiung Co-Chairs

Robert L. Wernli
President at First Centurion Enterprises, USA

Tamaki Ura
Professor of Kyushu Institute of Technology, Japan

Forng-Chen Chiu
Chairman at Ship and Ocean Industries R&D Center, Taiwan

For further information about UT'19 Kaohsiung please contact:
Email: info_ut19@narlabs.org.tw
http://ut19.tori.org.tw/

Transportation

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E-mail: info_ut19@narlabs.org.tw
Website: http://ut19.tori.org.tw/

UT'19 KAOHSIUNG TOPICS

- **Offshore Structure and Technology**
  Offshore investigation, offshore structure, seafloor engineering, corrosion protection, marine material science, floating platform, jack-up vessel.
- **ROV/AUV/Glider/USV/Manned Submersible**
  Vehicle design, system integration, positioning and navigation, operations.
- **Underwater Acoustics and Acoustic Oceanography**
  Modeling and simulation, measurement and analysis, sonar signal processing and applications.
- **Underwater Optics**
  Optical sensing, imaging and vision.
- **Ocean Observatory**
  Ocean observing platforms, observing systems, instrumentation, sensors.
- **Underwater Sensing and Communication**
  Sensor design, sensing algorithms, optical, RF, magneto-inductive.
- **Earthquake and Tsunami**
  Geotechnical hazards and response, tsunamigenic sources, risk analysis and management, tsunami propagation: physical oceanography, run-up and damage: wave hydraulics .
- **Coastal Engineering**
  Marine renewable energy, coastal information systems, monitoring, sustainability of coastal projects, data management.

VENUE

UT'19 Kaohsiung

International Building

National Sun Yat-sen University(**NSYSU**)
Kaohsiung, Taiwan

TECHNICAL & LOCAL TOUR

Technical Tour TORI, R/V Legend, CSBC Shipyard, Jong Shyn Shipyard

Local Tour National Museum of Marine Biology and Aquarium

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SAUVC'19

Design to Compete. Destined to Explore.

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IEEE | IEEE Oceanic Engineering Society | NUS | SINGAPORE POLYTECHNIC SP

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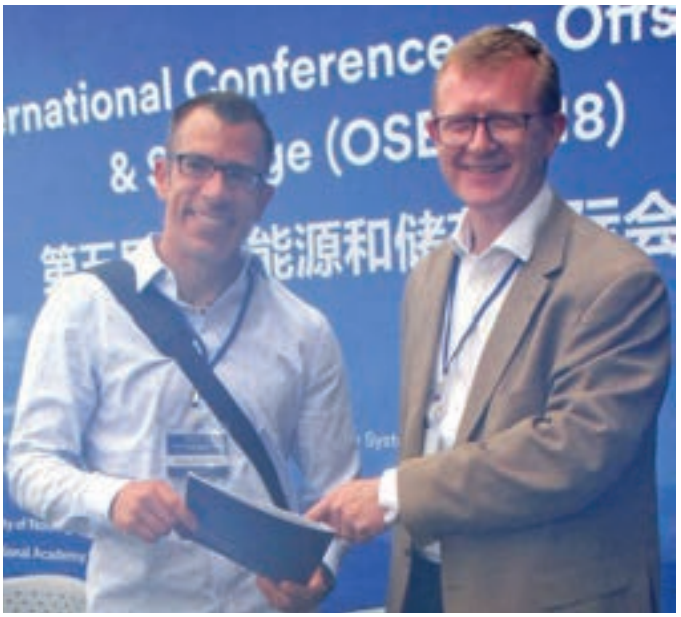
Ocean Energy Technology Committee Report

Seamus Garvey, Rupp Carriveau and Mal Heron

The Ocean Energy TC supported the 5th International Conference on Offshore Energy and Storage in Ningbo, China, 4–7 July 2018, in partnership with the Offshore Energy and Storage Society. Ningbo has a deep-water port and carries the biggest tonnage on China's coast. This, combined with the research of our hosts, The University of Nottingham, Ningbo, China, made it an attractive location. The theme was "The New Ambition for Offshore Energy" with an emphasis on Renewable Systems.

Over recent years we have seen development of a wide range of concepts for offshore energy generation with clear cohesion happening for offshore wind power. At the conference we saw a clear direction by UK and Denmark in the North Sea with fixed foundation wind farms in shallow water (up to about 50 m) producing significant energy into the grid. China is developing its offshore energy ambitions rapidly and talks at the conference indicated that within a few years it will overtake the UK and Germany to become the biggest collector of offshore renewable energy. The bulk of its population (like most countries) is close to the shore and conditions of the sea and seabed vary dramatically along this coast.

There was lively discussion about the future of floating platform wind farms for water depths in the range 20–200 m with some predicting that the floating systems will dominate the industry during the next decade. It was clear that offshore wind energy generation has become a mature industrial force. Other generation sources including waves, tidal elevation, tidal streaming, PV arrays, salinity gradients, and thermal gradients are still developing in silos with cohesion yet to emerge. A keynote speech on airborne wind systems by Joseph Coleman from Limerick made it clear that major disruptions in offshore energy are still possible.



Seamus Garvey, right, and Rupp Carriveau are co-chairs of the OES Ocean Energy Technology Committee.

Energy storage was the hottest topic attracting about half of the papers. This area is also early in development with a wide range of options being researched and piloted. The impetus for this area of development is being driven by the need to provide a stable feed into the grid as the uptake of renewable energy meets an increasing fraction of the supply—for both onshore and offshore.

This meeting was a fine example of one of the strategic directions of OES: it had one stream, arising from one of the Technology Committees, with a good partner society and host institution.

7th IEEE/OES Baltic Symposium—Clean and Safe Baltic Sea and Energy Security for the Baltic Countries

Jerry Carroll, OES Senior Past President

The 7th IEEE/OES Baltic International Symposium was held at the Klaipeda University in Klaipeda, Lithuania 12–15 June 2018. This was the 4th Symposium held in Klaipeda and once again was very successful. The local organizing committee did a great job of organizing the symposium with the highlight being presentations by the three plenary speakers; Victor Alari, Tallinn University of Technology, Jacek Beldowski, Researcher in the Institute of Oceanology Polish Academy of Sciences, and George Umgiesser, ISMAR-CNR Venice and Associated Position Lead Researcher Klaipeda University. The Symposium had only one track which allowed the audience to hear all the presentations and allowed time for questions and discussions. New information was provided by Sonja Krawezyk, Germany Mull and Partner Ingenieurgesellschaft mbH, and Jacek Beldowski, Risk Mitigation and Historical Investigation for unexploded Ordnance in the Baltic Sea. We were honored to have Georgii Gogoberidze from Murmansk Arctic State University and Tarmo Soomere, Chair Estonia Academy of Sciences, who led much of these discussions.

Special thanks to Viktorija Vaitkeviciene, our EU Chair and Sergej Suzdalev the EU Technical Program Chair who were critical to the organization of the Symposium and to Joseph Vadus U.S. Co-Chair who was responsible for starting the Symposiums.

Thanks to our Organizers:

- Marine Research Institute of Klaipeda University, Lithuania
- Association “Baltic valley”, Lithuania
- Coastal Research and Planning Institute, Lithuania

And our Supporters:

- South Baltic Oil Spill Response
- Interreg South Baltic
- European Union
- World Maritime University
- Universitat Rostock
- Akademia Morska Szczecin

Special thanks to Sandy Williams and James Barbera who have helped organize all the Baltic Symposiums. Professor Williams is arranging for the publication of the Baltic papers in the IEEE Explorer and Mr. Barbera is our financial manger for the IEEE/OES.

Enclosure (1) is a list of the organizing Committee and Enclosure (2) is the preface for the Symposium.

Pictures are from the Symposium and the Field Trip to the Curonian Spit.

Professor Juri Elken, Director, Marine Systems Department, Tallinn University of Technology, and Professor Tarmo Soomere, Chair, Estonia Academy of Science, would like to hold the next Baltic Symposium in Tallinn, Estonia in 2020. The Symposium has been held in Tallinn twice in the past and has been very successful.

Enclosure (1): From the Symposium program booklet

Symposium Organizing Committee

7th IEEE/OES Baltic Symposium
Clean and Safe Baltic Sea and Energy Security for the Baltic countries

SYMPOSIUM ORGANIZING COMMITTEE

Symposium Chairmen:

U. S. Chair: Jerry C. Carroll, Senior Past President, IEEE Oceanic Engineering Society, United States of America

U. S. Co-Chair: Joseph R. Vadus, Past Vice President, IEEE Oceanic Engineering Society, United States of America

EU Chair: dr. Viktorija Vaitkevičienė, Marine Research Institute of Klaipėda University, Lithuania

EU Co-Chair: dr. Nerijus Blažauskas, Association "Baltic valley", Lithuania

Finance Chair: Ingrida Sersnioviene, Association "Baltic valley", Lithuania

Finance Co-Chair: James Barbera, Past President, IEEE/OES, United States of America

U.S. Technical Program Chairs:

dr. Sandy Williams, Woods Hole Oceanographic Institution, United States of America

EU Technical Program Chairs:

dr. Sergej Suzdalev, Marine Research Institute of Klaipėda University, Lithuania

dr. Evelina Grinienė, Marine Research Institute of Klaipėda University, Lithuania

Rosita Milerienė, Marine Research Institute of Klaipėda University, Lithuania

dr. Aleksas Narčius, Marine Research Institute of Klaipėda University, Lithuania

dr. Jolita Petkuvienė, Marine Research Institute of Klaipėda University, Lithuania

Secretary:

Simona Mačiukaitė, Marine Research Institute of Klaipėda University, Lithuania

Scientific Committee and Preface

SCIENTIFIC COMMITTEE

dr. Victor Alari, Tallinn University of Technology, Estonia
dr. Nerijus Blažauskas, Klaipėda University, Lithuania
prof. dr. Zita Gasiūnaitė, Klaipėda University, Lithuania
dr. Evelina Grinienė, Klaipėda University, Lithuania
dr. Loreta Kelpšaitė-Rimkienė, Klaipėda University, Lithuania
dr. Jūratė Lesutienė, Klaipėda University, Lithuania
dr. Jolita Petkuvienė, Klaipėda University, Lithuania
dr. Sergej Suzdalev, Klaipėda University, Lithuania
prof. dr. Hans Georg Umgiesser, Klaipėda University, Lithuania, ISMAR-CNR; Institute of Marine Sciences, Italy
dr. Diana Vaičiūtė, Klaipėda University, Lithuania

All abstracts were reviewed by Scientific committee. The style and grammar of the abstracts were not corrected.

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PREFACE

In 2018 the IEEE/OES Baltic Symposium returns to Klaipėda (Lithuania) for the fourth time and continues the series of biennial Baltic International Symposiums, which have started in 2004. This unique initiative brings together US and European scientists, engineers as well as the research and innovation administrators, who share their knowledge, discuss common challenges and plans potential new trans-Atlantic cooperative science and technology programs.

This year the event addresses new challenges, standing high on the agenda. Energy Security for the Baltic countries has been of great concern for a long period of time and the countries have made great progress with the introduction of Liquid Natural Gas (LNG) and pipelines from Sweden, Finland and Poland. Through the help of the Norwegian government, the LNG terminal in Klaipėda is operational since 2014. There is a smaller terminal in Estonia and there are plans for future terminals. Offshore wind energy development projects have already started.

Sensitive environment of the Baltic Sea conceals tons of chemical munitions dumped into the sea after the Second World War. The event will go deeper into the topic, focusing on the available survey results and recommendations for safe disposal, recovery and management.

Presently, large volumes of oil and other hazardous substances shipped across the Baltic Sea in single hull tankers, posing the risk of accidental spillage and potential harm both to the environment and residents of the coastal areas. Hazard Planning and Mitigation requires joint efforts among the countries.

Klaipėda university Marine Research Institute is happy to host the event in the newly established premises of scientific research laboratories, which also provide excellent facilities for the Symposium.

We hope that 7th IEEE/OES Baltic Symposium will foster further development of scientific potential in participating countries and strengthen the constructive dialogue among different stakeholders for the purpose of clean and safe Baltic sea region.

WELCOME to Klaipėda!

dr. Sergej Suzdalev
On behalf of the Organizing Committee

Enclosure (2): Photos

Field Trip to the Curonian Spit.

Participants 7th IEEE/OES Baltic International Symposium.

Participants 7th IEEE/OES Baltic International Symposium.

OCEANS CONFERENCES

Past Conference Locations

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Japan
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6-9 April 2020

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OCEANS'18 MTS/IEEE Kobe/Techno-Ocean 2018 (OTO'18)

Koji Otsuka, Co-Chair of OTO'18 Executive Committee

OCEANS'18 MTS/IEEE Kobe / Techno-Ocean 2018 (OTO'18) was held at Port Island in Kobe from May 28th through 31st. Techno-Ocean, the only international convention on marine science and technology in Japan, has been held biannually in Kobe since 1986. During this period, two meetings in particular stand out—those of 2004 and 2008, held jointly with OCEANS, and named OTO (OCEANS / Techno-Ocean) '04 and '08. Held just ten years later, OTO'18 is the third such noteworthy joint convention. The local organizer, "The Consortium of the Japanese Organization for OTO'18 (CJO)", consists of the IEEE/OES Japan Chapter, MTS Japan Section, TON (Techno-Ocean Network), JAMSTEC (Japan Agency for Marine-Earth Science and Technology), and KCVA (Kobe Convention & Visitors Association).

Four years ago, Techno-Ocean 2014 was held under the theme "Mother Oceans", partly inspired by the experience of the Great East Japan Earthquake. The intent was to remind ourselves of the important blessings that our Mother Ocean yields to us, as well as to affirm the respect we hold for the seas. Wishing to continue to express these sentiments and to draw the attention of even more people to Mother Ocean, a theme "Return to the Oceans" was chosen for Techno-Ocean 2016. Two years later OTO'18 has employed a worthy successor to these two past Techno-Oceans concepts with the theme "Ocean Planet—It's our home". This conveys the meanings that our 'life-spring' is the sea, and that oceans are the original home to all creatures on planet Earth.

OTO'18 began with a tutorial program, consisting of 4 lectures and 42 participants, on Monday May 28th. Next morning, Thursday May 29th, a tape-cutting ceremony was held in the entrance area of Kobe International Exhibition Hall. Mr. Kizo Hisamoto, the Mayor of Kobe City, gave a welcome address. Following this, the mayor joined a tape-cutting ceremony together with Mr. Ichiro Hao, Director-General of the National Ocean Policy Secretariat, Cabinet Office, Government of Japan, Mr. Hiroshi Kanazawa, Vice Chair of Techno Ocean Network, Mr. Christian de Moustier, President of IEEE/OES, Dr. Richard Spinrad, President-Elect of MTS, Dr. Katsuyoshi Kawaguchi, Chairman of IEEE/OES Japan Chapter, Dr. Hideyuki Suzuki, Chairman of MTS Japan Section, and Mr. Masatoshi Omura, Executive Director of Kobe Tourism Bureau.

After the tape-cutting ceremony, keynote lectures were delivered at the Kobe International Conference Center to begin the international conference. Mr. Ichiro Hao, Director-General of the National Ocean Policy Secretariat, Cabinet Office, Government of Japan, lectured "A new Basic Plan on Ocean Policy." Then, Dr. Richard Spinrad, President-Elect of MTS, presented "The "Push" and "Pull" of Future Marine Technology." Finally, Dr. Jin-Yuan Liu, President of the Taiwan Society of Deep Ocean Water Resource Application, gave a lecture on "The Research and Development of Renewable Water from Deep Ocean."

108 Technical Sessions, presenting 514 papers, were also held at the Kobe International Conference Center from Tuesday May 29th, through to Thursday May 31st. 754 people from 29 countries including Japan participated in these sessions. Furthermore, 15 posters selected after careful examination from among 148 submissions were presented for the Student Poster Competition held at Kobe International Exhibition Hall. With their travel expenses covered by the Organizers, the select students were the proud recipients of a great opportunity to visit Kobe.

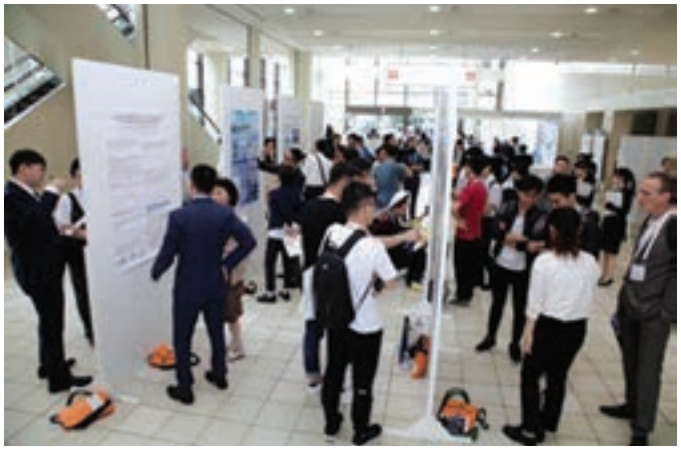
Another main part of the OTO'18 program was the Exhibition held at Kobe International Exhibition Hall from Tuesday

Tutorial.

Tape-Cutting Ceremony.

Keynote Lecturers; Mr. Ichiro Hao, Dr. Richard Spinrad and Dr. Jin-Yuan Liu (from left).

Winners of Techno-Ocean Awards; Dr. Tetsuro Urabe, Dr. Tomoko Takahashi and Dr. Toshitsugu Sako (from left).



Student Poster Competition.

Breaking of the Sake Barrel.

Exhibition.

Dolphin Live Performance.

May 29th through to Thursday 31st. The 170 exhibit spaces were occupied by 103 companies and several universities and research organizations. Their enthusiastic activities were complemented by a special stage in the center of the venue set up for exhibitor presentations and special sessions. A total of 1,340 participants visited over the three-day period to enjoy state-of-the-art displays and informative presentations.

The Techno-Ocean Award Luncheon was held at Kobe Portopia Hotel on Wednesday May 30th. The Techno-Ocean Award 2018 winner was Dr. Tetsuro Urabe, Professor Emeritus of the University of Tokyo. Dr. Tomoko Takahashi, Associate Professor of the Institute of Industrial Science, the University of Tokyo, was awarded the Kenji Okamura Memorial Award for Pioneering the Ocean Frontier 2018. Dr. Toshitsugu Sako, Professor Emeritus of Tokai University, was chosen as recipient of the Techno-Ocean Distinguished Service Award 2018. These winners each delivered a commemorative lecture after their prize-giving ceremony.

The Gala dinner, "OTO'18 Japan Night" was held at Suma Aqualife Park on Wednesday, May 30th and enjoyed an exciting

Children's Educational Program.

program, including a Japanese tea ceremony, traditional Japanese music performances, the ritual breaking of a sake barrel lid, and the awards for the Student Poster Competition. The highlight of the evening was a live dolphin show. All participants were clearly moved and impressed by the amazing rapport between dolphins and keepers which resulted in a fantastic display of aquatic skills and communication.

On Sunday May 27th, OTO'18 also presented concurrent educational events. An Underwater Robots Competition was held at Port Island Sports Center. 12 teams competed under 2 group categories, the AUV (Autonomous Underwater Vehicle) Class and the Free-style Class. The AUV and Free-Style winners were teams from the University of Tokyo and Shanghai Jiao Tong University, respectively. Many innovative vehicles with some great ideas performed to high levels of excellence during these exciting games. Furthermore, 2 public and 4 children's programs created around marine science and technology were organized by JAMSTEC (Japan Agency for Marine-Earth Science and Technology) and 5 technical co-sponsors, including the FRA (Japan Fisheries Research and Education Agency), JAXA (Japan Aerospace Exploration Agency), JOGMEC (Japan Oil, Gas and Metals National Corporation), MPAT (National Institute of Marine, Port and Aviation Technology), R-CCS (RIKEN Center for Computational Science). In addition, JAMSTEC's deep sea research vessel "Kairei" was opened up to the public at Kobe Port Central Pier.

The Student Poster Competition at OCEANS '18 MTS/IEEE KOBE

John Watson, OES Student Poster Competition Chair, Photos by Stan Chamberlain (OES)

The Student Poster Competition at OCEANS'18 MTS/IEEE Kobe

One of the Flagship events of any MTS/IEEE OCEANS conference is the Student Poster Competition (SPC) in which a selection of students are invited, on the basis of their abstract submission, to attend the conference at no expense to them whatsoever, wherever it is being held, and present a poster of their work. They also have the opportunity to win a monetary prize offered to the three posters judged to be the best, by an independent panel. The latest occurrence of the SPC was held during OCEANS'18 MTS/IEEE Kobe, Japan, at the Kobe Convention Centre on May 29th and 30th, 2018.

The student poster program was ably and efficiently organized by a sub-committee of the Local Organizing Committee consisting of Prof. Tokihiro Katsui, Kobe University, (LOC SPC Chair); Prof. Kana Kuroda, Osaka Prefecture University, (LOC SPC Co-Chair); and Prof. Motohiko Murai, Yokohama National University, with support (although not often needed!) from Prof. John Watson, (IEEE/OES SPC Chair) and Liesl Hotaling (MTS SPC Chair, who unfortunately could not attend). The SPC program was funded by grants from the Office of Naval Research Global (ONRG) and Arc Geo Support Co. Ltd., and to them we offer our sincere appreciation. Without their support the competition could not go ahead. For this edition of the SPC, 15 student abstracts were selected to attend at Kobe, out of 110 submissions from around the world. This not an insubstantial task given the quality of the abstracts submitted, but eventually those that were judged to be the best 15 were selected. Also, those not chosen for the SPC can still register and give their papers in the regular technical sessions.

Prof. Tokihiro Katsui introducing the students at the Award Ceremony.

The posters were on display at the entrance to the Exhibition Hall for two days. Like previous Student Poster Competitions, the posters described the work carried out by the students and, as is rapidly becoming the norm, were of a very high standard. The students enthusiastically describe their work to the judges and to any delegates who dropped by over the two-day period. The posters were judged by a team of judges who read and discussed the work of every student; anyone

Coffee time at the Posters.

More audience participation.

who has performed as a judge at any OCEANS will know that this is a very difficult, time consuming and intensive task over a two-day period and our thanks and appreciation goes out once again to the judges. Our judges often tell us how much they enjoyed the experience and getting to know the students. We even have former SPC participants coming back and judging at later events.

The full list of15 participants, with their affiliation and poster title were:

- ARBANAS, Barbara, University of Zagreb
  Consensus protocols for underwater multi-robot system using scheduled acoustic communication
- BORG, Mitchell, University of Strathclyde
  Numerical Analysis of a Ducted High-Solidity Tidal Turbine
- KIM, Byeongjin, Pohang University of Science and Technology
  Optimal strategy for seabed 3D mapping of AUV based on imaging sonar
- KIM, Juhwan, Pohang University of Science and Technology
  Development of manipulation purpose small agent vehicle for UUVs
- LI, Liang, University of Strathclyde
  Real-time latching control of wave energy converter with consideration of wave force prediction
- LIM, Jin Wei, University of Southampton
  Automated Interpretation of Seafloor Visual Maps Obtained using Underwater Robots
- LYU, Bozhi, Shanghai Jiao Tong University
  Combined Small-sized USV and ROV Observation System for Long-term, Large-scale, Spatially Explicit Aquatic Monitoring
- MASMITJA, Ivan, Universitat Politecnica de Catalunya
  Underwater multi-target tracking with particle filters
- TOMASZEWSKI, Christopher, Robotics Institute, CMU
  Augmenting LSPIV Surface Current Measurement with Drifting ASVs
- TU, Qiang, Xiamen University
  Acoustic Method for Measuring the Density of Particles in Water
- VIDAL, Eduard, Universitat de Girona
  Online Robotic Exploration for Autonomous Underwater Vehicles in Unstructured Environments
- XU, Fengqiang, Dalian Maritime University
  Real-time Detecting Method of Marine Small Object with Underwater Robot Vision
- YAN, Naizheng, Hokkaido University
  Acoustic distinction between pointhead flounder and juvenile walleye pollock by echo shape and frequency characteristics

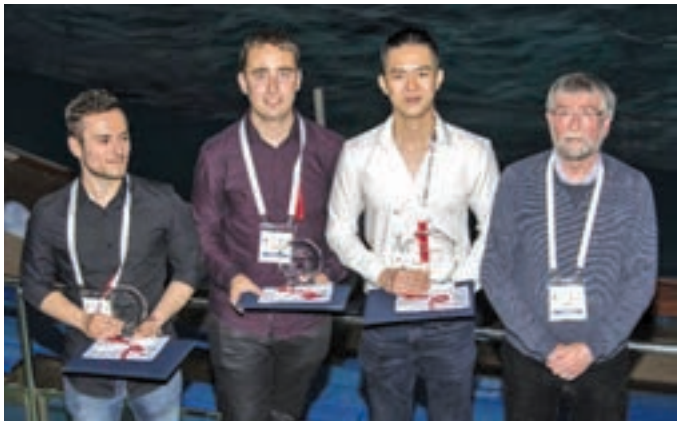
All the participants with the Local SPC committee.

- YAN, Qingyun, Memorial University of Newfoundland
  Sea Ice Detection Based on Unambiguous Retrieval of Scattering Coefficient from GNSS-R Delay-Doppler Maps
- YOO, Byunghyun, Korea Advanced Institute of Science and Technology (KAIST)
  Ship route optimization considering on-time arrival probability under environmental uncertainty

Each participating student was awarded a Certificate of Attendance and the top three posters were awarded a specially designed trophy and a monetary prize. The Award Ceremony took place during the Conference Banquet at the Suma Aqualife Park. The ceremony took place at the Dolphin Pool; unfortunately the students had to share the attention and their moment of glory with a pod of dolphins swimming in the background!! The ceremony began with a few words from the Local SPC Chair Tokihiro Katsui. Prof. John Watson then presented the awards. The winner of the SPC is awarded the Norman Miller Prize. Many will know that Col. Miller inaugurated the first SPC in 1989 and enthusiastically championed until he passed away in July 2015. The First Prize is named in his honor.

Describing their posters to the judges.

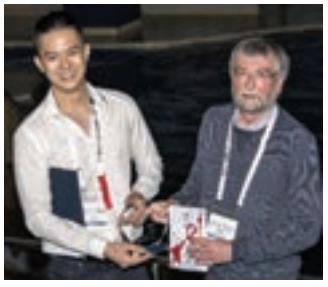
Some of the "participating" dolphins.



The three prizewinners (L to R): Mitchell Borg, Eduard Vidal and Jin Wei Lim with Prof Watson.

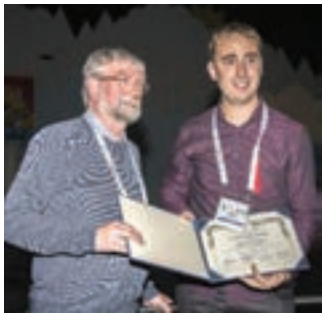
The prizes were as follows;

First Prize and The Norman Miller Award (Trophy, Certificate and $3000):



Mr. Jin Wei LIM, Maritime Robotics Laboratory, Faculty of Engineering and the Environment, University of Southampton, UK for work on *Automated Interpretation of Seafloor Visual Maps Obtained using Underwater Robots*

Second Prize (Trophy, Certificate and $2000):



Mr. Eduard VIDAL, Underwater Vision and Robotics Research Center (CIRS), Universitat de Girona, Spain, for his work on *Online Robotic Exploration for Autonomous Underwater Vehicles in Unstructured Environments*

Third Prize (Trophy, Certificate and $1000):

Mr. Mitchell BORG, Department of Naval Architecture, Ocean, and Marine Engineering, University of Strathclyde, Glasgow, Scotland, UK, for his work on *Numerical Analysis of a Ducted High-Solidity Tidal Turbine*

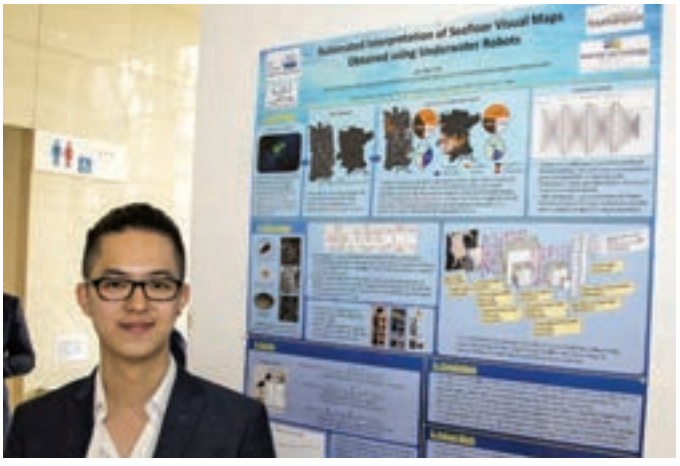
"It was a great experience for me to join the student poster competition as a local SPC co-chair. The students did their best in discussing their research with the audience and judges for long hours. Their earnest endeavor impressed me very much. I hope such a wonderful opportunity will be provided for many more students in the future."

AND—A great time was had by all!

The 15 SPC Participants in Kobe with their ABSTRACTS

First Prize and Norman Miller Award

LIM, Jin Wei, University of Southampton, *Automated Interpretation of Seafloor Visual Maps Obtained using Underwater Robots.*

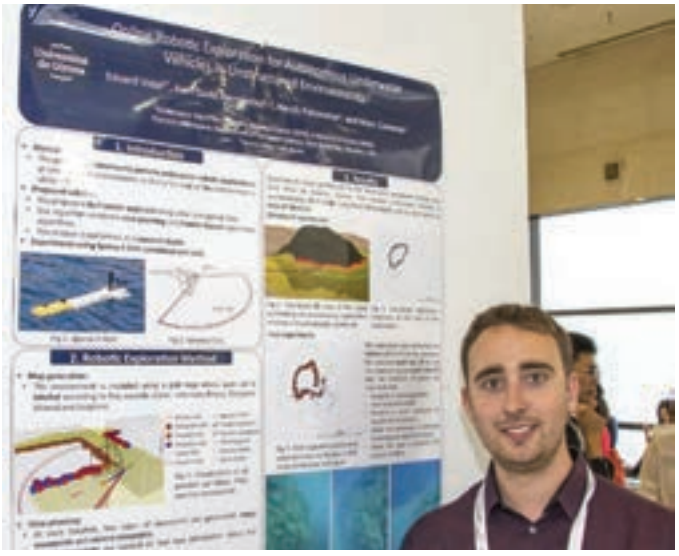


Scientific surveys using underwater robots can recover a huge volume of seafloor imagery. For mapping applications, these images can be packaged into vast, seamless and georeferenced seafloor visual reconstructions in a routine way, however interpreting this data to extract useful quantitative information typically relies on the manual effort of expert human annotators. This process is often slow and is a bottleneck in the flow of information. This work explores the feasibility of using Machine Learning tools, specifically Convolutional Neural Networks (CNNs) to at least partially automate the annotation process. A CNN was constructed to identify Shinkaia Crosnieri galetheid crabs and Bathymodiolus mussels, which are two distinct megabenthic taxa found in vast numbers in hydrothermally active regions of the seafloor. The CNN was trained with varying numbers of annotated data, where each annotation consisted of

a small region surrounding a positive label at the centre of each individual within a seamless seafloor image reconstruction. The performance was assessed using an independent set of annotated data, taken from a separate reconstruction located approximately 500 m away. While the results show that the trained network can be used to classify new datasets at well characterized levels of uncertainty, the performance was found to vary between the different taxa and with a control dataset that showed only unpopulated regions of the seafloor. The analysis suggests that the number of training examples required to achieve a given level of accuracy is subject dependent, and this should be considered by humans when devising annotation strategies that make best use of their efforts to leverage the advantages offered by CNNs.

Second Prize

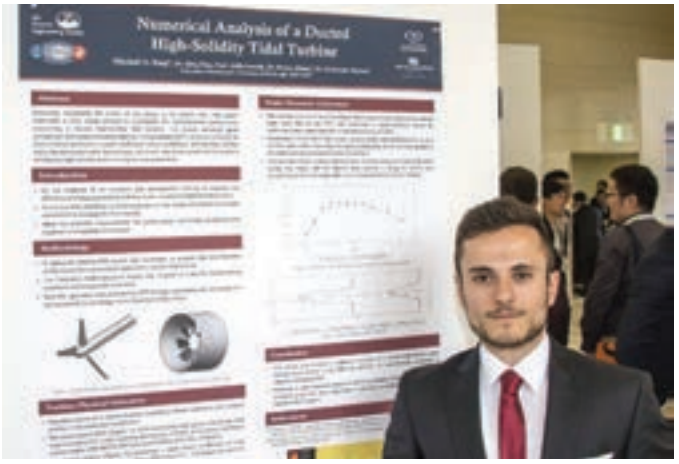
Vidal, Eduard Universitat de Girona, *Online Robotic Exploration for Autonomous Underwater Vehicles in Unstructured Environments.*



When it is not possible to use remotely operated vehicles (ROVs) or autonomous underwater vehicles (AUVs) with predefined missions to explore complex underwater structures, efficient and safe algorithms for autonomous online exploration are required. In this work we present a robotic exploration algorithm for AUVs which is able to autonomously explore 3D underwater structures. In our proposal, the explored structure must have vertical relief, and the exploration is performed in 2D at a user defined depth. No assumptions are made about the shape of the object, so this makes the algorithm particularly useful to explore unstructured environments. Our approach is able to plan the robot maneuvers to achieve full coverage of the scene with data from two sensors: a scanning profiling sonar, and a camera. The algorithm first incorporates the exteroceptive data from the profiler sonar into a labeled grid map. Then, different candidate viewpoints are generated and the best one is selected according to a metric that balances exploration and trajectory length. Once the best viewpoint has been selected, the robot navigates in the scene to achieve the selected viewpoint configuration. This procedure is repeated until the desired area has been fully explored. To validate our approach, we present simulated and real autonomous explorations of an underwater seamount.

Third Prize Winner

BORG, Mitchell University of Strathclyde, *Numerical Analysis of a Ducted High-Solidity Tidal Turbine.*



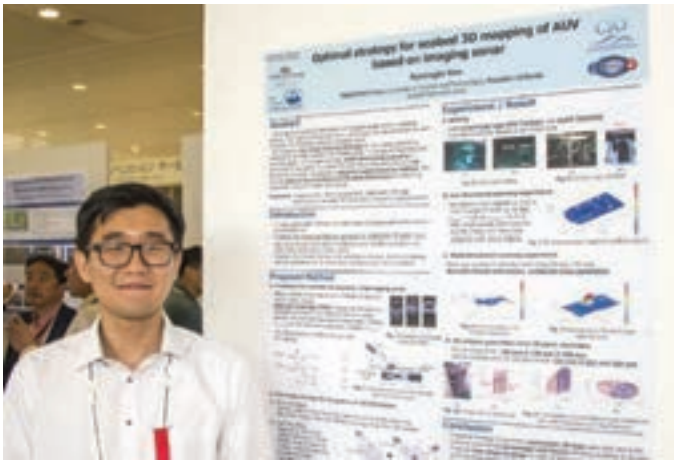
Effectively harnessing the power of the ocean for energy generation is no simple task. This paper elaborates a CFD model utilised to investigate the hydrodynamic performance concerning a ducted high-solidity tidal turbine. The model achieved good comparison with experimentation data for a three-bladed HATT, and was validated on three distinct parameters—power coefficient, thrust coefficient, and velocity profiles within the developed wake. Accordingly, the model was implemented for the analysis of a ducted high-solidity turbine, in aligned and yawed flows, where the outcomes were compared to data attained by means of BEMT, discussing the degree of similarity achieved.

Other Participants:

ARBANAS, Barbara University of Zagreb, *Consensus protocols for underwater multi-robot system using scheduled acoustic communication.*

In this paper, we present a newly developed consensus protocol for an underwater multi-robot system using acoustic communication. The approach is motivated by a system in which robots, called aMussels, are dispersed in the environment and measure its properties over longer periods of time. They communicate via acoustic modems using a simple sequenced communication protocol. The classical average consensus protocol has been modified to suit these conditions. The performance of the algorithm is analyzed in a simulation testbed, where we examine its properties and show the convergence of the method. The protocol is then applied to the real system in an underwater experiment, where we demonstrate its convergence in realistic conditions.

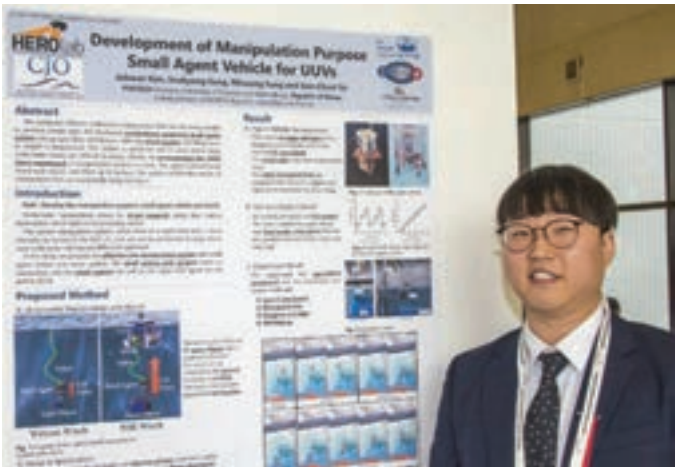
Kim, Byeongjin, Pohang University of Science and Technology, *Optimal strategy for seabed 3D mapping of AUV based on imaging sonar.*



An imaging sonar loses information of elevation angle while a mapping process. To overcome this limitation, the motion of the autonomous underwater vehicle (AUV) can be used to obtain 3D information using the imaging sonar. In this paper, we propose a two-stage mapping strategy for accurately generating underwater 3D maps based on an imaging sonar. It consists of searching and scanning stage. In the scanning stage, multi-directional scanning is performed on an object. To process 3D point cloud data obtained by multi-directional scanning, we propose a polygonal approximation method. This method reduces the uncertainty of 3D point cloud data by extracting intersection area of multiple data groups. To verify the feasibility of proposed strategies, we conducted indoor tank experiments using a hovering-type AUV 'Cyclops' and acoustic lens-based multibeam sonar (ALMS) 'DIDSON'.

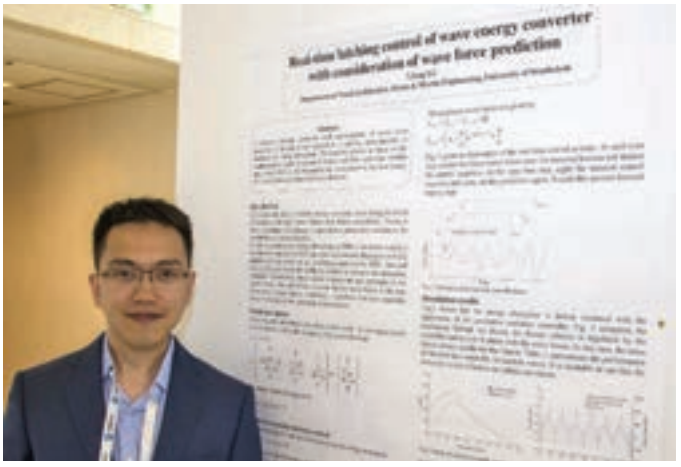
Kim, Juhwan, Pohang University of Science and Technology, *Development of manipulation purpose small agent vehicle for UUVs.*

We conducted efficient underwater manipulation that can lift heavy weight or perform simple tasks. We developed manipulation purposed small agent vehicle with gripper, flops and sensors. With the winch system, the lifting force of weight is empowered. The agent has independent navigation and object



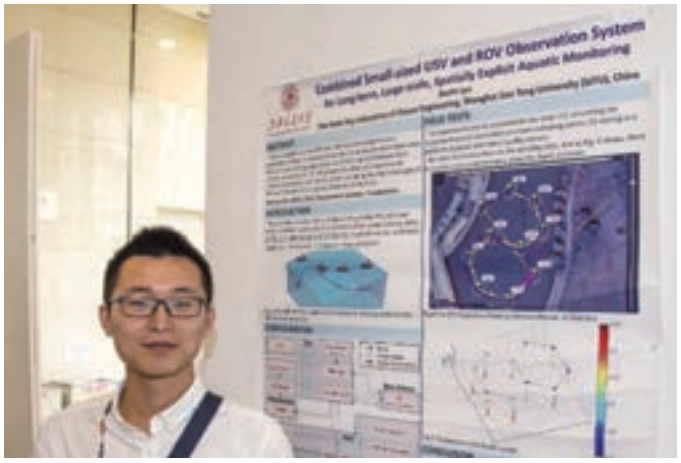
detection abilities, then only winding up winch signal is needed. This system is useful for use in areas where large underwater robots are difficult to access. We called this system as agent vehicle manipulation system. Finally, we accomplished the stand alone experiment of manipulation system in a water tank. The agent autonomously found such object, and lifted up to surface. The system verified the results of manipulation that can successfully bring the object.

LI, Liang, University of Strathclyde, *Real-time latching control of wave energy converter with consideration of wave force prediction.*



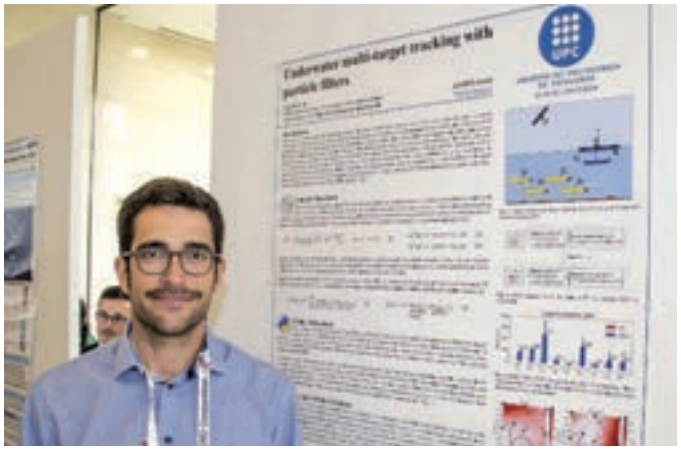
A real-time latching controller with consideration of wave force prediction is developed and applied to a heaving point-absorber to maximize its energy absorption. The control scheme is based on the combination of optimal command theory and first order-one variable grey model GM(1,1). By forecasting the wave forces in the near future, the control action at the next instant is deduced. Simulation results show that the energy absorption is increased due to the real-time controller. Therefore, the developed real-time controller is applicable to an industrial wave energy converter (WEC) in random waves. The effect of wave force prediction deviation is also examined. It is shown that the control efficiency is reduced in the presence of prediction deviation.

Lyu, Bozhi, Shanghai Jiao Tong University, *Combined Small-sized USV and ROV Observation System for Long-term, Large-scale, Spatially Explicit Aquatic Monitoring.*



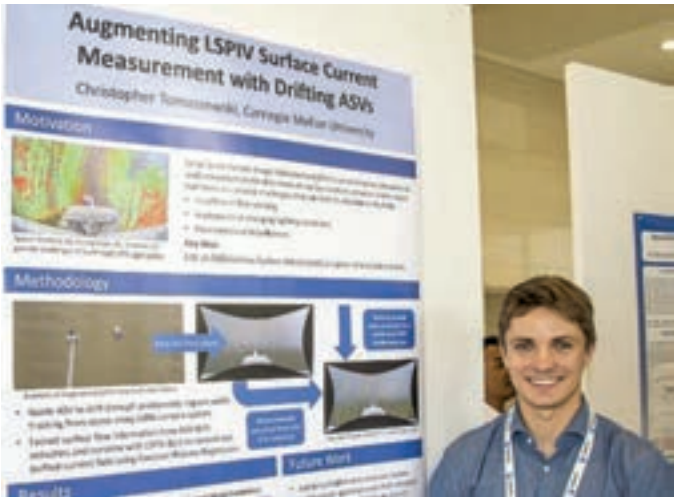
In recent years, there is a tendency to use complementary autonomous vehicles with different capabilities in fleets for monitoring aquatic environments. Vehicle combinations could enable more complex missions with a wider variety of tasks to be accomplished. This paper presents the design and experimental verification of an observation system for long-term, large-scale, spatially explicit aquatic monitoring. The proposed system is comprised of a man-portable unmanned surface vehicle (USV) and a remotely operated vehicle (ROV), which are connected by an intelligent tether system. This system combines the main advantages of these two autonomous vehicles. These include the high maneuverability of ROV to measure water parameters at different selectable depths, and great endurance of USV to vastly increase the observing scale and range. In this paper, the mechanical and electrical design of the observation system is introduced in detail, and field experiments are performed to characterize the performance of the system.

Masmitja, Ivan, Universitat Politecnica de Catalunya, *Underwater multi-target tracking with particle filters.*



Robotic platforms communication and interoperability is of relevance for marine science and industrial monitoring. We present results of a particle filter study based on underwater Multi-Target Tracking (MTT) using Autonomous Underwater Vehicles (AUV). The main goal was to assess the viability of using a single surface vehicle as a mobile landmark to track and follow a fleet of underwater targets, each one equipped with an acoustic tag where the slant ranges between the surface vehicle and the underwater targets are the unique input for the filters.

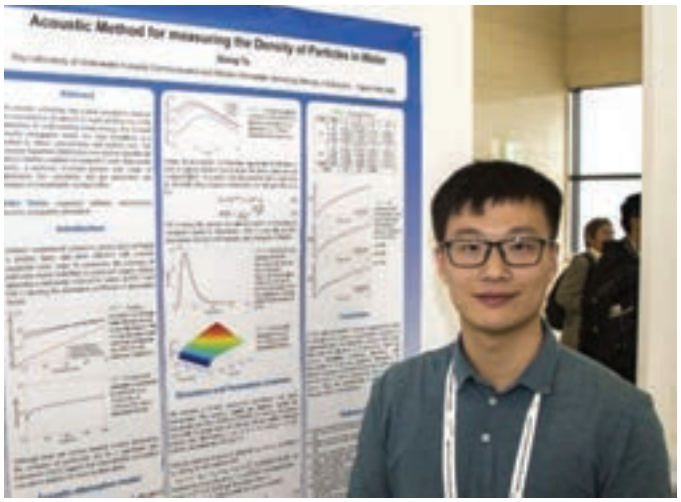
Tomaszewski, Christopher, Robotics Institute, Carnegie Mellon University, *Augmenting LSPIV Surface Current Measurement with Drifting ASVs.*



Large Scale Particle Image Velocimetry (LSPIV) has been successfully used in the field to gather water surface flow data, which is critical to understanding complex geomorphic, hydrologic, and ecological river processes. Its success, however, depends on lighting conditions and adequate flow seeding with trackable debris or visual features that can be hampered by environmental disturbances such as wind or wildlife. Instead, this research proposes augmenting traditional LSPIV methods by incorporating autonomous surface vehicles (ASVs) as pieces of actuated debris. This addressses the shortcomings of artificial seeding with tracers that may not be recoverable and impractical. Our method uses initial image velocimetry flow estimates to guide an ASV to sparsely seeded or poorly illuminated regions within the survey area. There it can be set adrift and tracked from above to capture additional measurements to improve the surface flow field reconstruction. We compare conventional techniques with our augmented LSPIV system in simulation and in field tests. The results showcase performance and capability enhancements ASVs can provide.

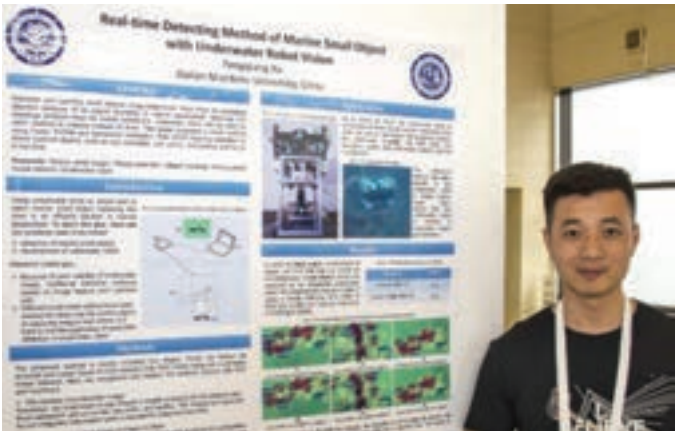
Tu, Qiang, Xiamen University, *Acoustic Method for Measuring the Density of Particles in Water.*

The acoustic technology has a great potential to measure the concentration of particles in water which is one of the parameters for understanding ocean ecology. To achieve this purpose, the forward acoustic propagation model has been considered as



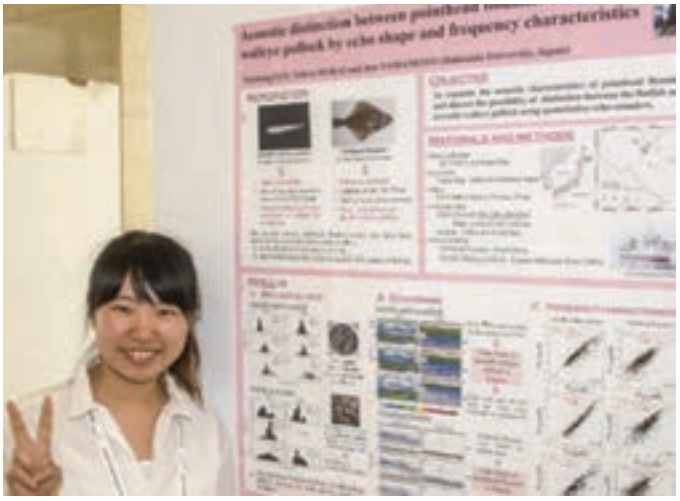
a method to obtain concentration and particle size. The Gaussian lognormal distribution was used to describe the particle matters condition in suspended water. Base on the model, a nonlinear inversion process took values of attenuation into calculation and get parameters of concentration, average radius and variance.

Xu, Fengqiang, Dalian Maritime University, *Real-time Detecting Method of Marine Small Object with Underwater Robot Vision.*



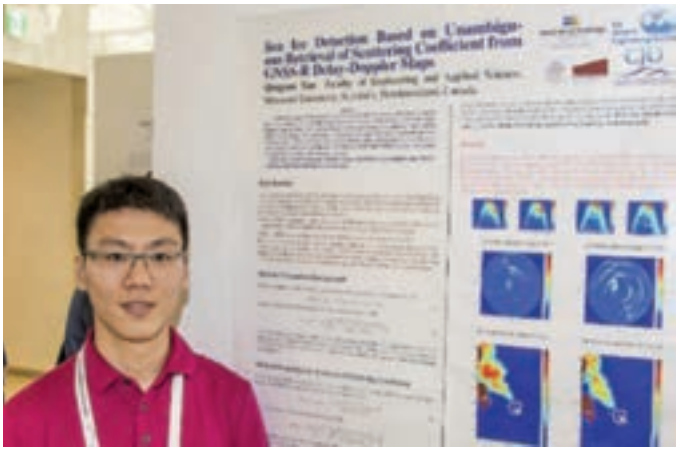
Detection and counting small objects using underwater robot draw an appealing attention because of its urgent demands in marine aquaculture. Because this challenge problem must be solved before the underwater robot can be used to catch seafood in practice instead of diver. This paper proposed a novel method using Faster R-CNN and kernelized correlation filter (KCF) tracking algorithm to detect seafood objects, such as sea cucumber, sea urchin, and scallop and so on in real time. Firstly, we trained an accurate and stable Faster R-CNN detector with VGG model using underwater image database, which is built by ourselves. Next, we recognized and tracked the seafood objects in order to fetch them using underwater robot vision in naturalistic ocean environment. The experimental results show the proposed method can recognized and catch seafood in real time using our integrated underwater robot.

Yan, Naizheng, Hokkaido University, *Acoustic distinction between pointhead flounder and juvenile walleye pollock by echo shape and frequency characteristic.*



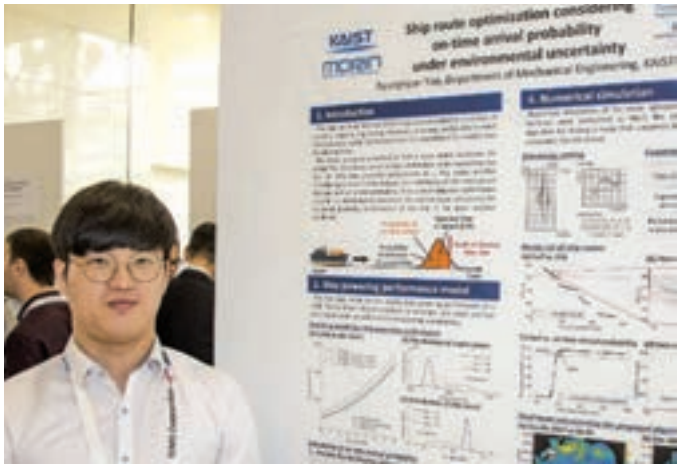
This study addresses the methods for distinguishing the pointhead flounder *Cleisthenes pinetorum* from the juvenile walleye pollock *Gadus chalcogrammus* in and near Funka Bay, Hokkaido, Japan. Acoustics data of th *Gadus chalcogrammus* fish were monitored using a Simrad EK60 (38, 120, 200 kHz) splitbeam echo sounder, and biological samples were collected using a rod for the pointhead flounder and a frame-type midwater trawl for the juvenile walleye pollock. The pointhead flounder schools presented a patch shaped echo on the echograms and showed strong scattering at all three frequencies, whereas the distribution patterns of the juvenile walleye pollock schools were layered. The volume backscattering strength (SV) of the target schools extracted from the echograms showed that the pointhead flounder presented a higher SV at high frequency, which is consistent with the early surveys of other bladderless fish. In contrast, the juvenile walleye pollock showed higher SV at low frequency, which also agreed with the early surveys.

Yan, Qingyun, Memorial University of Newfoundland, *Sea Ice Detection Based on Unambiguous Retrieval of Scattering Coefficient from GNSS-R Delay-Doppler Maps.*

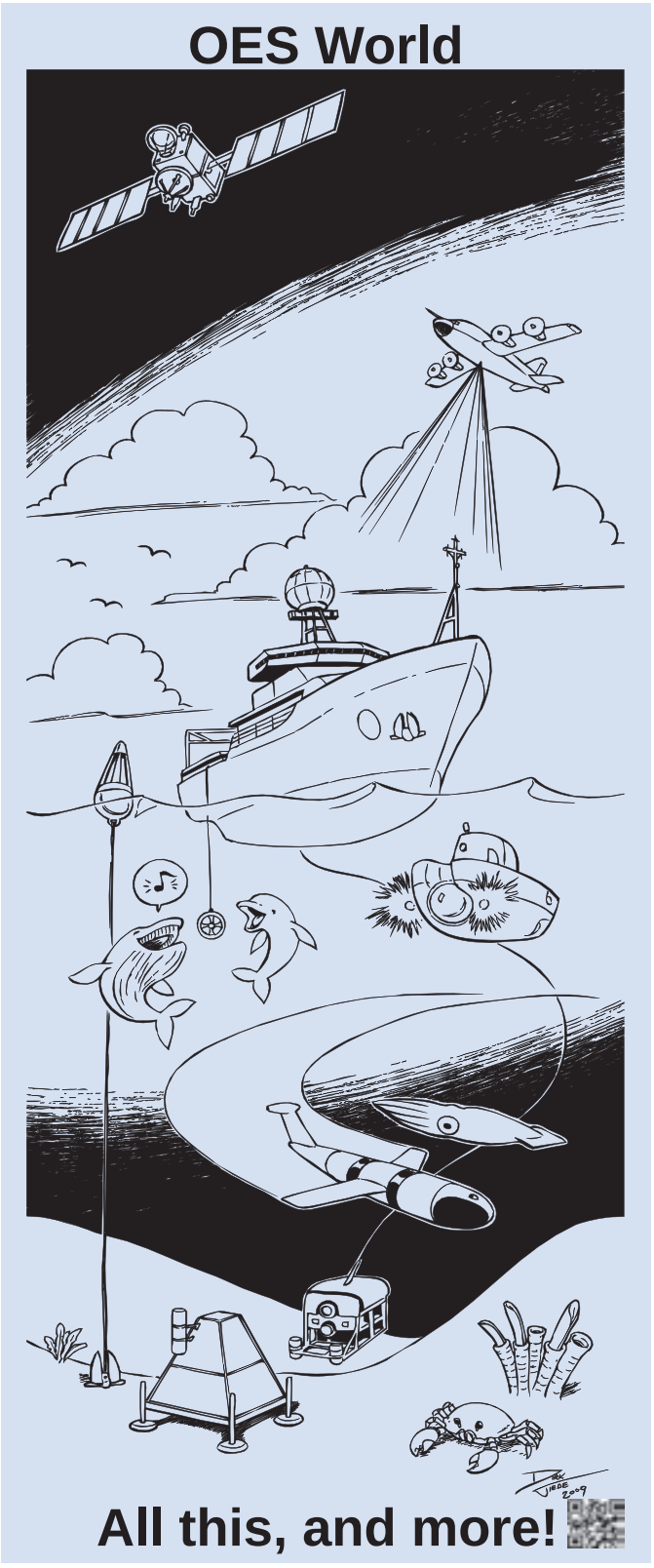


In this paper, a method is proposed for detecting sea ice based on the scattering coefficient (s0) retrieved from Global Navigation Satellite System-Reflectometry (GNSS-R) delay-Doppler maps (DDMs). First, a strategy for unambiguously retrieving the surface scattering coefficients is illustrated, by employing the spatial integration approach (SIA) and the multiscan technique. Next, the application of this proposed scheme for sea ice remote sensing is demonstrated using DDMs acquired from the U.K. TechDemoSat-1 (TDS-1) mission and verified with the collocated reference sea ice concentration (SIC) data obtained by Nimbus-7 SMMR and DMSP SSM/I-SSMIS sensors. The test results show that the proposed method offers a new solution to sea ice detection and a feasible aspect for resolving the ambiguity in the retrieval of s0 from GNSS-R DDMs.

Yoo, Byunghyun, Korea Advanced Institute of Science and Technology (KAIST), *Ship route optimization considering on-time arrival probability under environmental uncertainty.*



As international regulations for commercial ships regarding environmental pollution and global warming are being reinforced, worldwide efforts are growing to reduce the fuel consumption of ships; this is directly related to the emissions of environmental pollutants and greenhouse gases. A common method to reduce the fuel consumption of ships is to find a ship route that consumes less fuel. In many existing ship route optimization studies, the desired ship routes are calculated using a single objective optimization algorithm such as A * to minimize the path length, travel time, or fuel consumption. However, it is practically more important to reach the destination no later than the alloted time slot at a port even under weather uncertainties. In this study, a multi-objective optimization algorithm is employed to calculate the Pareto set with two objective functions: the fuel consumption and the expected time of arrival. Subsequently, using the Pareto set, the uncertainty of the arrival time and the probability that the ship will arrive within the specified time are estimated. Finally, the route to reach the port on time is determined with more certainty while minimizing fuel consumption. In order to verify the validity of the proposed method, a set of simulations were performed, and their results are discussed.



Winning Poster Paper
Automated Interpretation of Seafloor Visual Maps Obtained Using Underwater Robots

Jin Wei Lim[*], Adam Prügel-Bennett[†], Blair Thornton[*‡] [*]Maritime Robotics Laboratory, Faculty of Engineering and the Environment, University of Southampton, United Kingdom; [†]Department of Electronics and Computer Science, University of Southampton, United Kingdom; [‡]Institute of Industrial Science, The University of Tokyo, Japan. Email: j.w.lim@soton.ac.uk

Abstract—**Scientific surveys using underwater robots can recover a huge volume of seafloor imagery. For mapping applications, these images can be packaged into vast, seamless and georeferenced seafloor visual reconstructions in a routine way, however interpreting this data to extract useful quantitative information typically relies on the manual effort of expert human annotators. This process is often slow and is a bottleneck in the flow of information. This work explores the feasibility of using Machine Learning tools, specifically Convolutional Neural Networks (CNNs) to at least partially automate the annotation process. A CNN was constructed to identify Shinkaia Crosnieri galetheid crabs and Bathymodiolus mussels, which are two distinct megabenthic taxa found in vast numbers in hydrothermally active regions of the seafloor. The CNN was trained with varying numbers of annotated data, where each annotation consisted of a small region surrounding a positive label at the centre of each individual within a seamless seafloor image reconstruction. The performance was assessed using an independent set of annotated data, taken from a separate reconstruction located approximately 500 m away. While the results show that the trained network can be used to classify new datasets at well characterized levels of uncertainty, the performance was found to vary between the different taxa and with a control dataset that showed only unpopulated regions of the seafloor. The analysis suggests that the number of training examples required to achieve a given level of accuracy is subject dependent, and this should be considered by humans when devising annotation strategies that make best use of their efforts to leverage the advantages offered by CNNs.**

I. Introduction

Underwater robots instrumented with navigational sensors and imaging systems are capable of acquiring seafloor visual reconstructions over large spatial extents that cannot be obtained by other means [1], [2]. They can deliver georeferenced, millimetre resolution seamless reconstructions of the seafloor that can be used for scientific research and statutory monitoring [3]. However, while vast expanses of the seafloor can be mapped at rates of 1,000 to 10,000 m^2/h [4] the capacity for generating reconstructions significantly surpass the speed at which useful information can be extracted from them. To date, most application have relied on human experts to manually annotate the images, which requires a significant investment of time by trained experts and also lacks consistency and objectivity [5], [6]. The reliance on human interpretation of data forms a major bottleneck in the flow of information and means that patterns and statistics in imagery can remain undiscovered for long periods of time [7]. One such application on studying the megabenthic communities that populate areas around deep-sea vents, which pose a challenge to human annotators due to their diversity and their dense populations. In particular, concerns about the potential impacts of activities such as deep-sea mining on these ecosystems motivate regular studies to document temporal changes in these communities [5]. This paper investigates the potential application of machine learning techniques, specifically Convolutional Neural Networks (CNNs) to automate the identification of key taxa and improve the efficiency of deep-sea ecological studies. This is implemented using the TensorFlow machine learning library [8], which is used to analyse the distribution of different taxa in seafloor image mosaics. The advantage using CNNs is that they present a generic framework to learn the features of an object of interest in images without the need for tailored manual design or tuning of parameters.

The study is performed on data that was obtained from a deep-sea hydrothermal vent located in the Okinawa Trough, which was extensively drilled in 2010. Wide area visual mosaics were obtained from the drill affected regions 3 years and 4 months after the site was drilled using an undewater robot equiped with a visual mapping device. The data was processed in full 3D using the stereo mapping pipeline described in [9]. While the acquisition of the seafloor images used to generate the maps took just over 3 hours during a single dive, the annotation process of more than 100,000 organisms from 6 taxa in them took a human expert several weeks of dedicated effort. These annotations form both the ground truth for training and validation of the proposed method. Two sections of the mosaic (Fig. 1) that are located 500 m apart mapped at a higher resolution than the rest were used as the main data for this work. The metrics assessed in this work are the accuracy of the CNN output compared to the human annotations, and the potential savings of human time and effort that can be achieved through automation for this dataset.

II. Problem Formulation

Automating the annotation of benthic organisms is challenging since individuals of the same taxa can vary in size, be positioned in various orientation, be partially occluded and

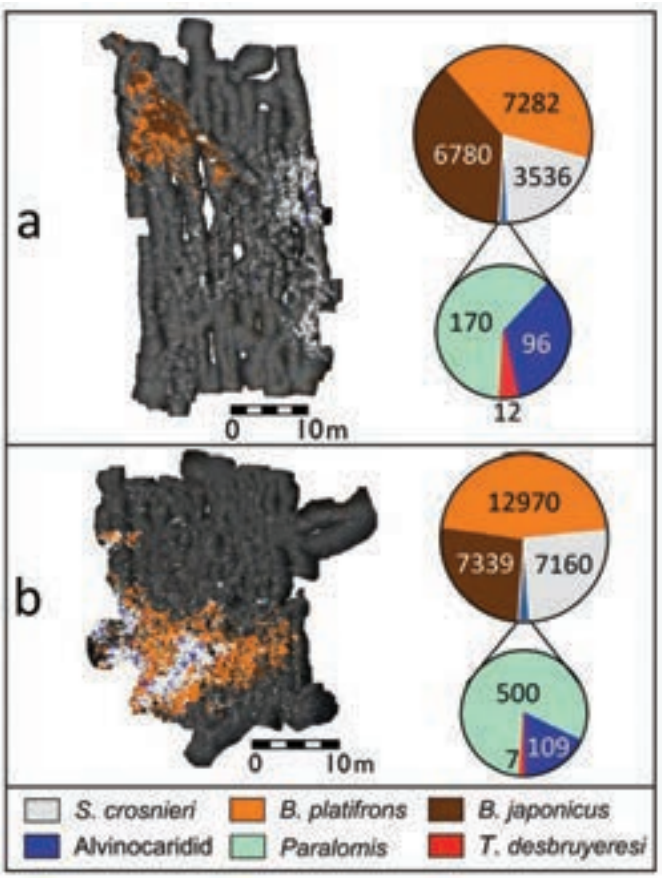


Figure 1. The two mosaics showing the distribution of the 6 different taxa in them, with pie charts corresponding to their abundance. (a) C0014 region. (b) North Big Chimney (NBC) region. Both regions are located at Iheya North Field approximately 500 m apart, and at a depth of approximately 1000 m [1].

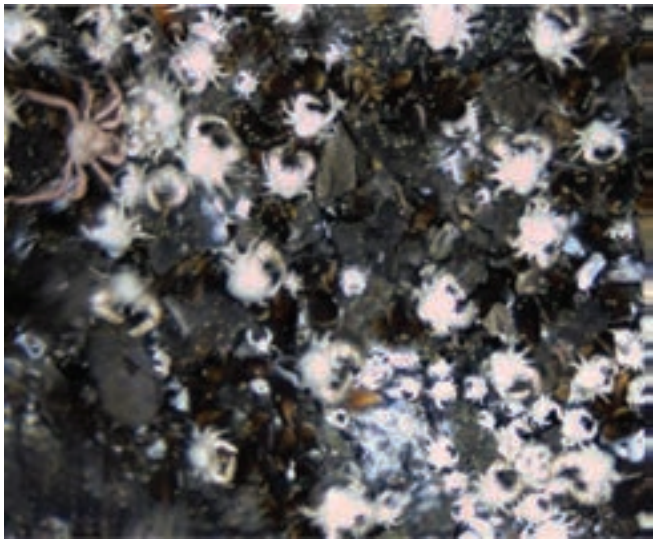


Figure 2. Heavy overlapping of multiple taxa, making it difficult to clearly distinguish one individual from another. Majority of the animals present here are the Shinakai crosnieri galatheid crab (with white appearance) and two taxa of Bathymodiolus mussels (with brown shells).

cluttered (Fig. 2). In addition, underwater imagery is typically of poorer quality than images in air due to wavelength dependent absorption and scattering of light and the fact that parameters that affect these such as water turbidity, vary both spatially and temporally [7]. This combined with the difficulty of maintaining a fixed altitude from the seafloor over rugged terrains. While significant advances have been made to correct for these effect [10], the sensitivity of the images to environmental and measurement conditions means that the recovery of color information is imperfect. There have been several attempts to automate annotation of objects such as starfish [11], sardine eggs [12], coral reefs [13], scallops [14], and crabs [13] in the marine environment. However, most of these approaches are either only applicable to identify one specific taxon using a tailored model with manually tuned parameters, or are sensitive to noise.

Furthermore, in most situations, the abundance of creatures on the seafloor is sparse, and so it is often not necessary to distinguishing creatures that overlap. For the application being considered however, the population densities are orders of magnitude higher than in most regions of the seafloor, hence it is necessary to develop methods that are robust to occlusions and cluttering, and insensitive to variations caused by imperfect illumination and color corrections. The novelty of this paper lies in the systematic analysis of how training data quantity and data augmentation affect the classification of different taxa.

III. Methodology

The 3 taxa selected for investigation make up 97% of the 45,961 individuals identified in mosaics obtained in this region, where a total of 6 taxa were identified [1]. These are Shinkaia crosnieri (SCr), Bathymodiolus platifrons (BPl), and Bathymodiolus japonicus (BJa). Due to the similar appearance of the two Bathymodiolus mussel taxa (BJa and BPl), they were combined into a single class called Bathymodiolus (Bat) for the purpose of this work.

The CNN in this project was built using the TensorFlow v1.0.0-rc0 software library released in January 2017. TensorFlow is an open source software library for numerical computation using dataflow graphs. The graph contains nodes that represent mathematical operations and the graph edges represent the multidimensional data arrays (tensors) communicated between them. TensorFlow also takes advantage of Graphical Processing Unit (GPU) in calculating the gradients needed to optimize the variables in the CNN, allowing for faster computational time. The computer used for this computations has these specifications: CPU (Intel Core i7-5700HQ CPU @ 2.70 GHz), 8GB RAM, 64-bit Operating System, Windows 10, GPU (NVIDIA GTX950M).

A. Training, Validation, and Test Sets

Based on the labels from experts, images of SCr and Bat around the pointwise labels were cropped to 50 × 50 pixels (approximately 50 × 50 mm to scale in the orthographic reprojection of the 3D reconstruction). This window size was chosen as the organisms targeted from the georeferenced mosaics for this

Table I. Number of Data for Each Taxon, for Each mosaic.						
Mosaic	**NBC**			**C0014**		
Class	SCr	Bat	NSe	SCr	Bat	NSe
Training (images)	5250	5250	5250	-	-	-
Validation (images)	1750	1750	1750	-	-	-
Test (images)	-	-	-	3500	3500	3500
Total (images)	21000			10500		

study fit within it. The number of independent SCr and Bat were limited to 7,000 each for the NBC mosaic, and 3,500 each for the C0014 mosaic to achieve class balanced dataset with maximum data points. A null set (NSe) containing 50 × 50 pixels cropped images of unpopulated regions of the seafloor (e.g. sand and rocks) was also generated for each mosaic, to allow the CNN to recognize inputs that have no organisms in it (negative event). NSe was generated by randomly cropping sections of the mosaic that contain no annotation.

Data from the NBC mosaic were split into a training set and a validation set at the ratio of 3:1. By varying the number of training data from the training set and evaluating each independently trained CNN against the fixed validation set, the optimal conditions for constructing the CNN for this dataset were determined. Data from C0014 mosaic, which was obtained under similar conditions from a location 500 m away from NBC mosaic, were used as the test set to evaluate the CNNs performance on new unseen data. This gives an idea how well the CNN will work if it were to be used for future monitoring of the same taxa using past data for training. Table I shows how the datasets were split.

B. CNN Architecture

The CNN was based on an architecture built to solve the CIFAR-10 problem [15]. CIFAR-10 is a common benchmark problem for classification in machine learning where the goal is to classify 60,000 images of 10 object classes (airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck). The model was chosen as it is complex enough to exercise much of TensorFlows ability to scale to large models, and small enough to be trained in short periods of time. It also utilizes PrettyTensor add on package [16] which provides important tools to analyse the performance of the CNN such as output classification confusion matrix and example error images. The hyperparameters of the CNN are shown in Table II.

Table II. Convolutional neural Network Architecture		
Layer Name	**Properties**	
1) Convolutional Layer	*Kernel = 5*	*Depth = 64*
2) Max Pooling Layer	*Kernel = 2*	*Stride = 2*
3) Convolutional Layer	*Kernel = 5*	*Depth = 64*
4) Max Pooling Layer	*Kernel = 2*	*Stride = 2*
5) Fully Connected Layer	*Size = 256*	
6) Fully Connected Layer	*Size = 128*	
7) Softmax Classifier Layer	*Classes = 3*	

C. Training Conditions

During the training step, images of the training dataset go through a pre-processing step that randomly distorts the input images to artificially increase the number of data available before being fed into the CNN. This number depends on the chosen number of iterations and batch size (1) defined in the source-code.

$$\text{Number of artificially increased data} = \text{Number of iterations} \times \text{Batch size} \quad (1)$$

At this point, it was unclear what number of artificially increased data is too little, ideal, or too much. Hence, to determine the effect this variable has on the performance of the CNN, three different set up were used. Only the number of iterations was varied for the different set ups, and the batch size was kept constant at 64 due to the limited size of RAM.

1) Proportionally Varying Iteration

The first investigation is to vary the number of artificially increased data proportionally with the number of available training data. This is to ensure that each training data on average will generate the same amount of artificially increased training data, thus allowing for a fair comparison between the results of different training numbers. The number of iterations in this approach is the same as the number of training data used. For instance, 2,000 training data would have 2,000 iterations, hence 2,000 × 64 = 128,000 artificial data points would be generated and used.

2) Constant Iteration

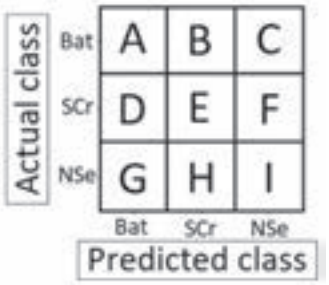
In proportionally varying iteration set up, the number of iteration is small for small training sets and large for larger training sets. In this investigation, the number of artificially increased training data is kept to a reasonably large constant number 640,000 (number of iterations = 10,000, train batch size = 64) to allow for comparison with the proportionally varying iteration. The comparison provides an insight into how the CNN performs with large numbers of artificially increased data, which is relevant in cases where only a small number of training data is available.

3) Early Stop Iteration

In this last investigation, the number of iterations is not fixed, and is dependant on the improvement of the model. This is achieved using an algorithm to make sure the iterations will stop when there has not been any improvement after 1,500 iterations. This is to check if the CNN of the previous two set ups were over-fitting. Over-fitting occurs when a CNN learns the noise of the training-set providing good results on that dataset, but performs poorly when generalised to other datasets. CNN are reported to be robust to over-fitting, and so this is not generally a problem. However the investigation is carried out as a precautionary measure.

D. Method for Assessment of Performance

The following methods are used to assess the performance of the CNN:



A confusion matrix describes the performance of the CNN, where elements A, E, and I are the correct predictions, and elements B, C, D, F, G, and H are the wrong predictions.

$$\text{Precision of a class} = \frac{\text{Correct predictions of that class}}{\text{Total number of prediction of that class}} \quad (2)$$

The precision of a particular class is defined as the proportion of correct predictions out of all predictions made by the CNN (2). In other words, of all the prediction of a class made by the CNN, the precision shows how often it was correct. For example, precision of Bat $= \frac{A}{A + D + G}$.

$$\text{Recall of a class} = \frac{\text{Correct predictions of that class}}{\text{Total actual number of that class}} \quad (3)$$

The recall of a particular class is defined as the proportion of correct predictions out of the total actual number of that class (3). In other words, of all the actual number of a particular class, the recall shows how often was it correctly predicted. For example, recall of Bat $= \frac{A}{A + B + C}$.

$$\text{Total accuracy} = \frac{\text{Total number of correct predictions}}{\text{Total number of predictions}} = \frac{A + E + I}{A + B + C + D + E + F + G + H + I} \quad (4)$$

The total accuracy of describes the overall measure of the CNN's performance given as the ratio of correct predictions over all predictions (4).

IV. Results and Discussion

A. Training and Validation with NBC Data

The results plotted in Fig. 3 show the overall accuracy and time taken to train the CNN, using varying number of training data (from 15 Bat + 15 SCr + 15 NSe = 45 images to 5,250 Bat + 5,250 SCr + 5,250 NSe = 15,750 images), evaluated against a fixed validation set consisting of 1,750 Bat + 1,750 SCr + 1,750 NSe = 5,250 images. Both the training and validation dataset were from NBC mosaic as detailed in Table I. The curve of the time taken reflects the variation in number of artificially increased data, since they are both directly proportional to each other.

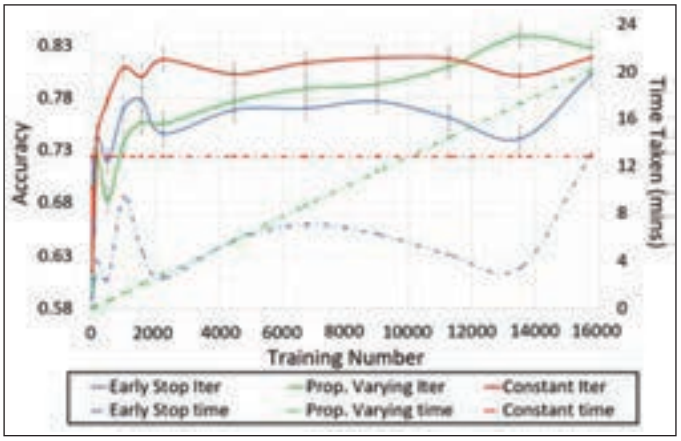


Figure 3. Total Accuracy.

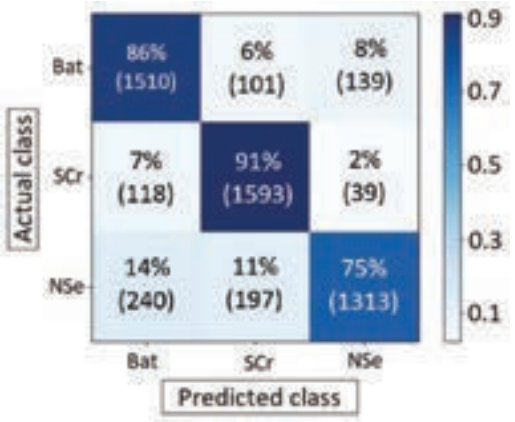


Figure 4. Confusion matrix of the best performing run with 13,500 training data, showing the recall rates % and actual numbers in brackets.

In general, increasing the number of artificially increased data improves the accuracy, as can be seen where whichever time taken curve has a higher value, the corresponding accuracy is high too. The graph also shows that beyond ~2,000 training data, the accuracy does not improve significantly. This means that efforts in generating more training data beyond that would not be an efficient use of human effort since it would not significantly improve the accuracy. For example, with 10,000 iterations of batch size 64, an averaged accuracy of 81.6% was achieved with just 2,250 training data (Constant Iter curve). The highest averaged accuracy achieved of all set ups is 83.9% with 13,500 iterations of batch size 64 with 13,500 training data (Proportionally Varying Iter curve), which is only a 2.3% increase in accuracy. Assuming it takes a human expert only 5 sec to make an annotation, generating 2,250 training data can be done in 3.125 hours, whereas generating 13,500 training data would require 18.75 hours.

1) Precision and Recall

While accuracy provides a rough idea of how well the CNN performs, it does not give insight to the quality of predicted

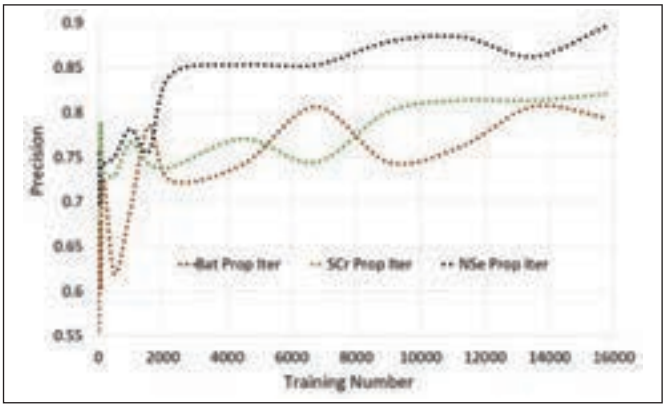


Figure 5. Precision of each taxa in proportionally varying iteration.

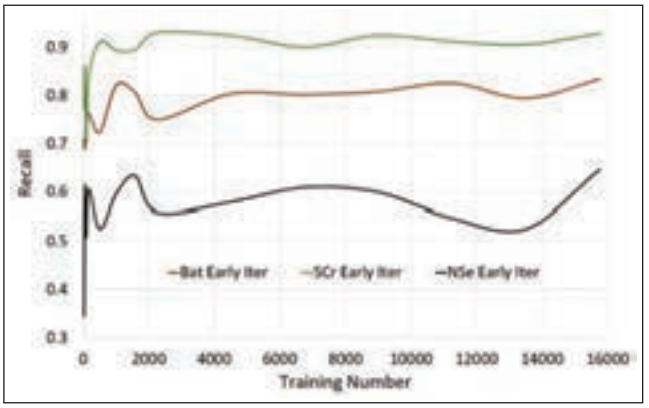


Figure 8. Recall of each taxa in early stop iteration.

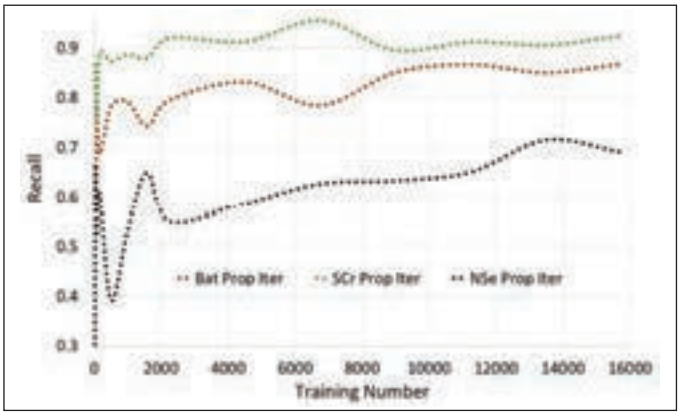


Figure 6. Recall of each taxa in proportionally varying iteration.

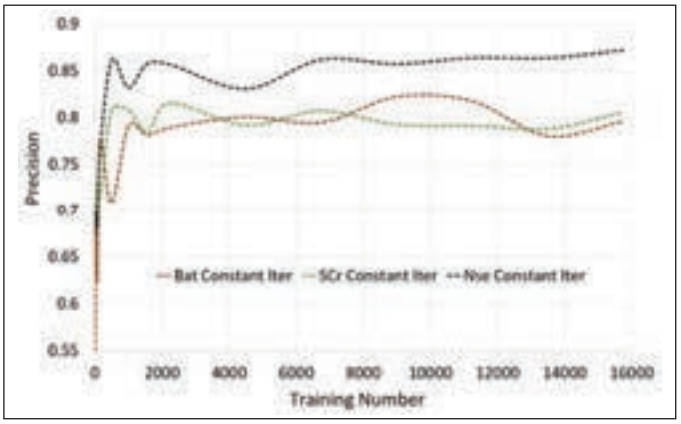


Figure 9. Precision of each taxa in constant iteration.

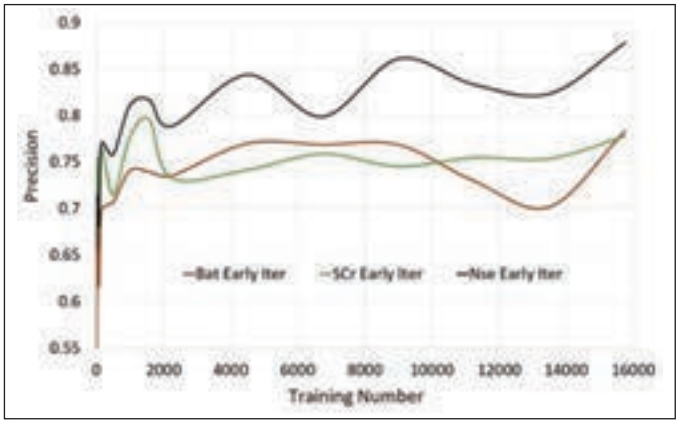


Figure 7. Precision of each taxa in early stop iteration.

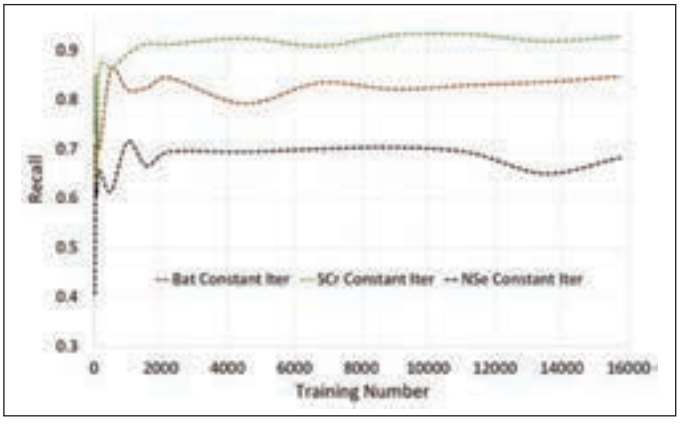


Figure 10. Recall of each taxa in constant iteration.

data. To investigate this, recall and precision graphs were calculated using the original number of instances of predicted vs actual classes in the confusion matrix of each run (see Fig. 4 for an example of the confusion matrix).

The recall graphs (Fig. 6, 8, 10) shows that of all the actual data in the validation set, the CNN is worst at identifying NSe, and best at identifying SCr. Although NSe has the worst recall, it has the highest precision as shown in Fig. 5, 7, 9. In other words, when this CNN is to be used on a different mosaic, although the predictions of SCr and Bat would capture most of the actual animals present in the dataset, their misclassifications would be more than that of NSe predictions. On the contrary, the NSe predictions would capture less of the total NSe available in the dataset, and the output would have fewer false negatives (i.e. the wrong prediction that SCr or Bat does not exist). This also means that, using this trained CNN, there will

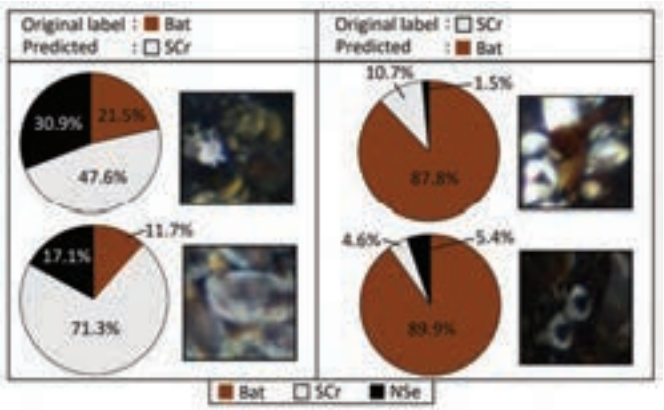


Figure 11. Samples of mispredicted taxa. Left column correspond to samples from element B, and right column correspond to samples from element D of the confusion matrix in Fig. 4.

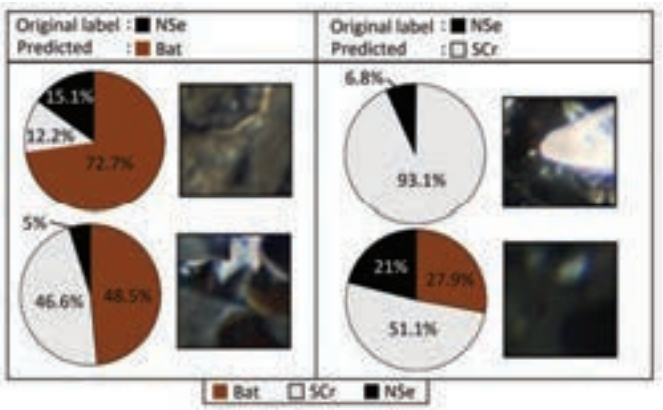


Figure 13. Samples of false positives (i.e. there is no animal in the image (NSe) but the CNN predicted that there is an animal in it (Bat or SCr)). Left column correspond to samples from element G, and right column correspond to samples from element H of the confusion matrix in Fig. 4.

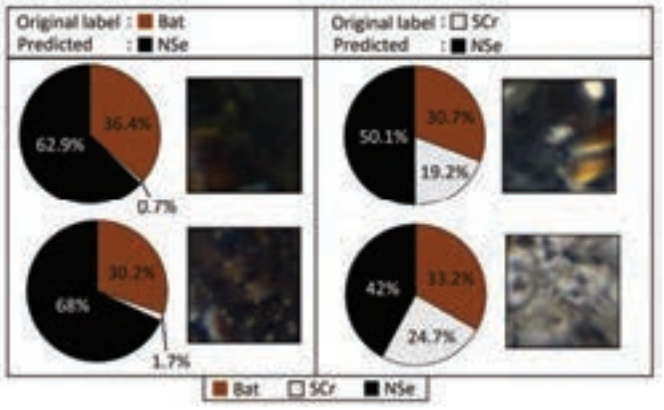


Figure 12. Samples of false negatives (i.e. there is an animal (Bat or SCr) in the image but the CNN predicted there is no animal in it (NSe)). Left column correspond to samples from element C, and right column correspond to samples from element F of the confusion matrix in Fig. 4.

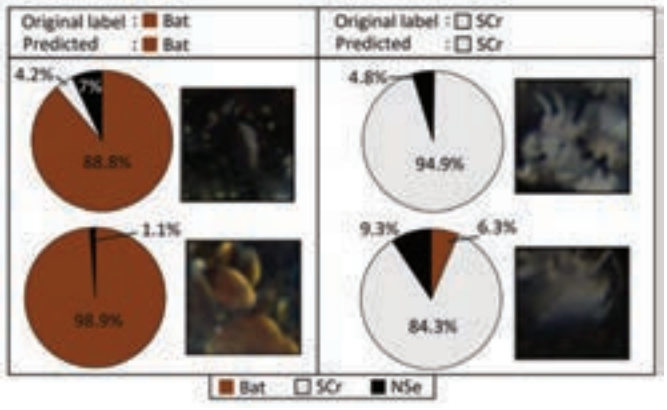


Figure 14. Samples of true positives (i.e. there is an animal in the image (SCr or Bat) and the CNN correctly predicted its class). Left column correspond to samples from element A, and right column correspond to samples from element E of the confusion matrix in Fig. 4.

almost certainly be an over estimation of SCr and Bat (which are the objects of interest), since the seafloor is vast and contains a large region that represents NSe.

2) Analysing Samples of Predicted Data

Figs. 11, 12, and 13 show some examples of the CNN misclassifications, and Figs. 14 and 15 show some examples of the correct CNN classifications, for the best performing run with 13,500 training data. They correspond to the elements in the confusion matrix in Fig. 4. The pie chart shows the percentage that reflects how confident the CNN thinks the image is of a particular class.

The results in Fig. 11 indicate that some misclassifications were due to multiple taxa appearing in the cropped image, resulting in the CNN recognizing features of the wrong class. This is shown in the pie chart where the probability assigned to the organism that matches the labelled cropped image is lower than that of others. In Fig. 12, some of the images have poor

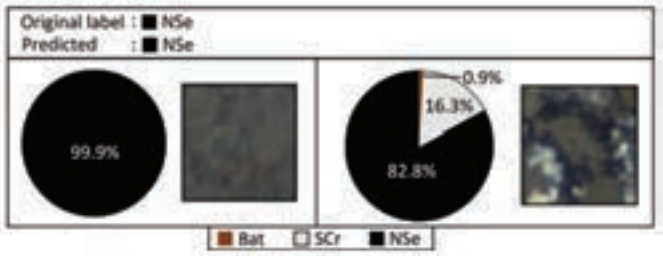


Figure 15. Samples of true negatives (i.e. there is no animal in the image (NSe) and the CNN correctly predicted it), corresponding to samples from element I of the confusion matrix in Fig. 4.

clarity (e.g. poor lighting, organism too far away) and is likely the reason for misclassification.

In Fig. 13, the high probability assigned to SCr whenever there are white bacteria mats in NSe indicates that the CNN has the tendency to associate white objects to SCr. Also in Fig. 13, there are a number of dead Bat appearing in the NSe labelled

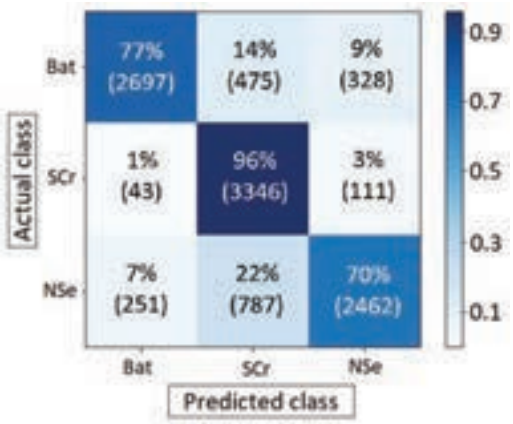


Figure 16. Confusion matrix of trained CNN on C0014 data, showing the recall rates % and actual numbers in brackets.

data that were not annotated by the human expert. The similarity of appearance of some of these to live Bat resulted in the CNN labelling these as Bat, since there were no provisions for the CNN to learn what dead Bat looks like. Some other misclassification noticed in areas where there are dark rocks and hydrothermally altered sediments indicates that the feature space of NSe is diverse, and that this was poorly described by the CNN.

In Fig. 14, some of the images contain taxa cluttered together and the CNN was able to correctly classify them. In Fig. 15, although both images were correctly classified as NSe, it can be seen again that the appearance of white bacteria mats cause an increase in the percentage of SCr in the pie chart.

These results suggest that proper segmentation or cropping of the organism in the image will likely improve the CNN performance, since it often correctly detects features of the unintended objects in the labelled box cropped image data. Moreover, further improvements are required for the NSe training data, with a more targeted approach to contain sufficient examples of regions that contain distinct visual features. One possible way of achieving this is to use unsupervised clustering methods to ensure the different types of members within NSe are sufficiently represented in the training data. Additionally, this strategy may also be useful to guide human annotation efforts. However, while these may improve the CNN's ability to distinguish these from members of the other classes, further investigation is required since any systematic change in the training data will have a coupled effect with the accuracy of automated labelling of other classes.

B. Training with NBC and Testing on C0014

The CNN trained with training data that showed the best performance with 13,500 images from NBC was used to evaluate the C0014 test batch containing 3500 each of SCr, Bat and NSe. The results are shown in Fig. 16.

An accuracy of 81% was achieved by testing the CNN on a total of 10,500 C0014 test samples. The overall characteristics of the performance is similar to Fig. 4, where the highest recall is SCr at 96%, followed by Bat which is 19% lower than SCr, and NSe which is 26% lower SCr.

V. Conclusions

Since the accuracy in Fig. 3 largely remains the same after a certain threshold number of training data and the time taken to train the CNN is relatively small compared to the time taken to generate training data, it is more important to look at the trade off between achieving optimal accuracy, time taken to generate training data, and cost of misclassification for this specific application. The varying performances for each individual class in Fig. 16 suggests that the human effort in generating training data can be optimised according to their respective performances for each class (i.e. more training data for low performing classes such as Bat and NSe) to improve the accuracy. Thus, while CNNs can classify new datasets at well characterized levels of uncertainty, the number of training examples required to achieve a given level of accuracy is subject dependent, and this should be considered when devising annotation strategies that make best use of human efforts.

References

[1] B. Thornton, A. Bodenmann, O. Pizarro, S. B. Williams, A. Friedman, R. Nakajima, K. Takai, K. Motoki, T.-o. Watsuji, H. Hirayama et al., "Biometric assessment of deep-sea vent megabenthic communities using multi-resolution 3d image reconstructions," Deep Sea Research Part I: Oceanographic Research Papers, vol. 116, pp. 200–219, 2016.

[2] M. Johnson-Roberson, M. Bryson, A. Friedman, O. Pizarro, G. Troni, P. Ozog, and J. C. Henderson, "High-resolution underwater robotic vision-based mapping and three-dimensional reconstruction for archaeology," Journal of Field Robotics, vol. 34, no. 4, pp. 625–643, 2017.

[3] O. Beijbom, P. J. Edmunds, C. Roelfsema, J. Smith, D. I. Kline, B. P. Neal, M. J. Dunlap, V. Moriarty, T.-Y. Fan, C.-J. Tan et al., "Towards automated annotation of benthic survey images: Variability of human experts and operational modes of automation," PloS one, vol. 10, no. 7, p. e0130312, 2015.

[4] T. Kwasnitschka, K. Köser, J. Sticklus, M. Rothenbeck, T. Weiß, E. Wenzlaff, T. Schoening, L. Triebe, A. Steinführer, C. Devey et al., "Deepsurveycama deep ocean optical mapping system," Sensors, vol. 16, no. 2, p. 164, 2016.

[5] N. MacLeod, M. Benfield, and P. Culverhouse, "Time to automate identification," Nature, vol. 467, no. 7312, p. 154, 2010.

[6] P. F. Culverhouse, R. Williams, B. Reguera, V. Herry, and S. González-Gil, "Do experts make mistakes? a comparison of human and machine identification of dinoflagellates," Marine Ecology Progress Series, vol. 247, pp. 17–25, 2003.

[7] O. Beijbom, P. J. Edmunds, D. I. Kline, B. G. Mitchell, and D. Kriegman, "Automated annotation of coral reef survey images," in Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on. IEEE, 2012, pp. 1170–1177.

[8] M. Abadi, A. Agarwal, P. Barham, E. Brevdo, Z. Chen, C. Citro, G. S. Corrado, A. Davis, J. Dean, M. Devin, S. Ghemawat,

I. Goodfellow, A. Harp, G. Irving, M. Isard, Y. Jia, R. Jozefowicz, L. Kaiser, M. Kudlur, J. Levenberg, D. Mané, R. Monga, S. Moore, D. Murray, C. Olah, M. Schuster, J. Shlens, B. Steiner, I. Sutskever, K. Talwar, P. Tucker, V. Vanhoucke, V. Vasudevan, F. Viégas, O. Vinyals, P. Warden, M. Wattenberg, M. Wicke, Y. Yu, and X. Zheng. (2015) TensorFlow: Large-scale machine learning on heterogeneous systems. [Accessed: 17-Feb-2017]. [Online]. Available: https://www.tensorflow.org/

[9] M. Johnson-Roberson, O. Pizarro, S. B. Williams, and I. Mahon, "Generation and visualization of large-scale three-dimensional reconstructions from underwater robotic surveys," Journal of Field Robotics, vol. 27, no. 1, pp. 21–51, 2010.

[10] A. Bodenmann, B. Thornton, and T. Ura, "Generation of high-resolution three-dimensional reconstructions of the seafloor in color using a single camera and structured light," Journal of Field Robotics, vol. 34, no. 5, pp. 833–851, 2017.

[11] R. Clement, M. Dunbabin, and G. Wyeth, "Toward robust image detection of crown-of-thorns starfish for autonomous population monitoring," in Australasian Conference on Robotics and Automation 2005. Australian Robotics and Automation Association Inc, 2005.

[12] J. Powell, S. Krotosky, B. Ochoa, D. Checkley, and P. Cosman, "Detection and identification of sardine eggs at sea using a machine vision system," in OCEANS 2003. Proceedings, vol. 1. IEEE, 2003, pp. 175– Vol.

[13] A. F. Gobi, "Towards generalized benthic species recognition and quantification using computer vision," in OCEANS 2010 IEEE-Sydney. IEEE, 2010, pp. 1–6.

[14] J. Howland, S. Gallager, H. Singh, A. Girard, L. Abrams, C. Griner, R. Taylor, and N. Vine, "Development of a towed survey system for deployment by the fishing industry," in OCEANS 2006. IEEE, 2006, pp. 1–5.

[15] M. E. H. Pedersen. (2016) Tensorflow tutorials. [Accessed: 17-Feb- 2017]. [Online]. Available: https://github.com/Hvass-Labs/TensorFlow-Tutorials

[16] E. Moore. (2016) Pretty tensor - fluent neural networks in tensorflow. [Accessed: 17-Feb-2017]. [Online]. Available: https: //github.com/google/prettytensor

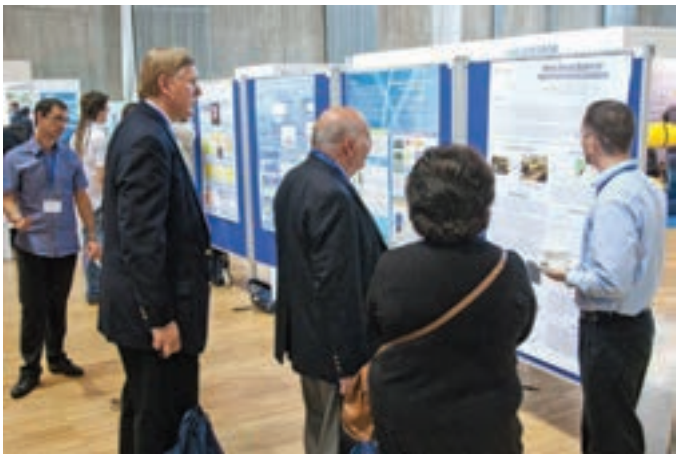
Congratulations and see you in Charleston!

A Blast from the Past!

Bob Wernli—Beacon Co-Editor-in-Chief

Is there fun at an OCEANS conference? See for yourself in this **Blast from the Past**.

Magnificent Light Show at OCEANS '12 Yeosu Gala.



Student Poster Competition, OCEANS '11 Santander.

Full House for OCEANS '07 Vancouver Plenary.

OCEANS '06 Boston Chair John Irza's Opening Remarks.

President Jim Barbera at the Helm OCEANS '05 Brest.

Stan Chamberlain and Harumi Sugimatsu OCEANS '08 Kobe.

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Member Highlights

Contact the Editors If You Have Items of Interest for the Society

Chinese Boat Wins Volvo Around-the-World Ocean Race

Stan Chamberlain

On June 24, 2018, in the closest finish in race history, Dongfeng Race Team became the first Chinese-flagged team to win the 45,000 mile, around-the-world Volvo Ocean Race. At the start of the 11th, 970-mile last leg, there were three boats in a tie for the lead. Each of those three teams, MAPFRE, Team Brunel and Dongfeng Race Team, led at various points on the leg and had their opportunities to grab the prize. In winning this leg

First and 2nd Place VOR Winners.

Beating to Wind ward.

First and 3rd Place VOR Winners.

Downwind Parade.

(it's first leg win), Dongfeng became the winner of the overall VOR race. Here are some photos of the boats while in Newport, Rhode Island, USA, during their stop-over between legs 8 and 9.

Who's who in the OES

Venugopalan Pallayil (Venu), OES AdCom Member

When Bob asked me to write for the column 'Who is Who in OES' in the BEACON Newsletter, I kept thinking what would the readers want to know about me and why should they bother with who I am? People who would want to know my official side of things can always take a look at my work-related website or Google for it. And sometimes even personal things could also pop up (Recently I was surprised to see many of my personal details, including the date of my marriage on a website apparently hosted somewhere in Russia. Some of my personal information leaked from my desire to be listed under 'Marquis Who is Who' for which I had registered a few years back). In this column I wish to share some things that I want you to know about me, which will hopefully be of interest.

About me: I was born in Kerala, widely known as Gods Own Country, which is a land of coconut trees, backwaters, mountains and beaches. It is the southernmost state of India and our mother tongue is Malayalam (it reads the same both ways when written in English). I graduated with a Masters in Physics and a PhD in Microwave Electronics from Cochin University of Science and Technology. However, I ended up working at much lower frequencies, though at the same wavelength. I worked as an R&D scientist in the Defence Research and Development Organisation, India, for 11 years with major contributions in the field of air-borne ASW systems. Prior to joining DRDO, India, I also underwent a one-year Electronics Fellowship Course, attended by 50 select graduates at all India level annually. In 1998, I moved to Singapore and joined the Acoustic Research Laboratory (ARL), Tropical Marine Science Institute (TMSI), National University of Singapore (NUS) as a Research Fellow. Currently, I am a Senior Research Fellow and deputy head at ARL. For 5 years I also served as Manager for Operations at TMSI, supporting my then Director to manage both finance and facilities.

My work at ARL: You can read all about my research at ARL from the website www.arl.nus.edu.sg. But, I would like to share with you a couple of my achievements, which I am proud of. One of them is the project ROMANIS (Remotely Operated Mobile Ambient Noise Imaging System) initiated by Dr. John Potter when he was the head of ARL. This is a broadband acoustic camera, which uses snapping shrimp noise for imaging underwater objects. It was a big challenge building ROMANIS considering we started to work on the system in 1998 (or even before) and when there was no off the shelf technology available to build a Gigabit/sec data acquisition system. Nevertheless, we built a custom solution and the first prototype in 2003. In 2009 we rebuilt the whole system based on Gigabit Ethernet and currently we have a system that can stream data at 1.6Gbps from 508 sensors and form images in real-time. ROMANIS won the Defence Technology Prize, a prestigious award instituted by the Ministry of Defence, Singapore, in 2004 for the best engineering project. See a recent publication related to this project in JOE, January 2016 issue.

The second project that needs mention is the development of a Digital Thin Line Array (DTLA) system, specifically developed for underwater research using small autonomous underwater vehicles. The array, 15 to 20mm in diameter with 12 to 24 acoustic channels has found itself a place on many AUV platforms for research purposes. These include Ocean Explorer, from CMRE, Italy, SEACAT from Atlas Electronik, Germany, STARFish from ARL, Singapore, and lately REMUS 100 from Woods Hole Oceanographic Institution, USA. It was destined to make a trip to the Arctic this year for a collaborative experiment with SIO, San Diego, California, for measuring ice calving noise. Unfortunately, the trip was postponed and the array is now expected to take a dip in the cold waters of the Arctic next summer.

I have been part of many research cruises, some of them on naval vessels prior to coming to Singapore. After coming to Singapore, I have been 'fortunate' to be part of three overseas cruises, viz., AsiaEx in 2001 in the South China Sea, TREX-13 in 2013 off the Florida Coast and SBCEX in 2017 at the New England Mud Patch. Each of these cruises lasted between 10 to 15 days and was exciting in different ways. This was a great opportunity for me to work together with international scientists from different areas of acoustic and oceanographic research and learn from them. The SBCEX 2017 cruise was more challenging as we had to work at sub-zero temperature (see figure) and under stormy conditions (30-35 knots wind). Out of the 15 days at sea we could deploy our AUV-array system only on the last day and collect data for a couple of hours.

ROMANIS, the 2D ambient noise imaging camera getting ready for deployment (top) and its 508 sensor array exposed (bottom).

On two occasions we had to make our way back to the WHOI dock due to severe weather conditions.

Me and IEEE OES: I have been a member of IEEE for 21 years, becoming a senior member in 2004. The Singapore OES Chapter was started in 2002 and I was among the first to serve the committee. I served the chapter in various capacities such as its treasurer, Chair, etc., and continue to engage myself in an advisory role. In 2006, when Singapore hosted the first OCEANS conference, I was assigned the role of Finance Chair. Under my initiative the local chapter gave shape to an annual industrial workshop, a half-day event, where the industry representatives were given a venue to showcase their product and capabilities to the researchers. This unique event has been a successful one so far and helped to build a closer relationship with the Chapter and the

A view of the deck of R/V SHARP during Seabed Characterisation Experiment (SBCEX) 2017 at the New England Mud Patch.

local industry. In 2013, our chapter organized the first AUV international student competition and I served as vice-chair and also as chair for sponsorship. In 2014, I also served as the chair for this event. Annually, I help to generate money to the tune of $35-40K to run this event and that made me the 'default' chair for sponsorship until the 2019 event. In addition, I help to organize a workshop as part of this event where speakers who are experts in the field of marine robotics deliver lectures and participate in panel discussions with students. In 2014, I got an opportunity to be part of the Offshore Technology Asia (OTC Asia) conference. I have been serving on the Technical Programme sub-committee as a member, co-Chair and Chair respectively in the years 2014, 2016 and 2018. Apart from organizing technical sessions, I was also leading the organization of special and panel sessions on behalf of the IEEE OES with great support from Mr. Bill Kirkwood. I got nominated to the IEEE OES AdCom in 2015 and served for a year (Thanks to Dr. Rene Garello). In 2017 I got elected as an AdCom member to serve the society from 2018-2020. This would not have been possible without the encouragement from many senior

Relaxing in front of Luxembourg Garden in Paris. From left to right Govind, Gautam and Maya.

IEEE OES colleagues. I must thank specifically Mr. Jerry Carrol, Dr. Mal Heron and Mr. Bob Wernli for encouraging me to run for the AdCom when I contested and lost for 4 times. Yet another responsibility that I have undertaken is to run the OCEANS 2020 Singapore conference successfully, and I believe that with support from a very strong and dedicated LOC this will be achieved. My special thanks to Dr. Sandy Williams, VP, Conference Development, IEEE OES, who has been an inspiration and advisor at many stages.

My hobbies: I love many sports activities and have tried my hands at Cricket, Shuttle Badminton and Table Tennis. Due to the onset of sciatic pain in recent years, I had to give up most of the sports activities including weekend running. I go for occasional brisk walks around the parks and started to spend most of my leisure time now cooking Kerala food. On average, I spent two to three hours each day in the kitchen cooking for me and my family. Otherwise, IEEE OES and other scientific volunteer work keeps me busy. I also like to get together with friends over a drink and enjoy some evenings.

My family: This article is about me, but it may not be complete without mentioning something about my family. Maya (Google the meaning), my wife, holds a Masters in Electrical Engineering and is currently a senior lecturer in one of the Polytechnics in Singapore. We have two sons, Gautam and Govind. Gautam is a PhD student at Caltech, USA, having completed his BS and MS in physics from the Indian Institute of Technology, Chennai, India. Govind is currently pursuing a double degree in mathematics and computer science at the National University of Singapore. We have travelled together to many parts of the world, exploring those locations and enjoying the food and culture there.

Ms. Saima and Venu promoting OCEANS 2020 Singapore at OCEANS 2018 Kobe.

If you still wish to know more about me, you can find me at some of the forthcoming OCEANS conference events. I will probably be busy manning the Singapore booth promoting the OCEANS 2020 Singapore conference, so look for me there. Let me know if you need a shot of 'Singapore Sling' when you visit the booth.

AdCom Election Results

The election results are in for the 2019-2021 Administrative Committee members. This year we had a great list of 8 candidates from around the world (see their bios in the last issue of the Beacon) and the results were very close. Congratulation to the following six candidates who were elected:

Welcome aboard. Now…let's get to work!

Stephen M. Holt

Marinna Martini

M.A. Atmanand

Ferial El-Hawary

Jay Pearlman

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Underwater Robots Competition at OTO'18

Co-chairs: Masakazu Arima (Osaka Prefecture University) and Kazuo Ishii (Kyushu Institute of Technology)

1. Introduction

The Underwater Robots Competition was held at Kobe Port Island Sports Center on 27th May, 2018 (Sun) as a concurrent event of the OCEANS'18 MTS/IEEE Kobe/Techno-Ocean2018 (OTO'18). The competition categories were the 'AUV Group' and 'Free-style Group.' This report provides an overview of the competition including the rules, evaluation criteria, and results.

2. AUV Group

The competition rules for the AUV Group are as follows:

• Competition Scoring

Scoring for Autonomous Underwater Vehicles under 50 kg is based on the following three criteria:

(1) Presentation	[70 points]
(2) Underwater mission performance	[210 points]
(3) Vehicle handling	[70 points]

For a combined total score of 350 points.

• Presentation

Presentation points are given based on the quality of the slides, comprehensiveness, technical content, Q&A session, and timeliness. Each team should present the technical details and originality of their robot on a one-page A4 handout (single-sided) along with their PC presentation. A total of 10 minutes is allotted for each presentation in which 5 minutes is for the oral presentation and 5 minutes for Q&A. The PC for this session is provided, however, the presenters can bring their own.

• Underwater Mission Performance

Each team is allotted 20 minutes to complete all tasks. However, this may change depending on the total number of participating vehicles. The order of competition is decided and announced after registration. Each team should confirm that their vehicle is ready to compete as scheduled.

The dimensions of the pool are 15 m x 25 m x 1.1 m in length, width and depth, respectively.

Competition Overview

1) *Preparation*: Each team should bring their vehicle and equipment on time to the Start/Goal Zone, as shown in Fig. 1.
2) *Start Up*: Each team should set up their station and power up their vehicle (or exit standby mode) to start the correct program for the missions.
3) *Launch*: Each team should make sure their vehicle is safely deployed in the water to start the mission.
4) *Mission Start*: Each team can start whenever their vehicle is ready. Although the missions can be restarted at any point, the vehicle must be returned to Area0 for a full score. Please refer to "Vehicle handling" for further information.
5) *Surfacing*: When the tasks are completed, the vehicle should be returned to Area0 to surface.
6) *Retrieval*: The vehicle can be retrieved at the Start/Goal zone after a safety check.
7) *Data Confirmation*: Each team should retrieve then submit their vehicle data to the judges.
8) *Finish*: The vehicle should be powered off and withdrawn from the starting area along with the team's equipment.

The competition course consists of a total of 6 missions: ① Line Tracking, ② Buoy Touch, ③ Gate Passing, ④ Landing, ⑤ Surveying, and ⑥ Token Dropping.

Figure 2 shows the dimensions of the objects that are used for each mission. An outline of each mission is detailed below. Each team should check the specific arrangements in the pool on the competition day.

① **Line Tracking** [2 straight lines, 2 curves: 10 points x 5 = 50 points, 1.2 times more points for the reverse route]

The vehicle should track the black line (Fig. 1) placed at the bottom of the pool (1.1 m depth) and proceed forward from the starting point until reaching point 2, turn 180 degrees and return by an outward route (Fig. 3, left). There are normal and reverse routes to choose from. If the vehicle can successfully perform the reverse route, the team will receive 1.2 times more points.

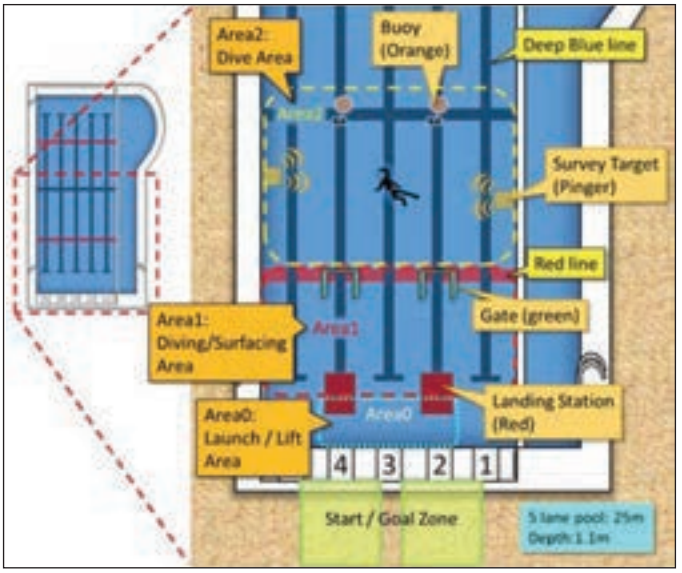


Figure 1. Competition zones and mission areas.

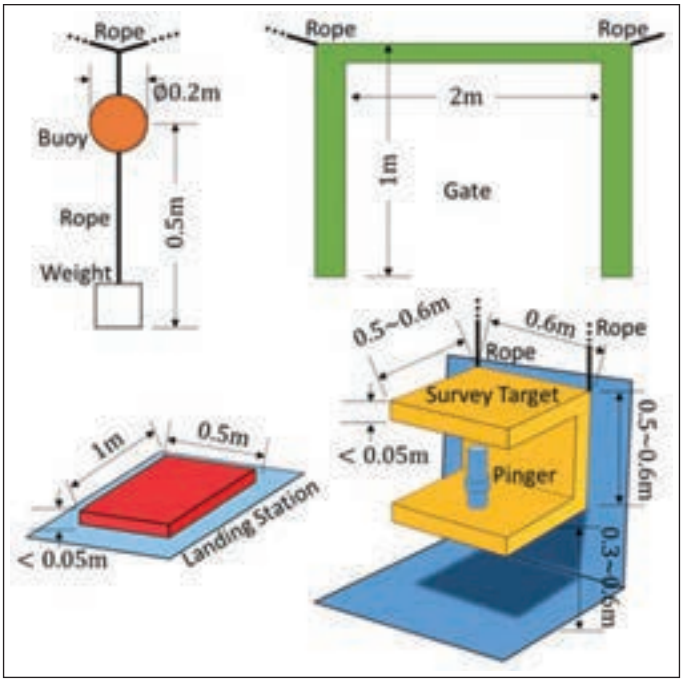


Figure 2. Dimensions of the underwater objects.

② **Buoy Touch** [1 Orange buoy: Forward 10 points + Outward 10 points = 20 points; 5 additional points if shootable objects (or droppable objects) are used]

The vehicle should touch the orange buoy floating 0.5 m from the bottom of the pool (additional points for using shootable objects). One touch should be attempted during each forward and outward maneuver with10 points given per touch (see Fig. 3).

③ **Gate Passing** [20 points]

The gate is located at the beginning for the normal route and at the end for the reverse route. Points are given each time the vehicle passes inside the gate (see Fig. 3)

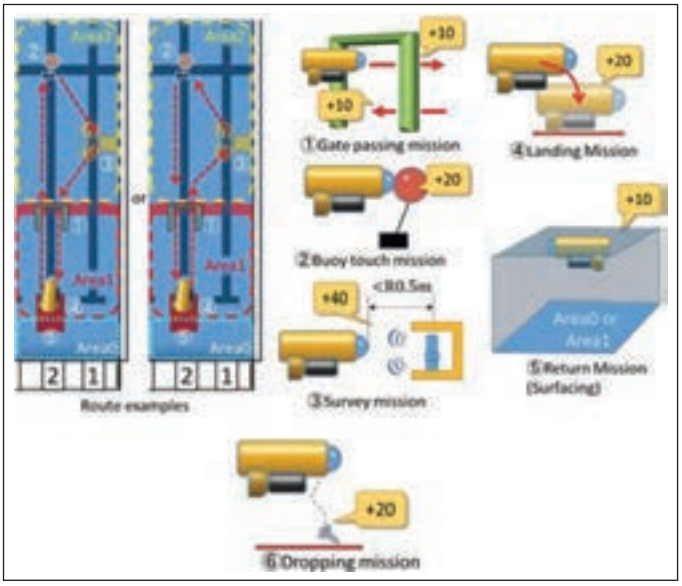


Figure 3. Mission details.

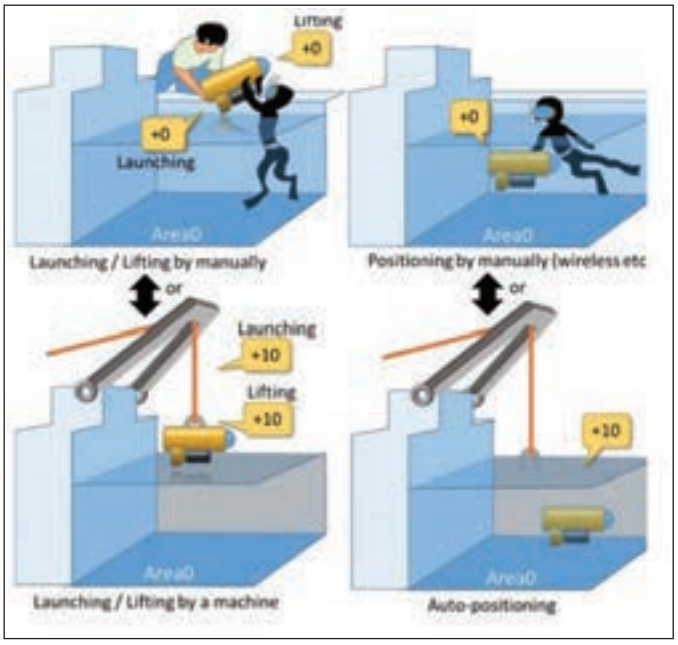


Figure 4. Points for vehicle handling.

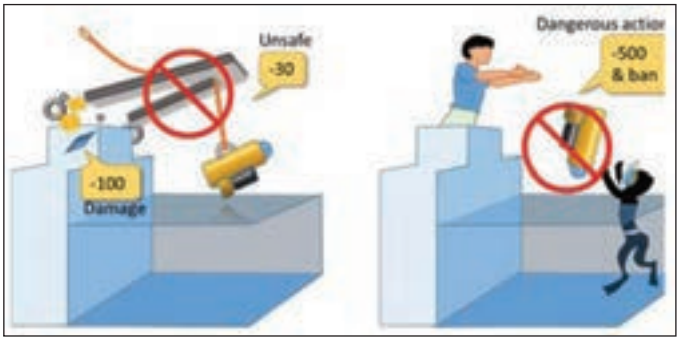


Figure 5. Deduction of points for risky handling.

Figure 6. Orca Mk.IV of Kyushu Polytechnic College.

④ **Surveying** [bottom panel 10 + front panel 10 + ceiling panel 30 = 50 points]

A U-shaped object (Fig. 3) has been placed at point 3, as shown in Fig. 2. There are panels (bottom, front and top) on its three inner surfaces. Each panel has a drawing or keyword written on it. The vehicle should record these with a camera. The judges will decide the scores after each team submits their data after retrieval of their vehicle at the end of the missions.

⑤ **Token Dropping** [inside 20 + top 20 = 40 points]

The vehicle should drop a token (or shootable object) inside or on top of the target surveying panels.

⑥ **Landing** [20 points]

A landing port of 1.2 m x 0.6 m in dimension is located at the bottom of the pool and 20 points are given if the vehicle can land inside this red area.

• Vehicle Handling

Each team's vehicle handling technique is evaluated. Figure 4 shows the additional points that can be achieved.

The judges look specifically at the team's launching and retrieving techniques [handling using a lift: 20 points vs manual handling: 2 points], initial vehicle positioning [20 points for autonomous positioning vs 2 points for positioning by a diver], and surfacing [10 points for surfacing at the end of all missions]. For safety concerns, we strongly recommend advanced techniques for launching and lifting. Causing damage to the pool or possible danger to others (Fig. 5) will result in a loss of points. Any individual deemed a danger to others will be asked to leave.

3. Free-style Group

The competition rules for the Free-style Group are as follows:

Each team must give a demonstration of their underwater robot for about 5 minutes at poolside. The quality of their presentation, content novelty, performance of their vehicle, level of the free-style demonstration, and the attractiveness of their flier will be respectively evaluated, as follows:

1) Quality of Presentation (Presentation Points) [Max. 20 points]
2) Novelty of concept & design (Artistic Points) [Max. 10 points]

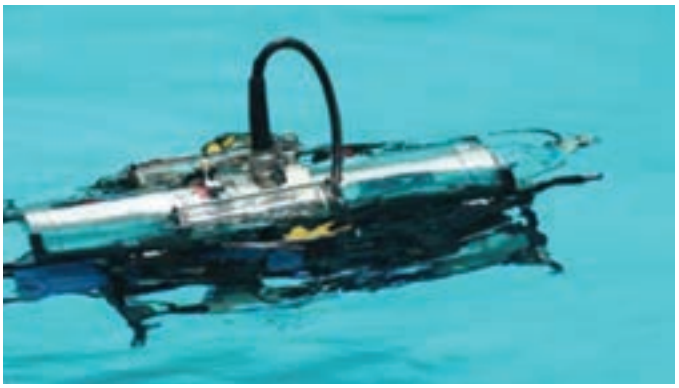


Figure 7. Daryabird of Kyushu Institute of Technology.

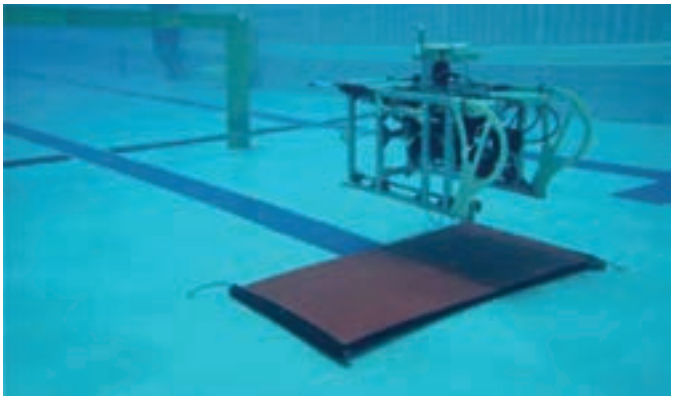


Figure 8. Minty-Roll-α of the University of Tokyo.

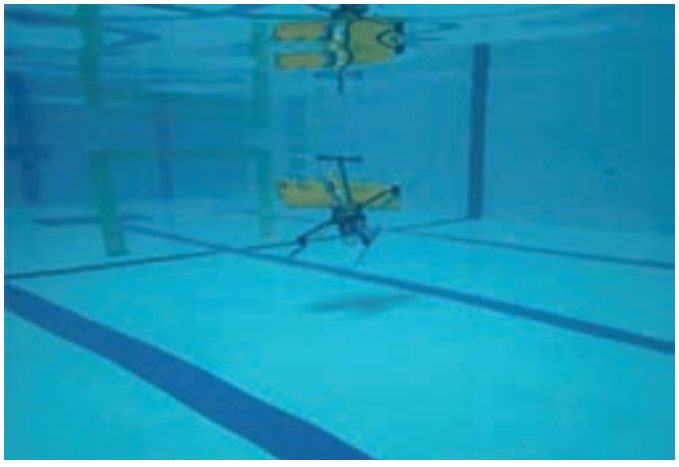


Figure 9. NEZHA of Shanghai Jiao Tong University.

3) Maneuverability/performance (Technical Points) [Max. 10 points]
4) Level of completion (Demonstration Points) [Max. 30 points]
5) Flier design & content (Document Points) [Max. 30 points]

The above points are calculated to decide the rankings.

The flier should be written in English (One A4-size page, PDF file) and submitted by the 18th of May (9 days before the competition). It should include descriptions of the team's demonstration (diving, surfacing, turns, torpedo launching, jumping, etc.) in as much detail as possible. During the demonstration, the reliability of performance will be evaluated.

The Free-Style Group Award is given to the team that presents the most comprehensive and interesting demonstration of their vehicle.

4. Results

The competition results are summarized in the table below. Five teams including 1 from overseas registered for the AUV Group, however, 2 teams withdrew due to malfunctions of their vehicles. The AUV Group initially planned a tournament-style competition but decided on a league game instead. Some of the vehicles experienced minor malfunctions during the competition, but Minty-Roll-α of the University of Tokyo won the championship.

Seven teams including 2 from overseas entered the Free-style Group competition. The NEZHA robot from Shanghai Jiao Tong University won 1st prize. This vehicle is a multi-copter type drone which can transform into an underwater glider. When the audience saw the transformation from air to underwater vehicle, they cheered with surprise. The one high-school team participating was recognized with a Best Effort Award.

There were more than 300 competitors and visitors, including the OTO'18 participants from overseas, elementary and junior high school students, and citizens from the neighborhood so that the venue was full of excitement and activity all day long.

5. Conclusions

In Japan, Underwater Robot Competitions have been held in Kobe, Kita-Kyushu and Tokyo almost biannually since 2006. An Underwater Vehicle Competition Forum was first established in early 2007 and then the NPO Japan Underwater Robot Network was established in 2014. This report introduces the Underwater Robots Competition at OTO'18 as one of Japan's awareness-raising activities for the younger generation through demonstrations of underwater vehicles. This Competition was the 22nd underwater robot festival/convention held since 2006. The authors will continue to actively support and develop such work towards a better understanding of ocean engineering and underwater robotics for future generations. The organizers are also planning to realize regional elimination events and to evolve these competitions into international events.

Acknowledgements

The Underwater Robots Competition was supported by the IEEE/OES Japan Chapter, MTS Japan Section, Techno-Ocean Network (TON) and NPO Japan Underwater Robot Network. The authors would like to express their sincere appreciation to the sponsors for their strong support and cooperation in realizing the Underwater Robots Competition and to all staff members for their dedicated assistance. The Figures in the overview and rules for the AUV Group were drawn by Professor Takashi Sonoda of Nishi-Nippon Institute of Technology and his students. The authors would like to thank them for their valuable contributions.

Competition Results (Vehicle Name/Team Name/Affiliation)

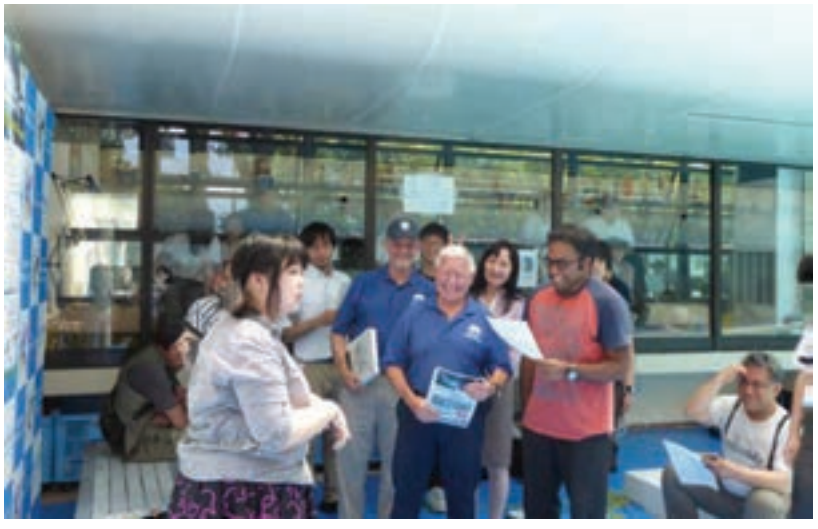
- **AUV Group**

Champion	Minty-Roll-α/Clairvoyance/Univ. of Tokyo
2nd Prize	Orca Mk.IV/KPC_AUV/Kyushu Polytechnic College
3rd Prize	Daryabird/Kyutech Underwater Robotics/Kyushu Institute of Technology

- **Free-style Group**

Champion	NEZHA/AOSHEN/Shanghai Jiao Tong University
2nd Prize	COMET/Robotics Laboratory/Osaka City University
3rd Prize	Amphibious Truck with Soft Spikes/T&J/National Institute of Technology, Tsuyama College
Efforts Award	Mark2/Industrial Technology Club/Okayama Shoka University High School

The Underwater Robots Competition was held at Kobe Port Island Sports Center.



With judges.

Ready to go (Minty-Roll-α of Univ. of Tokyo).

High School Phytoplankton Group Goes to Cape Cod

Charlotte Tyson, First Flight High School, Kill Devil Hills, NC

The First Flight Phyto-Finders is a group of high school students who collect and analyze phytoplankton off the North Carolina coast as part of the NOAA Phytoplankton Monitoring Network. Recently, four Phyto-Finders were able to visit Woods Hole on Cape Cod (Figure 1). We are the fourth group to do so, using the funds the IEEE Oceanic Engineering Society generously provides to support our research and education.

We recently began to extract DNA from our samples, a supplement to our established microscope examinations. The extracted genetic material is sent to one of our mentors, Dr. Hilary G. Morrison, at the Marine Biological Laboratory (MBL) in Woods Hole, where it is sequenced and analyzed to better understand the makeup and variability of the microbial and phytoplankton communities in the waters off the Outer Banks. While in Woods Hole, we learned some of the procedures required to process our samples (Figure 2). We also began learning about how the processed information is used and interpreted (Figure 3).

Although our club is focused on phytoplankton collection and research, we explored beyond our scope: we also toured the Deep Submergence Lab at the Woods Hole Oceanographic Institution and the Marine Resources Center of MBL (Figure 4). And, while staying at their house, our mentors and hosts, Dr. Archie Todd Morrison III and Dr. Hilary G. Morrison, patiently reviewed and edited our papers for the upcoming OCEANS Conference in Charleston. We are eager to attend and to present at our first scientific conference this fall.

Figure 1. The Phyto-Finders find a beautiful Cape Cod lighthouse.

Figure 3. Initial results.

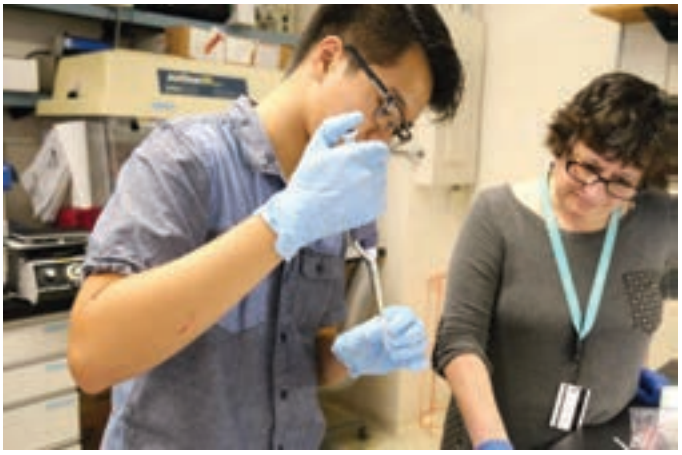


Figure 2. Learning to sequence DNA at the Marine Biological Laboratory.

Figure 4. Admiring the touch tank at the Marine Resources Center.

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