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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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University of Tokyo
harumis@iis.u-tokyo.ac.jp

ROBERT WERNLI
First Centurion Enterprises
wernli@ieee.org

Editor, OES e-newsletter
TOSHIHIRO MAKI
University of Tokyo
maki@iis.u-tokyo.ac.jp

Webmaster
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Student Activities
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kfoote@whoi.edu

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From the President

I'm Grieving,

I was in the process of writing this editorial, late as usual, when the horrific and deathly attack took place in Paris. How can so much darkness and hatred be possible is beyond comprehension and imagination. Yet, it happens. And this is so far away from the value we share in our worldwide scientific community and more specifically our IEEE Oceanic Engineering community: friendliness, exchanges, debates, will to pass the knowledge around and to the younger generation, etc. We pass this knowledge for improving societal benefits and for building a better world. This is a total opposite to the masterminds behind the scene passing false information and Dark Age "beliefs" in order to destroy our world. It's probably not the best one but it's the only one we have. There is no glory in blindly killing people. But for the "masterminds," it's the bravery of being out of range, maybe . . .

We won't give up. Ever!

And life will go on. And it was going on for the past few months since the last edition of Beacon. So to go back to the events we shared since May, the following ones went extremely well:

- The Eurathlon event in Italy (http://www.eurathlon.eu/), with a large amount of help from CMRE (http://www.cmre.nato.int/) and us, OES—the sole Platinum Sponsor of the competition. A very good and comprehensive report is given in this Beacon.
- OES was also a financial sponsor of the third SAUVC event, which was organized by the IEEE OES Singapore Chapter in collaboration with the National University of Singapore, DSO National Laboratories and the Singapore-MIT Alliance. A report on the AUV competition and the winners is included in this issue of the Beacon.
- Of course, our flagship conference OCEANS, was held in Washington, DC in October. As usual we had a very good showing, and being in the Capital we benefited from the presence of many NOAA and NRL scientists. A long report is also given in this Beacon.
- OTC Brazil 2015, held in Rio de Janeiro, at the end of October was again an opportunity for OES to show our continued commitment to the development of means of underwater observations and survey.

(continued on page 27)

What is the VP for Professional Activities – And How Can You Help?

Bob Wernli, Vice President for Professional Activities

So, what is the VP for Professional Activities and what does the position have to do with you as an OES member? Well, in short, the position covers all of our Membership, Chapters, Communication and Promotion for the society. Within this position is a large team of volunteers that are participating in the society, learning about its operations, and positioning themselves for future elected positions within the society. In more detail, the VPPA position includes the following:

Steve Holt – Ad-hoc Committee Chair for Communications and Promotion

1) Beacon Newsletter – Harumi Sugimatsu and Robert Wernli – Co-EICs
   - Kevin Hardy – Associate Editor-In-Chief
   - Univ. of Tokyo – Editorial Team
2) E-Newsletter (Sub-Committee) – Toshihiro Maki
3) Promotional Activities (Standing Committee) – Steve Holt
4) OES Webmaster – Steve Holt
5) OES Linked In – Drew Bennett
6) Other Social Media – Drew Bennett
7) Calendar – Harumi Sugimatsu

Jim Collins – Ad-hoc Committee Chair for Membership and Chapters

1) CONFERENCE ACTIVITIES TO PROMOTE MEMBERSHIP
   a) Booth preparation, giveaways, posters and shipping – Robert Wernli
   b) Booth workers – Barbara Fletcher, Kevin Hardy, Jerry Carroll, Jim Barbera, R. Wernli.
   c) Co-Participating Societies – Kevin Hardy
2) MEMBERSHIP
   a) New Memberships, especially students – Barbara Fletcher
   b) Membership Development (Standing Committee) – Jim Collins
      - Membership Follow-up (members in arrears)
      - Senior Member Promotion
      - Young Professionals – Frederic Maussang
      - Women in Engineering – Brandy Armstrong
3) CHAPTERS
   a) Chapter development and finances – Jim Collins
   b) Regional Chapter Coordination (Operational Sub-Committee) – Jim Collins
4) STUDENT ACTIVITIES
   a) Student Activities (Standing Committee) – Barbara Fletcher
   b) Student Scholarships – Christophe Sintes
   c) Student Socials – Barbara Fletcher
   d) NOSB Competition – Liz Creed
   e) MATE Competition – Marinna Martini

Obviously, there are plenty of opportunities to participate on the VPPA team. This is especially significant in the area of outreach to the Young Professionals, those who have graduated in the past 10 years. We're working on expanding our capability to provide social media outreach.

And, all of these position need backup, so even if someone is assigned to the position, there exists opportunities to support the position and possibly advance to running the activity in the future.

If you have any interest in participating, please send an email to me at wernli@ieee.org.

From the Editor's Desk

N. Ross Chapman – Journal Editor-in Chief

Farewell to Leif

Before starting to write about things from the Editor's desk, I have a very sad message to bring.

Leif Bjorno, one of the true giants in Underwater Acoustics (and many other branches of acoustics) passed away unexpectedly in October of this year, just after the OCEANS'15 conference in Washington. Leif's career in research science and engineering spanned the past five decades, and he was active with colleagues until the time of his death. Many folks in the Oceanic Engineering Society, especially the ones who were active in underwater acoustics, will likely have met him during that time, and some like me may have worked with him. I have asked his friend, Dr Tom Neighbors, to write a short obituary which is appended here and will also appear in the January issue of the Journal. This short introduction serves as an opportunity for me to write a brief memory of my own.

I first encountered Leif in one of the European Underwater Acoustics Conferences (ECUAs) that was held in Copenhagen in 1994. Leif was the general chairman of the meeting. Subsequently, I came to know him better at many other meetings, and developed a great respect for the breadth of his knowledge and his concern for helping younger scientists along in their careers. When he, along with his great friend John Papadakis, introduced the highly successful Underwater Acoustic Measurement conferences that happened in the summertime on various Greek Islands, he asked me to help in the organizing committee. It was through this association that I learned most about his strong desire to help younger scientists advance new ideas in Underwater Acoustics. The plan for the conferences was to ask scientists who were leaders in their field of research to organize special sessions for the meeting. In this way, the best new ideas were always lined up for presentation. We went to the meetings to learn about new advances that would help us in our own research. But beyond that, it was a chance to socialize with Leif and his wife Irina. I will miss those many times at dinners in the warm Mediterranean evenings as we enjoyed a Greek dinner with endless plates of delicious food, wine and wonderful company.

It was a great shock to learn that Leif had died. Tom Neighbor's obituary tells the rest of the story.

In happier times, at lunch with Irina and Leif in Rhodes, June 2014.

Some other news, starting with some changes to the Editorial Board. First, it's a pleasure to introduce and welcome new Associate Editors who have been appointed over the summer to three year terms:

Dr. M.A. Atmanand was appointed to strengthen our expertise on the Editorial Board in handling manuscripts related to ocean resource exploration, ocean energy and underwater vehicles. Dr Atmanand holds the prestigious position of Director of the National Institute of Ocean Technology in Chennai, India.

Dr. Eliza Michaloupoulou is an expert on acoustic inversion methods and localization techniques and was appointed to manage reviews of manuscripts related to these aspects of underwater acoustics. Eliza is a Professor in Mathematical Sciences at the New Jersey Institute of Technology.

Dr. Ralf Bachmayer was appointed to strengthen our expertise on the Editorial Board in handling manuscripts related to autonomous underwater systems. Ralf is an Associate Professor in Engineering and Applied Science at Memorial University in St. John's, Newfoundland, where he leads the Autonomous Ocean Systems Laboratory in research in control systems for gliders and mission control for groups of vehicles.

I look forward to working with these new appointees over the next three years. Unfortunately, it's also necessary to report that Ryan Eustice, one of our Associate Editors who manages reviews of manuscripts related to underwater vehicles, is resigning. Ryan's advice in assessing manuscripts and his service in managing reviews over the past two terms has been very much appreciated and I wish him well.

We are actively working on developing new topics for special issues. The second set of papers from the UCOMMS conferences on underwater communication were published in October. Additionally, three new special issues have been announced. In July we announced a collection of papers featuring results from the Target and Reverberation Experiment, a major experiment sponsored by the Office of Naval Research in 2013. In October we announced another two, one featuring papers from the Sensors and Systems for a Changing Ocean workshop/conference that was held in Brest in the fall of 2014, and another featuring papers on waterborne noise from surface shipping. All these are scheduled for publication starting as early as October 2016 and into 2017. Watch the coming issues of the Journal and our OES webpage for more.

I am continuing to use this opportunity to list the papers that have been published as Early Access papers roughly since the

last Beacon newsletter. Readers of the Journal will note that I am also listing these papers in editorials, but it doesn't hurt to advertise in as many ways as possible. These 18 papers listed below will of course appear in due course in regular issues of the Journal. Those of you eager beavers who don't want to wait can go directly to IEEE Xplore to get them now:

'Development of Underwater Short-Range Sensor Using Electromagnetic Wave Attenuation', Park, D., Kwak, K., Chung, W.K. and Kim, J.

'Integrated Flexible Maritime Crane Architecture for the Offshore Simulation Centre AS (OSC): A Flexible Framework for Alternative Maritime Crane Control Algorithms', Sanfilippo, F., Hatledal, L.I., Styve, A., Pettersen, K.Y. and Zhang, H.

'A Low-Complexity Real-Time 3-D Sonar Imaging System With a Cross Array', Liu, X., Zhou, F., Zhou, H., Tian, X., Jiang, R. and Chen, Y.

'Design of Optimal Multiple Phase-Coded Signals for Broadband Acoustical Doppler Current Profiler', Chi, C., Li, Z. and Li, Q.

'An Efficient Receiver Structure for Sweep-Spread-Carrier Underwater Acoustic Links', Marchetti, L. and Reggiannini, R.

'Experimental Confirmation of Nonlinear-Model-Predictive Control Applied Offline to a Permanent Magnet Linear Generator for Ocean-Wave Energy Conversion', Tom, N. and Yeung, R.W.

'Minimizing Underwater Noise Generated by Submarine Maneuvering: An Optimal Control Approach' Ovalle, D.; Garcia-Pelaez, J.

'Robust Estimation Method of the K -Distribution Shape Parameter', Zhang, K. and Yang, F.

'Ampacity Derating Analysis of Winch-Wound Power Cables: A Study Based on Deep-Water ROV Umbilical', Vedachalam, N., Umapathy, A., Ramesh, R., Babu, S.M., Muthukumaran, D., Subramanian, A., Harikrishnan, G., Ramadass, G.A. and Atmanand, M.A.

'Retrieval of Young Snow-Covered Sea-Ice Temperature and Salinity Evolution Through Radar Cross-Section Inversion', Firoozy, N., Komarov, A.S., Mojabi, P., Barber, D.G., Landy, J.C. and Scharien, R.K.

'Reduction Method of Sinusoidal Noise due to Phase Drift of Interferometric Optical Fiber Hydrophone', Saijyou, K., Okuyama, T., Nakajima, Y. and Sato, R.

'Doppler-Resilient Orthogonal Signal-Division Multiplexing for Underwater Acoustic Communication', Ebihara, T. and Leus, G.

'An Overview of Underwater Time-Reversal Communication', Song, H.-C.

'Experimental Study of the Electric Pulse-Width Effect on the Acoustic Pulse of a Plasma Sparker', Huang, Y., Zhang, L., Yan, H., Zhu, X., Liu, Z. and Yan, K.

'Statistical Modeling of the Reflection Symmetry Metric for Sea Clutter in Dual-Polarimetric SAR Data', Gao, G., Wang, X. and Niu, M.

'Human-Visual-System-Inspired Underwater Image Quality Measures', Panetta, K., Gao, C. and Agaian, S.

'Experimental Broadband Channel Characterization in a Sea Port Environment at 5.8 GHz', Reyes-Guerrero, J.C.

'Computing the Scattering from Slightly Deformed Spherical Shells', Fawcett, J.A.

Ross Chapman
Editor in Chief

Obituary In Memory of Leif Bjørnø

Tom Neighbors

Leif Bjørnø, 78, a leading researcher in ultrasonics and underwater acoustics, passed away on 25 October 2015 due to a cerebral aneurysm. He had a stroke a few days earlier and was in the hospital when he died. This was very sudden and there were no indications that he had any problems that would result in the stroke which would lead to his death. Leif was born on March 30, 1937 in Svendborg, Denmark and is survived by his wife Irina K. Bjørnø.

Leif Bjørnø

Leif's career, which spanned over five decades, includes diverse research ranging from linear and non-linear acoustics including the measurement and modeling of the response of Lithotripters, acousto-optic measurement of transducer pressure profiles, anomalous sea-surface reverberation, sea surface noise generated by rainfall, and waterside security. After receiving his Ph.D. at the Technical University of Denmark (DTU), Lyngby, DK, in 1967, Leif became an assistant professor. He was a visiting professor at the Imperial College, London, UK, from 1969 to 1970, received a diploma from the Imperial College in 1971, and was the Stephens Lecturer in 1985 at the Institute of Acoustics, UK. As a professor at DTU he was the head of the Industrial Acoustics Department from 1978 until he retired in 2000. The students that Leif mentored have gone on to found companies, such as Reson A/S, and are in academic positions at universities, such as the Massachusetts Institute of Technology. Leif has been a visiting professor in university departments in Chile, China, Greece, South Africa, UK, and USA.

Until his death Leif was active as an organizer, chairman, and member of the scientific committee for numerous

conferences and served on several NATO committees. He was the chairman or member of the scientific committee for the 2010, 2012, and 2013 Waterside Security Conferences. Leif was the joint conference chairman with Professor John S. Papadakis for the 2005 through 2012 international conferences on underwater acoustic measurements held in Crete, Greece. He was also the organizer and joint conference chairman with Professor Papadakis of the 2012, 2013, and 2015 international conference and exhibition on underwater acoustics. Leif served as a member of the Scientific Council of National Representatives (SCNR) for the SCALANT Undersea Research Center, La Spezia, IT, and was a national delegate to the European community program on Marine Science and Technology (MAST).

Leif was recognized within Denmark and globally for his accomplishments. In 1991 he was named a Knight of the Order of Dannebrog by Her Majesty, Margrethe II, Queen of Denmark. He received the French Acoustical Society Gold Medal in 1995. Also, in 1995 he was the first recipient of the International Congress on Ultrasonics Gold Whistle award. In 1997 in London he was awarded the Lord Rayleigh medal by the UK Institute of Acoustics. He was awarded the Danish Hartmann Prize, in Copenhagen in 1999 for his outstanding contributions to the Danish community and his profession. In addition he was awarded the Medal of Merit and Johannes Hevelius Medal by the Gdansk University of Technology, as well as, the Ignacy Malecki Medal by the Polish Acoustical Society. Leif was professor honoris causa at the University of Harbin, China, and he was a Doctor of Philosophy honoris causa at the University of Crete, Greece.

In addition to his academic career Leif also served on the board of directors of several companies and occasionally served as the chairman of the board. He was the founder and chairman of the board of Ultra Tech holding company. For several decades he also served on the board of directors for Reson A/S.

Leif was a member of several national acoustics and engineering organizations. He was a member of SIGMA XI. He was a member of the Polish, Danish, and Spanish acoustical societies. He was a Fellow of the Acoustical Society of America, UK Institute of acoustics, South African Acoustical Institute, as well as a Life Fellow of the US IEEE.

OES Society Awards

Harumi Sugimatsu, Photos by Stan Chamberlain

The OES Society Awards Ceremony was held at the IEEE/OES Award Luncheon at OCEANS'15 Washington DC. We are honored to introduce the following 2015 OES award recipients. Congratulations!

2015 Distinguished Technical Achievement Award: Milica Stojanovic

Professor Milica Stojanovic, a recognized leader in the field of communications and networks, is Professor of Electrical and Computer Engineering at Northeastern University. She was awarded a Postdoctoral Fellowship at the Woods Hole Oceanographic Institution and subsequently a Postdoctoral Research Scholarship at Northeastern University. She is also a Guest Investigator at the Woods Hole Oceanographic Institution (WHOI) and a Visiting Scientist at MIT. She was elected an IEEE Fellow in 2010 "For contributions to underwater acoustic communications".

Milica Stojanovic receives Distinguished Technical Achievement Award from OES president René Garello.

Professor Stojanovic is the chair of the OES Technology Committee for Communication, Navigation, and Positioning. She is an Associate Editor of the IEEE Journal of Oceanic engineering and a past editor for the IEEE Transactions on Signal Processing and Transactions on Vehicular Technology. She also serves on the Advisory Board of the IEEE Communication Letters.

She is active in both technical contributions and educational fields. She continues to be engaged as a leader in multi-disciplinary projects where underwater acoustic communications are the enabling technology. Her contributions are marked by an innovative and judicious use of theoretical analysis and modeling concepts that focus on the physical aspects of underwater acoustic communications channels and Proof-of-concept analyses.

Signal detection methods she developed provided the basis for real-time implementation of the first high-speed acoustic modems at WHOI. Today the modem is used routinely in a variety of missions including those with multiple autonomous underwater vehicles thus providing the communication fabric for other advanced research.

Her original transceiver designs remain the de-facto standard for evaluating acoustic communications techniques.

2015 Distinguished Service Award: Elizabeth Creed

Elizabeth Creed, more familiarly known as Liz, has been a member of IEEE/OES since 1987.

A Senior Member of IEEE, she has participated in OES activities first as an Elected Member of the Society's Administrative Committee for two terms, then serving two terms as Vice President for Professional Activities. She is now assisting the President by developing guidelines for workshops and symposiums. She is also an active member of the Current, Waves, and Turbulence Measurement Technology Committee.

Liz Creed receives Distinguished Service Award from OES president René Garello.

During her terms as Vice President, Ms. Creed made substantial improvements to Society operations in Promotion, Membership, and Student Activities. She developed an Exhibit Booth suitable for use at conferences and other meetings. She also laid out procedures that ensure its effective use and transit to and from the meetings.

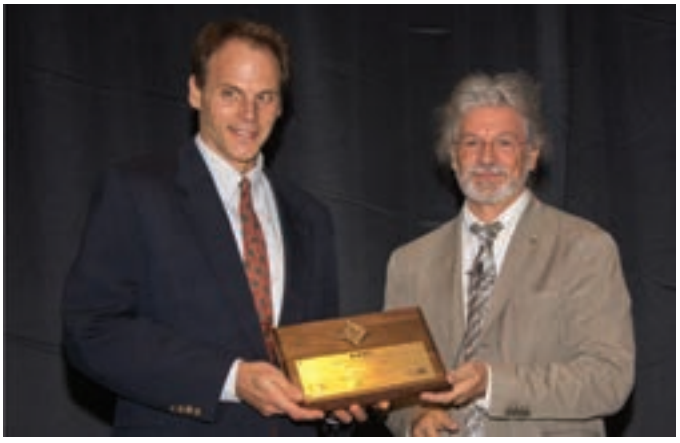
Because of the quality of the booth and its contents, and because of her detailed understanding of IEEE Membership procedures, she became, and trained others to be, an effective recruiter of Potential Society members.

Liz instituted the Student Social at OCEANS conferences, a Networking Activity for the benefit of Student Members and other students providing opportunity for students to meet their peers, and to engage more senior Society members in informal discussions about technical, professional, and personal issues. This activity is now an integral part of each OCEANS conference.

Liz's professional career has focused on underwater gliders for the last 13 years. A well-known expert in the field, she continues to work on improvements to the vehicles, integrate new sensors, pilot test and demonstration vehicles, and train others in the art of piloting.

2015 Presidential Award: Franz Hover

Franz Hover is presented the Presidential Award with appreciation and thanks for the outstanding service to the Society as a volunteer.



Franz Hover receives the Presidential Award from OES president René Garello.

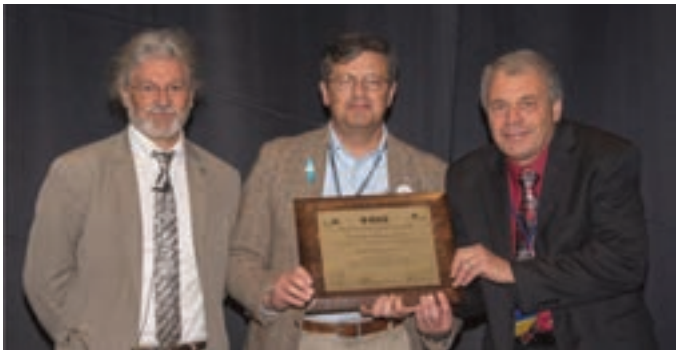
2015 Company Award: Kongsberg Maritime

Kongsberg Maritime is presented the IEEE Oceanic Engineering Society's Company Award for their contribution and generous effort for our membership and their support to our technical activities.

Kongsberg Maritime receives the Company Award from OES president René Garello.

Continued Support Award: Archie Todd Morrison

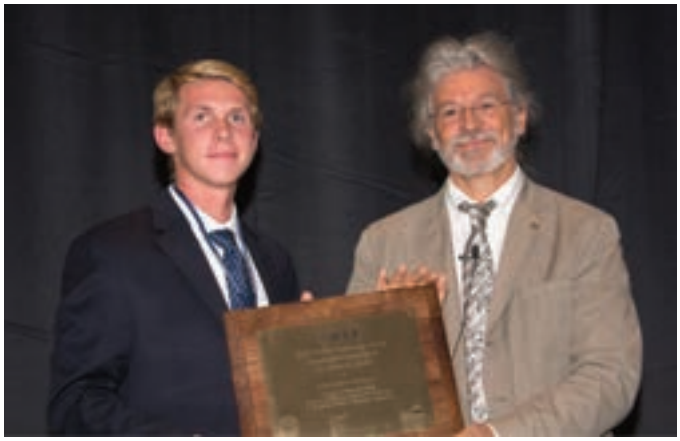
For his many roles within OES and his long-term support, the Continued Support Award is presented to Archie Todd Morrison.



Todd Morrison receives Distinguished Service Award from OES president René Garello and MTS president Ray Toll.

2015 Emeritus Award: Joe Vadus and Claude Brancart

Joe Vadus and Claude Brancart are presented the Emeritus Award with appreciation and thanks for the outstanding service with distinction on the Administrative and Executive Committees.



Ethan Mended receives the Emeritus Award from OES president René Garello on behalf of his grandfather, Claude Brancart.

Unfortunately, Joe Vadus could not attend the ceremony, however, we received the following remarks from him, which are provided so we can share the happiness with him.

I greatly appreciate receiving the Emeritus award and thank René Garello for introducing it to OES and the OES Selection Committee. I served OES as VP International, VP Technical Activities, and VP Development. Now VP Emeritus and very proud of 53 years with IEEE and OES, as a Life Fellow; 49 years with MTS as a Fellow; and 40 years with UK's Society for Underwater Technology as a Fellow. 140 years of society activity. Some of my society activity follows:

Joe Vadus, Emeritus Award Recipient

Promoted two OCEANS conferences each year; one in North America and one offshore and two VP's: one for development and one for operations; initiated the concept of Reconnaissance (Recon) of future conferences.

Played a major role in developing joint conferences with OES and MTS. In 1976 Bicentennial year added the "S" on OCEAN to make it OCEANS. OCEANS has prevailed since.

In 1978, introduced the acronym ROV for Remotely Operated Vehicles. At NOAA, I funded a 100 K study to Frank Busby for a worldwide review, and together we produced a hardbound book entitled. "Remotely Operated Vehicles" (ROV's). Tim Jenaitis was there, along with Drew Michel, who became the first chair of MTS's ROV Committee.

As U.S. Chairman in the U.S.-Japan Cooperative Program in Marine Technology promoted forming the OES Japan Chapter and the MTS Section.

Initiated and organized the first Underwater Technology Symposium in Tokyo in 1998; perpetuated in Asia-Pacific Region and the most recent UT'15 in India (#10); and going strong under the leadership of Tamaki Ura, Bob Wernli and Harumi Sugimatsu.

In 2002, initiated the U.S. Baltic International Symposium series rotated in Lithuania, Latvia and Estonia. The 7th symposium in Riga, Latvia in 2016. Over this 15 year period OES leadership remained the same: Jerry Carroll, Jim Barbera, Sandy Williams, Vic Klemas and me. NATO visibility is helpful.

Being associated with good colleagues has been a privilege.

As VP Emeritus, I will slow down. I'd like to thank all of you for letting me share your journey over all these years. Semper fidelis.

Joseph R. Vadus

IEEE/OES Award Luncheon at OCEANS'15 Washington DC.

Awards for OES Members

Brian G. Ferguson named recipient of the Silver Medal in Signal Processing in Acoustics from Acoustical Society of America

Melville (NY), 8 October 2015—Brian G. Ferguson, Principal Scientist in the Maritime Division at the Defence Science and Technology Organization (DSTO), Australia, has been named recipient of the Acoustical Society of America's Silver Medal in Signal Processing in Acoustics *for contributions to in-air and in-water acoustic classification, localization and tracking.* The award will be presented at the 170th meeting of the ASA on 4 November 2015 in Jacksonville, Florida.

The Silver Medal is presented to individuals for contributions to the advancement of science, engineering, or human welfare through the application of acoustic principles, or through research accomplishments in acoustics.

"The Acoustical Society of America is the premier international learned society in acoustics. This prestigious award by the Society for scientific achievement represents the highlight of a career committed to scientific research in acoustic signal processing. I am grateful to the Society's leaders, members, and my nominators, who have always welcomed, involved, taught, and inspired me for three decades. Thank you. Finally, I am appreciative of the enduring support, which enables my participation in the Society's activities, provided by Australia's Defence Science and Technology Organisation that has excellence in defense science and technology as its core value." said Ferguson.

Brian Ferguson received a Ph.D. from The University of New South Wales. He served in various positions at DSTO since 1992 including Head, Submarine Sonar and Head, Acoustic Systems. His research interests are in acoustic signal processing having Defense and national security applications, which involves detecting, classifying (including imaging), localizing and tracking sources of sound, both in air and under water. Acoustic signal processing extracts information about an object from its acoustic signature (sound that it radiates) or its echo (response after insonification by a sonar transmission). The received signals are often weak and masked by interference, reverberation or noise.

Dr. Ferguson is a Fellow of the Acoustical Society of America and the Institution of Engineers Australia. Also, he is a Chartered Professional Engineer. He received the NATO Research and Development Organisation's Scientific Achievement Award in 2009 and the Science and Technology Achievement Award of The Technical Cooperation Program between the Governments of Australia, Canada, New Zealand, the United Kingdom and the United States in 2011. He has published over 40 papers in peer reviewed science and engineering journals and is author or coauthor of three book chapters. He has over 50 papers published in the proceedings of international conferences.

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The Acoustical Society of America (ASA) is the premier international scientific society in acoustics devoted to the science and technology of sound. Its 7000 members worldwide represent a broad spectrum of the study of acoustics. ASA publications include the *Journal of the Acoustical Society of America*—the world's leading journal on acoustics, Acoustics Today magazine, books, and standards on acoustics. The Society also holds two major scientific meetings per year. For more information about the Society visit our website, www.acousticalsociety.org.

Robot Competitions

The euRathlon 2015 Grand Challenge: The First Outdoor Multi-domain Search & Rescue Robotics Competition, Inspired by the 2011 Fukushima Accident

Gabriele Ferri[1], Fausto Ferreira[2], Vladimir Djapic[3], John Potter[4]

[1]Technical Director, [2]Deputy Technical Director, [3]Member of the Technical Committee, [4]CMRE Principal Strategic Development Officer

Inspired by the 2011 Fukushima accident, euRathlon is an outdoor robotics competition funded by the European Union (FP7 EU project coordinated by Prof. Alan Winfield - University of the West of England) with a focus on realistic cooperative search and rescue response scenarios for land, sea and air robots. The **euRathlon 2015 Grand Challenge,** for which IEEE OES was a platinum sponsor, can only be met when these three domains of robotics are working cooperatively. Previous single-domain euRathlon competitions focused on the land (2013) and sea (2014) domains. These events, coupled with team building workshops, ramped up to the 2015 Grand Challenge.

The 2015 Grand Challenge was locally organised by the NATO STO Centre for Maritime Research and Experimentation

of La Spezia, Italy, supported by the euRathlon international consortium. The event brought multi-disciplinary and multi-organisation teams comprised of about 140 students and engineers to Piombino, Italy, during 17–25th September to tackle this unique challenge. A total of 16 teams from 11 different countries, armed with some 40 robots, surveyed the scene, collected data, searched for missing workers, identified critical hazards, and more, all in a race against the clock.

The roots of this project lie in the ELROB competition (for the land domain), the Student Autonomous Underwater Vehicle Challenge – Europe (SAUC-E) competition (for the marine domain) and the Workshop in Research Development and Education on Unmanned Aerial Systems (for the aerial domain). In particular, the SAUC-E competition has been running since 2006 and organized since 2010 by NATO STO CMRE at CMRE's on-site sea basin. This year, the SAUC-E competition was included in euRathlon Sea Trials.

The Competition

The euRathlon 2015 Challenge was held in Piombino, Italy, in the area surrounding the Tor del Sale building, and in the Enel-owned thermal power plant sheltered harbor, Fig. 1. The area was set up to simulate the euRathlon's Fukushima-like disaster area.

The euRathlon Grand Challenge presented several missions to multi-domain robotics teams composed of land, air and sea robots. The missions were to find missing workers (simulated with mannequins), survey the disaster area to identify dangerous leaks and to close valves inside the Tor del Sale building and underwater to stem leaks.

The competition was designed as a 9-day event, in which teams had three days of practice before starting to compete in the scenarios. The euRathlon 2015 scenarios were arranged in increasing order of complexity, with single-domain trials in the first two days, followed by sub-challenges (double-domain) and finally the Grand Challenge in the last two days where land, sea and air robots had to cooperate to solve the three missions of the Grand Challenge.

The main goal of the teams was to complete the tasks, for which autonomy and cooperation between domains were essential. The environmental conditions and difficulties presented in the scenarios were intended to be as realistic as reasonably possible, while remaining safe for competitors and spectators alike. The success criteria reflected straightforward end-user priorities such as task completion and minimal manual intervention by operators.

In particular, for the marine domain, sea trials were proposed with tasks like an environmental survey (area inspection), leak localisation by finding a plume of orange buoys and pipe following and manipulation. An underwater photo of a simulated valve closing task apparatus is shown in Fig. 2.

The Land and Sea sub-challenges had similar tasks for the marine robots, but in this case they had to cooperate with the land robots to know which valve they should close. Marine and land robots had to close, in a coordinated way, an underwater valve and a land-based valve located inside the Tor del Sale building.

Finally, in the Grand Challenge, besides the tasks already mentioned, the marine robots had to search for a missing worker represented by a mannequin dressed in bright orange clothes. The Grand Challenge was successfully met if all three missions were accomplished within 100 minutes. Strategy was important as the teams were free to tackle the mission goals in

PHOTO CREDIT: euRATHLON

Fig. 1. Sea scenarios took place in the harbour of the Enel power plant, Piombino, Italy (top panel). The lower panel shows the nearby Tor del Sale building, which simulated the Machine room which the land robots, supported by UAVs, had to reach and to explore.

PHOTO CREDIT: CMRE

Fig. 2. One of the two underwater piping assembly structures and the valve to be closed (red circle).

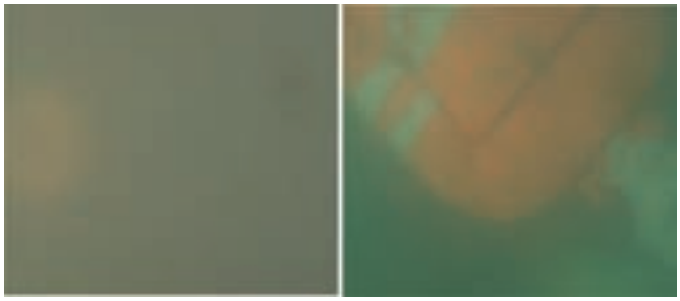


PHOTO CREDIT: CMRE

Fig. 3. Left panel; An orange buoy is hardly visible. Right panel; an underwater mannequin dressed in orange.

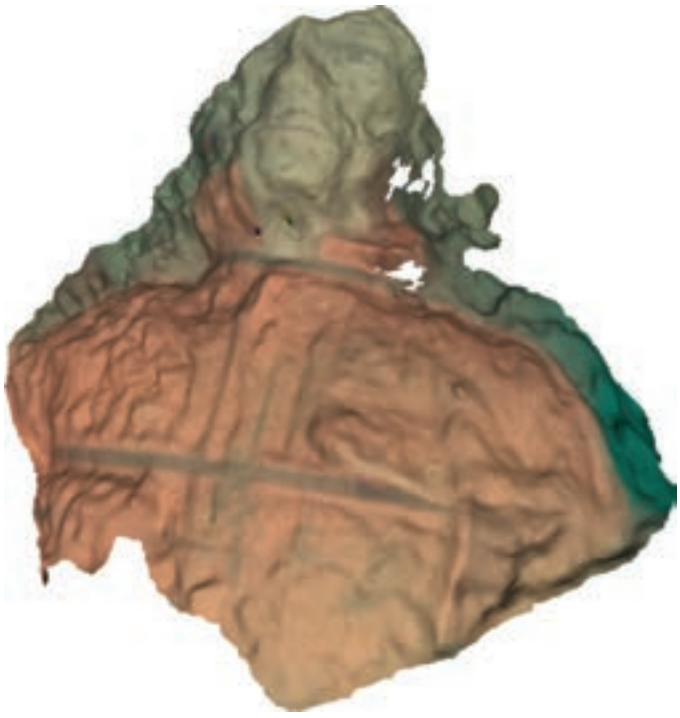


PHOTO CREDIT: UNIVERSITY OF GIRONA

Fig. 4. The 3D reconstruction of the submerged mannequin from the University of Girona.

parallel or in sequence, and to choose the order. Teams were also free to choose which types of robots to deploy, as well as how and when to deploy them. Taking place over two days, the Grand Challenge was designed to encourage and reward cooperation between ground, marine and aerial robots, while allowing maximum flexibility in participation and innovation; testing not just the robots, but the human-robot teams.

Regarding the marine domain, the conditions were harsh. Although the area was in a protected harbour with shallow water, the visibility was very poor due to a storm that occurred a few days before the competition, stirring up sediment. Fig. 3 illustrates the poor visibility encountered. Even though the objects were bright orange, in some cases they were hardly visible. Nonetheless, several teams were able to perform the tasks, mostly achieving their goals. As an example, the University of Girona produced an outstanding 3D reconstruction of the mannequin (Fig. 4)

The Participant Teams

Of the 16 teams that participated in euRathlon 2015, 12 were from the marine domain. Of these, only 3 had not participated previously in any edition of SAUC-E and were new entries in the competition. The consortium budgeted acquisition of three AUV robotic kits and two Doppler Velocity Log (DVL) sensors to be given to newcomers to the competition. The robotic kits ended up being base versions of SPARUS II AUV without payload sensors. This was done in order to expand the number of teams in the marine domain, give them a sort of "jump start" as building an underwater robot is not a trivial task and promote rapid development and innovation. In turn, the goal was acomplished as three new teams entered the competition and did very well. For instance, OUBOT team from Obuda University (Hungary) was given a robot in April 2015 and they integrated payload sensors in very short time and accomplished demanding competition goals. By having access to borrowed vehicles, good teams could focus on sensing and navigation, achieving good results at sea. The SPARUS II is another story of success of SAUC-E: the platform has performed well in previous competitions, which have proved an excellent environment to develop the vehicle, which the University of Girona is now commercialising.

The participant teams with a marine robot were:

1) AUGA; From ACSM (Advanced Crew and Ship Management), a company that participated in the sea trials with one of the SPARUS II AUVs that were loaned to less experienced teams by the euRathlon consortium.
2) AVORA; From the University of Las Palmas de Gran Canaria, Spain. This team participated in previous SAUC-E competitions.
3) AUV Team Tom Kyle; From the University of Applied Sciences of Kiel, Germany. Past participant of SAUC-E.
4) B.R.A.I.N. Robots; From Esslingen, Germany, participated in euRathlon 2013.
5) ENSTA Bretagne Team 1; One of the 2 multi-domain teams from the Institute of ENSTA Bretagne, France. ENSTA is the only institution that participated in both euRathlon 2013 and 2014. Regular participant and awarded team of SAUC-E.
6) ENSTA Bretagne Team 2; The 2nd of the two multi-domain teams from the Institute of ENSTA Bretagne, France. Regular participant of SAUC-E.
7) ICARUS; Team of the ICARUS EU-FP7 Project, with partners from Belgium, Germany, Poland, Portugal and Spain.
8) Team Nessie; From the Heriot Watt University (UK). Past participant of SAUC-E.
9) OUBOT; From Obuda University (Hungary), participating with one of the loaned SPARUS II UAV.
10) Robdos Team Underwater Robotics; Formed by a group of students from the University Polytechnic of Madrid (UPM) and the company Robdos SRL. They participated with one of the loaned SPARUS II both in euRathlon 2014 and 2015. Past participant of SAUC-E.
11) UNIFI Team; Fom the University of Florence (Italy). Past participant of SAUC-E.
12) Universitat de Girona; Formed by students and researchers of the Underwater Vision & Robotics Research Centre

(CIRS). The team develops and operates the robot vehicle SPARUS II AUV. Past participant and awarded team of SAUC-E and euRathlon 2014.

The Winners

From the 6 multi-domain teams that participated in the euRathlon Grand Challenge, the multi-team (Fig. 5) composed of Team Cobham (Land), Universitat de Girona (Sea) and INESP/INESC TEC (Air) won over the 2 second-placed ex-aequo ICARUS and Bebot-team (Land and Air) together with AUV Team TomKyle (Sea).

The Sea + Land sub-challenge was won by Cobham + Universitat de Girona.

In the sea trials, the University of Girona won both Sea Trial 1 and 2, followed by ENSTA Bretagne Team 1 and AUGA.

For the SAUC-E competition, the University of Girona won again with ENSTA Bretagne Team 1 in 2nd place and AUV Team TomKyle coming in 3rd.

A special prize for the rookie of the year sponsored by VideoRay Inc was presented to Team OUBOT for their excellent performance, taking into account the limited time they had available with the loaned vehicle and the previous lack of experience in marine robotics.

Sponsors and Exhibitors

IEEE OES played a fundamental role as Platinum Sponsor, contributing to the competition awards. Evologics, Texas Instruments and SBG Systems contributed as Silver sponsors on a smaller scale for the prizes. Many local companies sponsored or supported the event in different ways. IEEE RAS was an institutional supporter and gave goods as awards for the Best Autonomy Award and Best Multi-Robot Cooperation Award.

Many (mainly marine) exhibitors took the opportunity to display their activities at stands at Tor del Sale, including:

- IEEE OES
- Evologics GmbH
- Interuniversity Center of Integrated Systems for the Marine Environment (ISME)
- An Italian Research Consortium
- ROBOCADEMY FP7 EU project
- ICARUS FP7 EU project
- Institute of Biorobotics from the Scuola Superiore Sant'Anna, Pisa, with their Marine section
- Applicon
- Nexse
- WSENSE

euRathlon 2015: More than a Competition – An International Robotics Event for the General Public

euRathlon 2015 has not only been a complex and challenging robotics competition, involving more than 100 young and creative researchers, but also an international robotics event for the technical and general public, creating outreach to increase awareness of the role and potential of robotics in our society.

Several satellite events were organised around the euRathlon competition.

PHOTO CREDIT: euRATHLON

Fig. 5. Winner of euRathlon 2015 Grand Challenge: Team Cobham (Land) + Universitat de Girona (Sea) + INESP/INESC TEC (Air).

PHOTO CREDIT: euRATHLON

Fig. 6. (Left) WALK-MAN robot closing a valve during the exhibition. (Right) DRC-HUBO robot from Team KAIST.

- A series of conferences on robotics were held at the Piombino Castle in the evenings of the 20th and 21st.
- A demo of the Robot-Era project (urban robots for the elderly assistance) was conducted by the Scuola Superiore Sant'Anna in Piombino downtown on the 22nd
- The WALK-MAN robot (from IIT, Italy) and HUBO (from KAIST, South Korea) were demonstrated, the latter being the winner of the DARPA Robotics Challenge in 2015 (Fig. 6)

HUBO performed to a very crowded demo at the Tor del Sale area, an absolute premiere in Europe. The DARPA Robotics Challenge (DRC), which HUBO won, is the world leading competition of humanoid robots with the aim to develop robots capable of assisting humans in responding to natural and man-made disasters.

In total, around 1200 people attended the public programme, including several large parties of school students who visited the competition, from elementary to high school groups. Over 300 robotics experts were also present during the event, including participants, staff, judges and international guests, among them Mr. Shinji Kawatsuma of the Japan Atomic Energy Agency (JAEA). euRathlon 2015 Grand Challenge attracted also a great interest in national TV and local and national newspapers.

PHOTO CREDIT: euRATHLON

Fig. 7. Group of the local organizers.

PHOTO CREDIT: CMRE

Fig. 8. René Garello (President IEEE OES) (centre-right) and Andy Pickup (Deputy Director CMRE) (right) during the euRathlon award ceremony in Piombino. René Garello presented the marine single-domain competition awards.

Professor René Garello, President of IEEE OES was present and awarded the marine domain awards. Professor Satoshi Tadokoro, the IEEE RAS president elect, awarded the IEEE RAS TC prizes for autonomy and innovation. Dr. Nick Chotiros, Associate Director of the Office of Naval Research Global (ONRG) also attended and was part of the judging team. As in past years, ONRG supported the competition by providing personnel.

The euRathlon 2015 may thus be considered a great success, establishing itself as a leading robotics competition in Europe, with IEEE OES as a core founding sponsor. euRathlon 2015 was not only a great competition, but also a robotics event that produced significant exposure in the scientific community and in the general public. The 9 days of the competition have seen inter-domain cross-fertilisation with research groups expert in different domains working together to solve complex tasks that may not be solved only by using a single type of robot. This kind of collaboration between researchers from different domains is essential to start thinking about complex multi-robot systems capable of providing

PHOTO CREDIT: euRATHLON

Fig. 9. Group photo of euRathlon 2015 participants.

an effective answer to the search and rescue tasks raised by a disaster such as the Fukushima 2011 nuclear accident.

The public interest that the event raised has also helped to create robotics awareness, teaching people how sea, land and air robots can be of fundamental importance in responding to natural and man-made disasters. Finally, it is clear that young people were really interested in the competition and in the robots. This demonstrates how the upcoming generation is ready and keen on using and supporting novel technologies such as robotics.

We are very proud of these results and we are also extremely grateful to IEEE OES and other sponsors, together with all the teams, judges, exhibitors, visitors and indeed everyone involved, who made euRathlon 2015 such as a successful event. Professor René Garello, President of IEEE OES was present and presented the marine single-domain awards (Fig. 8).

But what about the future? The future plans include another competition for land, sea and air robots in September 2017, funded through an H2020 European project. For 2016, the plan is to again hold SAUC-E at the CMRE, continuing the tradition to keep a strong interest by the marine community in the competition.

We invite you all to participate in our next events! YouTube videos are available at: https://www.youtube.com/user/euRathlonVideos.

Underwater Robot Convention in Japan

Takumi Matsuda, Kenichi Asakawa, Toshihiro Maki, OES Beacon Editorial Team

The Underwater Robot Convention, organized by NPO Japan Underwater Robot Network and supported by IEEE OES Japan Chapter and MTS Japan Section, is held annually to enhance the research collaboration among the underwater robotics researchers in Japan and neighboring Asian countries, and to enlighten and encourage the next generation of underwater robotics researchers. The annual event typically brings together approximately two dozen university teams with their supervisors and postdoctoral mentors, most of whom are active researchers in the underwater robotics community. The teams bring their latest underwater robots which are materializing the latest ideas and innovations occurring real-time in their laboratories. Consequently, this is a unique and excellent opportunity to hold a community forum to discuss and

exchange the latest ideas and innovations in the friendly competitive atmosphere. Moreover, the convention is held in collaboration with the other countries such as Singapore.

Underwater Robot Convention 2015 was held at JAMSTEC (Japan Agency for Marine-Earth Science and Technology) from August 28 to August 30, 2015. More than 400 researchers, engineers, students, and visitors from a number of institutions all around Japan attended the convention. There are three sections of the competition, AUV (Autonomous Underwater Vehicle) section, Free Style Vehicle section, and Junior section in which participants make a ROV (Remotely Operated Vehicle).

The junior section is organized for high school and junior high school students to assemble, tune, operation-practice and compete with each other. This section was held for two days. On the first day, obtaining an instructor's advice, participants assembled the robot using vinyl chloride pipes, thrusters, and control devices which were prepared. On the second day, they competed to pick up an empty can on the pool floor by controlling their robot and show the ability of the vehicle operation.

The AUV and free style vehicle sections are to compete for the performance of their own robots. Teams are scored and awarded based on their presentation at the workshop and the competition. In the free style vehicle section, participants compete for their ideas of their robots. In the AUV section, participants competed for autonomy of their own robots. The missions are prepared such as line tracking, buoy touching, landing, and gate passing. These missions are essential for the AUV operation in the sea environment.

Prior to the competition, the workshop was held. The objective of this workshop is to bring together researchers and their latest robots in the Japanese underwater robotics community in order to encourage the information exchange and strengthen the technical expertise of the whole community. More than 100 researchers, engineers, and students from a number of institutions all around Japan attended the workshop in this year. There were 21 presentations on their original works on underwater robotics, such as mechanical design, control, electronics, software architecture, image processing, followed by active discussions.

The attendees of the workshop came from ten universities (Iwate University, The University of Tokyo, Tokyo University of Marine Science and Technology, The University of Electro-Communications, Keio University, Kyushu Institute of Technology, Nagasaki Institute of Applied Science, Nishinippon Institute of Technology, Kyushu Polytechnic College, Okinawa Polytechnic College), one technical college (National Institute of Technology, Kitakyushu College), three high schools (Waseda University Honjo Senior High School , Tokyo Tech High School of Science and Technology, Yamate Gakuin Junior and Senior High School), one private company (Ikehouse ltd.).

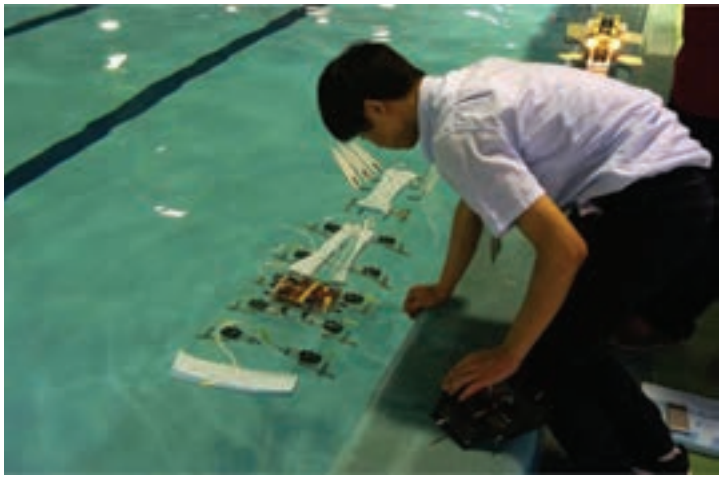
In the free style section, there were various kinds of robots, such as a fin-running type robot, a tortoise type robot, a penguin type robot and a fish type robot, made by participants based on their unique ideas. The Anomalocaris fin-running type robot won the first prize in this year. This robot moves based on fin-running propulsion.

The guidance of the junior section. Participants guided about how to make the ROV by the instructors.

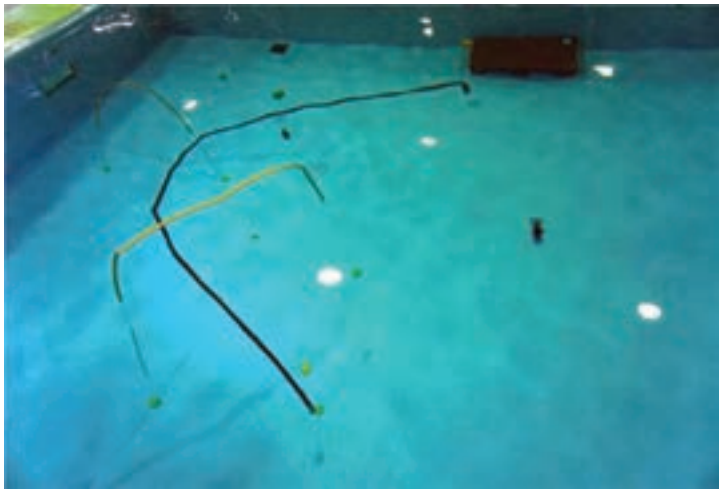
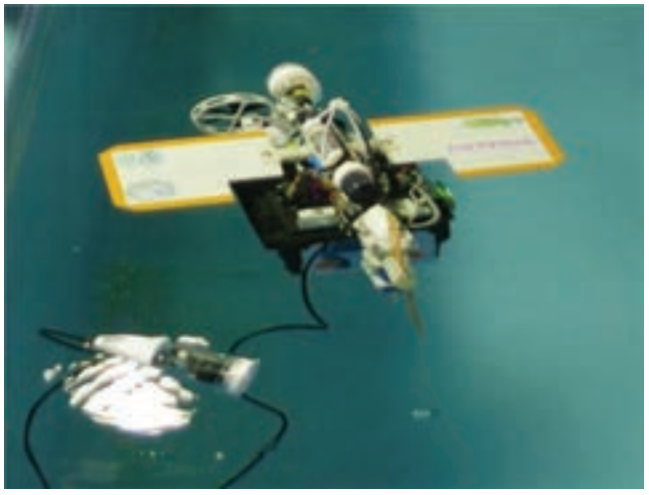
The ROV which was assembled by the participant in the junior section. The robot picks up an empty can on the pool floor.

The workshop of the AUV and free style vehicle sections. The participants show the technical originalities and algorithms of their robots.

12 teams participated in the AUV section. All teams were trying to the prepared mission. The major approach was to extract the shapes of the line, the buoy, and the landing platform based on its color by using a camera. Many teams had a hard time. One could not follow the line well owing to the sharp curve of the line, and also one could not extract the shape of the




The scene of the free style vehicle section. The left: the Anomalocaris fin-running type robot which won the first prize, The right: the penguin type robot.

The scene of the AUV section. The left: the course (line tracking, gate passing, buoy touching, and landing). The right: the AUV developed by the private company, Ikehouse ltd. which won the first prize.

The appearance of the pool belonging to JAMSTEC. All participants were checking their own robot and testing its performance using the prepared course.

line or the buoy well due to the condition of the light. Many teams also had difficulty with hardware trouble such as thrusters, cameras, water leak and so on.

With many regular teams were having a hard time, the AUV developed by Ikehouse ltd. won the first prize in this year. The unique idea of their AUV is waterjet propulsion using an agricultural pump and calculating the distance travelled based on rotation speed of the propeller. It has a gyro sensor and a pressure sensor. It showed the stable performance, succeeding in the line tracking and the gate passing.

The convention was an excellent opportunity for all participants to show and share the latest technique in the field of the

The awards ceremony.Top three teams in each section were awarded. Special awards were also given to some teams.

The group photo of the Underwater Robot Convention 2015.

underwater vehicles. After the convention, they share each idea and leave with a sense of satisfaction. Human network made through the convention will lead to the development in underwater techniques and the encouragement of the next generation of underwater robotics researchers.

For more details about the activity of the Underwater Robot Convention, NPO Japan Underwater Robot Network, IEEE OES Japan Chapter and MTS Japan Section, visit the following links.

'15 Underwater Robot Convention in JAMSTEC, http://underwaterrobonet.org/jamstec/index_e.htm

NPO Japan Underwater Robot Network, http://underwaterrobonet.org/link.html#.html

IEEE OES Japan Chapter, http://www.ieee-jp.org/japancouncil/chapter/OE-22/

MTS Japan Section, http://www.rioe.or.jp/rioehp12.htm

The Singapore AUV Challenge (SAUVC) 2015 – Summary

Venugopalan Pallayil

The third SAUVC event was organised by the IEEE OES Singapore Chapter in collaboration with the National University of Singapore, DSO National Laboratories and the Singapore-MIT Alliance. The Singapore Polytechnic was a co-organiser of the event and provided the pool and associated facilities free of charge. It was one of the biggest challenges in the past for the organisers to secure a suitable venue for the competition. With the strong support from Singapore Polytechnic this issue has been resolved at least for the moment. The SUAVC 2015 was the most successful event in terms of team participation. Out of twenty teams who had registered, nine teams turned up on the day of the competition; two teams from the local institutions, while seven from overseas. The overseas teams consisted of student teams from India, China, USA, Malaysia and Russia.

A list of teams who made it to the competition is given below.

1) National University of Singapore
2) Singapore Polytechnic
3) Far Eastern Federal University, Russia
4) North Western Polytechnical University, China
5) SRM University, India
6) University Sains Malaysia
7) Hindustan University, India
8) Prairie View A&M University, USA (jointly with Harbin Engineering University and Jinan University, China)
9) Panimalar Institute of Technology, India

The competitions started off with a presentation by each team on their AUV design followed by interactions with the

Fig. 1. Team members with their AUVS along with organisers and Chief Guest Dr William Kirkwood.

Fig. 2. Team from Hindustan University interacting with the FEFU team from Russia.

Fig. 3. A section of the crowd at the pool eagerly waiting for the AUV to surface in the designated surfacing zone.

chief guest. The students were also interviewed to understand the difficulties they faced during the building of their AUVs and how they overcame those. The teams were given some time to practice in the pool on the first day and the second day started off with qualifying rounds where each AUV has to make a straight run of 15m in the pool. Those who qualified in this round were allowed to compete in the final round. Out of the nine teams, seven qualified for the final round.

The tasks for the final round of the competition were the same as those for the SUAVC 2014 event. The AUV was required to swim through a gate, follow a line and drop a golf ball into a bucket kept on the floor of the swimming pool, then bump against a flare and drop the ball hosted on it and finally surfacing at a designated point. The AUV was required to navigate itself, with no lines to follow, after dropping the ball into the bucket until it surfaces at the designated point. The surfacing zone was equipped with two acoustic pingers so that the AUV may use acoustic localisation techniques to aid in its navigation towards the surfacing zone. A video on the various tasks and the scores awarded for successful completion of each of the tasks can also be found on our website www.sauvc.org.

The NUS team, who completed all the tasks successfully, emerged as the winners of the competition for the second time in a row (they had won the 2014 competition as well). The team from Far Eastern Federal University, Russia, though hit by some technical snag, was able to complete all the tasks and make it to second place. The team from Northwestern Polytechincal University, China, took third place. The Hindustan University from India and the Singapore Polytechnics won consolation prizes for their efforts. The teams were awarded cash prizes and certificates.

Dr William Kirkwood, Senior Engineer from MBARI and Treasurer for IEEE OES, was our chief guest for the competition. Dr Kirkwood gave a presentation on 'Robots for in-situ science: moving from ROVs to AUVs' on the second day of the competitions. A YouTube video of the same is available on our SAUVC website. This was well attended by the participants and invitees. On the concluding day he distributed the prizes for winning teams over a barbeque dinner. Another highlight of the 2015 event was that the Chapter organised a half-day workshop at the request of some of the participating teams on the acoustic localisation technologies used on AUVs.

Fig. 4. The Bumble bee team from NUS, which won the first position, during the BBQ night.

Fig. 5. Student team from China testing their AUV in the pool.

Asst. Prof Mandar Chitre from the Acoustic Research Lab, NUS lead the workshop.

The event was well supported by various sponsors both from academia and industries. We would like to acknowledge the strong support provided by the Office of Naval Research (Global), IEEE OES, National University of Singapore, Singapore-MIT Alliance, Atlas Electronik, Germany, Thales Asia Pte Ltd., Singapore, Liquid Robotics, USA and ST Electronics InfoComm, Singapore. There were many volunteers (including students) who helped with the dive operations at the pool and also many logistics.

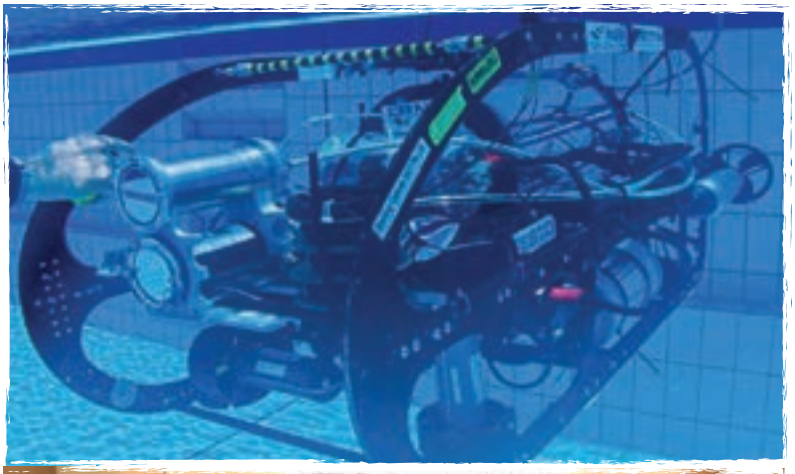
We are now preparing for the 2016 competition, which will be held from 6–8 Mar 2016 at the Olympic size swimming pool of Singapore Polytechnic. So far 18 teams have registered for the competition. Please visit www.sauvc.org or our Facebook page for details of the 2016 event and also past events. There are many photographs and videos of the past competitions also available on our website. We have contributed and presented a paper on our competitions in a recent OCEANS conference held in Genoa and sponsored jointly by IEEE OES and MTS. You can download a copy of the paper from our laboratory website given below

Fig. 6. An AUV design using PVC pipes and plastic boxes by University Sains Malaysia.

http://arl.nus.edu.sg/twiki6/pub/ARL/BibEntries/Pallayil2015SAUVC.pdf

We look forward to an exciting competition in Mar 2016.

MARCH
04-06



SINGAPORE AUV CHALLENGE SAUVC 2016

Info: www.sauvc.org

Chapter News

Providence Chapter Presentation by Jules Jaffe, September 21, 2015 at U. Mass. Dartmouth, Massachusetts

Albert J. Williams 3rd, OES Providence Chapter Chair

On September 21, OES Distinguished Lecturer Jules Jaffe presented a talk to the OES Providence Chapter on swarms of AUVs as sensors, underwater stereo microscopes, and even his interview on TV about the hunt for Malaysian Airlines flight 370. The diverse and fascinating explorations Jules and his team of engineers has been engaged in kept the audience of 59, including a student chapter, enthralled. Providence Section covers a large area and a central location was selected for this general interest talk at U. Mass. Dartmouth in South Dartmouth, Massachusetts.

Fig. 1. Jules Jaffe at the lecturn.

Fig. 2. Lecture attendees.

Spanish Chapter—Martech Workshop 2015

Marc Carreras

The Spanish Chapter of the Oceanic Engineering Society sponsored a plenary talk entitled "Space: the next frontier in interdisciplinary ocean sciences" given by Dr. Kanna Rajan, Visiting Professor at University of Porto, at the 6th International Workshop on Marine Technology – Martech Workshop 2015. The workshop took place in Cartagena (Spain) on September 15–17, 2015, and was organized by the Universidad Politécnica de Cartagena and the Universitat Politècnica de Catalunya. The main goal of this workshop is to show the latest investigations and to exchange information and points of view on current research in MARine TECHnology. Martech Workshop brings together a diverse set of researchers who are jointly committed to developing technology, not just for its own sake, but to generate innovation in the field of maritime technologies.

Martech Workshop 2015 brought together 60 contributions, which were presented orally in two parallel sessions, and can be categorized in 10 different topics: Operational Oceanography; Instrumentation, Metrology, Signal processing; Marine sensors, sensor networks; Observatories, remote sensing; Marine Robotics: ROVs, AUVs, ASVs, Gliders; Underwater imaging and communication; Sea floor characterization; Structures and materials; Marine Biology and Aquaculture; and Renewable energies. This year the Marine robotics topic had the largest number of contributions. Companies exhibiting in the workshop also offered tutorial sessions.

Next edition of Martech Workshop will take place in Barcelona in October 2016, and it will be organized by the Mediterranean Center for Marine and Environmental Research (CMIMA-CSIC). For more information visit: http://www.martech-workshop.org/

Kanna Rajan at Martech Workshop 2015 in Cartagena (Spain).

Realizing Multiple AUVs Operation

Introducing the Current AUVs Research Works in Japan

Takumi Matsuda, OES Beacon Editorial Team

The importance of the seafloor observation by an Autonomous Underwater Vehicle (AUV) is increasing. There are many underwater missions such as seafloor mapping, exploring benthic resource, monitoring underwater environment, and surveying the damage caused by accidents or natural disasters. AUVs have a potential to perform the tasks automatically and gives us important information in the mysterious underwater environment.

To enhance AUV operations, multiple AUV operations have been studying in the Underwater Robotics Laboratory of the Underwater Technology Collaborative Research Center, the Institute of Industrial Science (IIS), the University of Tokyo, Japan. In our approach, the AUVs themselves become the acoustic landmark for each other. Highly accurate position estimation can be realized as AUVs navigate relative to the landmark AUV. Wide seafloor survey is also realized by alternating the landmark role among the AUVs. AUVs can perform the mission as long as their energy continue.

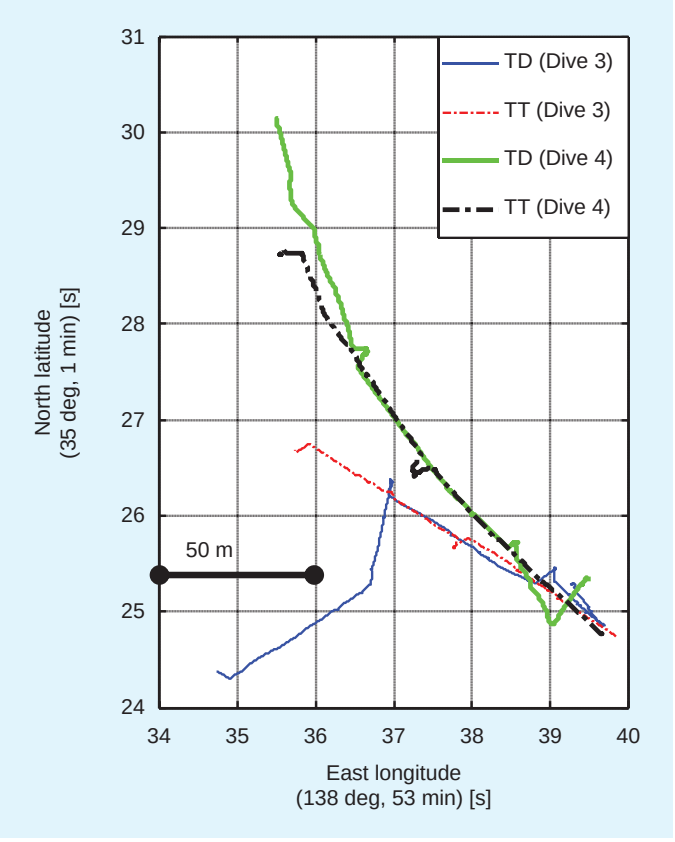
The laboratory is involved in the development of the AUV navigation method and the observation strategy to perform visualization of the underwater environment. The laboratory has the environment developing AUVs such as a test tank and a pressure test machine. IIS also has the workshop which can make AUV components such as a pressure hull. AUV Tri-TON 1 and Tri-TON 2 belonging to the laboratory were jointly-developed with the company "ONO-denki". The positioning and communication device for multiple AUV operations was also developed with "SGK SYSTEM GIKEN CO., LTD". These environment and collaboration support the development of the AUV system.

The tank belonging to the IIS. The performance of the AUVs can be checked in this tank.

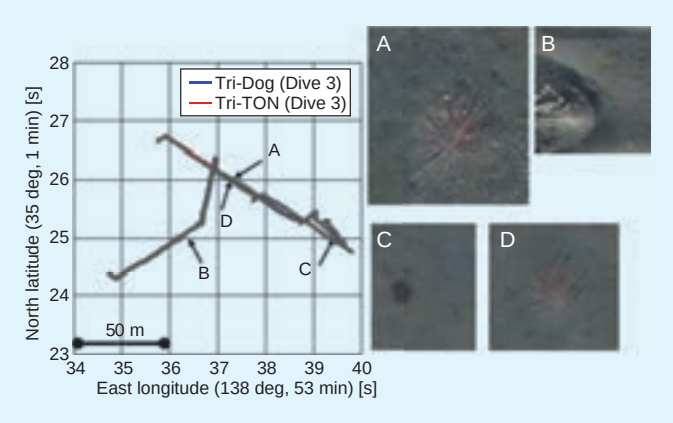
The weekly seminar is organized to discuss the algorithms of the robotics. The laboratory members participate in the seminar and obtain the essential knowledge of the robotics. This supports the development of the intelligent algorithms.

The series of experiments were conducted at "OKI SEATEC" in Uchiura bay in Japan and was supported by the staff of "OKI SEATEC" from August 24 to August 27, 2014. In the experiments, the AUVs "Tri-Dog 1" and "Tri-TON 1" succeeded in 4 dives, performing completely autonomous navigation without any surface support. In particular, in Dive 4, they succeeded in 200 m distance navigation and obtained environmental data near the

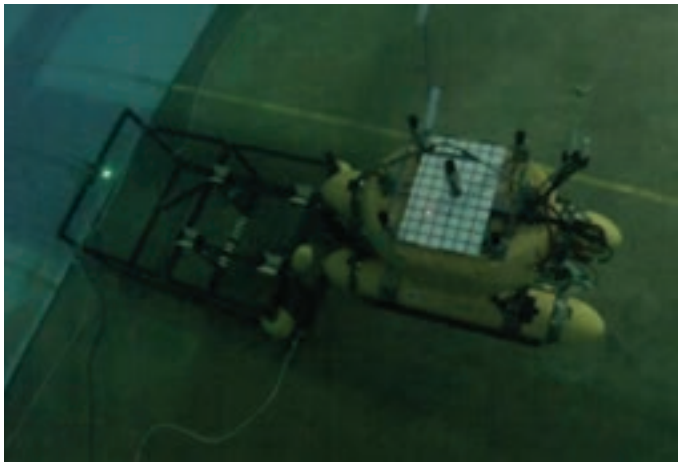
Deployment of the AUV Tri-Dog 1 (left) and Tri-TON 1 (right).



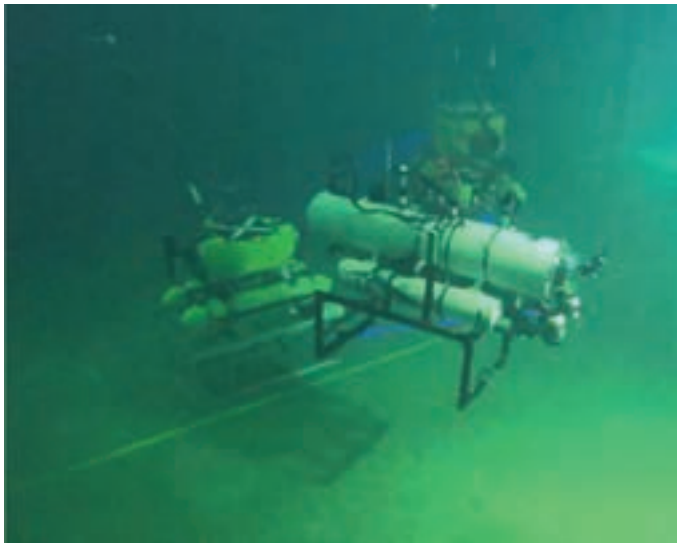
Results of the sea experiments showing estimated trajectories of the AUV Tri-Dog 1 (TD) and Tri-TON 1 (TT).



Seafloor photographs obtained by the AUVs (dive 3). Pictures A and B were obtained by Tri-Dog 1. Pictures C and D were obtained by Tri-TON 1.



The experiment of the docking method. The method is under development.



Performance test of the multiple AUVs operation in the tank. Two AUVs navigate based on the landmark AUV keeping stationary on the tank floor.

The deployment of the AUV "Tri-TON 2". The AUV navigated based on the station and visually observed the hydrothermal bent field.

seafloor such as photographs of the seafloor and temperature profiles.

Station-based operations have also been studying. The AUV navigates around the station and observes the seafloor. After completing the mission, the AUV goes back to the station, and docks to the station to recharge its own batteries. The docking method is under development. Station-based operations will realize long-term observation without any surface support.

The Underwater Robotics Laboratory has been developing the intelligent observation system by multiple platforms. In case of the multiple AUV operation, it aims to realize wide seafloor surveys by only AUVs which has been difficult for a conventional navigation approach. The method can be applied to several types of the surveys such as bathymetry mapping, monitoring of seafloor life, resource survey, searching for lost objects, and so on. The multiple AUVs operation will certainly contribute to the field of the AUVs and will certainly reveal several unknown facts of the seafloor in the future.

For more details about the work of the Underwater Laboratory of the IIS, visit the following links.

Maki Laboratory, http://makilab.iis.u-tokyo.ac.jp/

IEEE / OES Japan Chapter

IEEE Oceanic Engineering Society

SUT Society for Underwater Technology

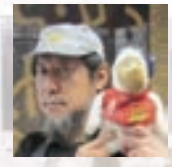
2016 IEEE OES Autonomous Underwater Vehicle

Call for Papers

AUV 2016

November 6 - 9, 2016

IIS Conference Hall "Haricot" Tokyo, Japan





Every two years the IEEE Oceanic Engineering Society (IEEE OES) sponsors a collaborative workshop to bring together those working in the field of autonomous underwater vehicles. In 2016 this diverse group from around the world will meet in Tokyo, Japan at the University of Tokyo for AUV 2016.

Topics

AUV2016 invites the authors to submit contributions in the following topics.

- Vehicle Design
- Vehicle Navigation
- Vehicle Performance
- Vehicle Applications
- Multi Vehicle System
- Open Source Robotics

Student Poster Competition – "Imaginary AUV project"

Students are invited to submit proposals for an "Imaginary AUV Project".
The winners will receive incentive fund and travel support!

Important Dates

- Abstract Submission Page Open: April 8, 2016
- Deadline for Abstract Submission: June 20, 2016
- Notification for Authors: July 16, 2016
- Deadline for Full-paper Submission: September 2, 2016

Organizers

- IEEE/Oceanic Engineering Society (IEEE/OES)
- IEEE/OES Japan Chapter
- Institute of Industrial Science, the University of Tokyo

Technical Co-Sponsor

- Society for Underwater Technology (SUT)

For Inquiries, please contact:

AUV2016 Secretariat: **info@auv2016.org**

URL: http://www.auv2016.org/

2015 IEEE/OES Acoustics in Underwater Geosciences Symposium

Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Peru, Puerto Rico, and Venezuela joined together in Rio to develop a strong network of underwater acousticians in Latin America.

Jean-Pierre Hermand and Arthur Ayres Neto

Dedicated to the multiple facets of acoustics in underwater geosciences, the 2nd edition of RIO Acoustics Symposium gathered between 29 and 31 July 2015 in the heart of Rio de Janeiro about 130 delegates from 24 countries. First of its kind in Latin America, the Symposium was conceived to respond to the demands of professionals and researchers. The enthusiasm of the 1st edition's attendees led to the call for this year's event, which took place in the beautiful venue of the Brazilian Geological Service headquarters in the Urca neighbourhood, at the foot of the emblematic Sugar Loaf Mountain.

A highlight of the Symposium was the participation of ten countries from Latin America: Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Peru, Puerto Rico, and Venezuela. This represents a major step forward given that most of the Latin American participants to RIO Acoustics 2013 came from Brazil. A travelling grant offered by IEEE/OES helped to make the difference, especially in the current difficult economic climate. However, about twenty abstracts submitted from Brazil and overseas countries were withdrawn due to budget cuts in authors' institutions. Nevertheless, the Symposium featured 87 technical papers including both oral (53) and poster presentations (34), representing an increase of 60 % with respect to 2013. Most symposium topics were explored in well-attended sessions. Beyond the classical, emerging topics involving: passive acoustics; underwater vehicles as platforms for survey; submerged landscape archaeology; and, underwater mining, drew much attention. *Fisheries and Bioacoustics* was by far the most represented topic thanks to the additional contributions of countries facing the Pacific Ocean and Caribbean Sea. The diversification of topics was largely appreciated by the audience as it favoured a productive atmosphere and intellectually stimulating cross-disciplinary exchanges.

RIO Acoustics is intended to be an international event, drawing papers and participants from Asia, Australia, Europe, and North America – but it is primarily meant to have a strong focus on South and Central Americas. The objective is to develop a strong network of practitioners and end users – such as those already well-established in Europe, the United States and Canada. Progress towards those ambitions is now well underway and there is a definite need for such a flagship event to encourage local co-operation in the sub-continent, where the expectations are many.

On the Pacific coast, the Humboldt Current Large Marine Ecosystem is one of the major upwelling systems of the world, supporting an extraordinary abundance of marine life. Sustainable management of fish stocks requires better acoustic survey tools and practices. On the Atlantic side, Brazil – with one of the world's longest coastlines and adjacent territorial waters – is today the second-largest producer of petroleum in South America in 2014 (behind Venezuela), thanks to discoveries of large offshore, presalt oil deposits. A wide range of off-the-shelf acoustic survey equipment – as well as the development of new approaches – are needed to prospect for mineral resources on the continental shelf and in the deep ocean beyond. In addition, equipment and new approaches are needed to survey underwater infrastructures, and to assess and forecast the environmental impacts of fast-growing exploitation. Harbour management is another concern, with the need regularly to dredge the mud accumulating in access channels or basins. Inland, thousands of kilometres of waterways have to be maintained to preserve navigability.

The Symposium is organized by Arthur Ayres Neto and Jean-Pierre Hermand in the framework of a co-operation agreement between the Fluminense Federal University (UFF) and the French-speaking Free University of Brussels (ULB). Special thanks go to the ULB LISA secretary Arlette Grave for her dedication and the group of UFF and ULB student volunteers who lent a very precious hand on the spot.

The Keynote Speakers were a highlight of the Symposium, with four lectures dealing with new, important, applications. The CPRM specialist, Dr. Ivo Pessanha, presented "Marine Geology in the Geological Survey of Brazil (CPRM) – Projects and Perspectives". Prof. Lauro Madureira, University of Rio Grande, Brazil, tackled the use of hydroacoustics for fishing (up and down the marine food web). The AXA Engineering representative, Mr. Donizetti Carneiro provided insights into how to overcome the challenges of underwater pipeline inspection using autonomous underwater vehicles. Prof. Isabel Rivera-Colazzo, University of Puerto Rico, addressed a novel topic: the "Continent Divided by Water" – coastal and human dynamics, and the potential for submerged landscapes in the Caribbean.

The RIO Acoustics initiative has been raising the interest of forward-thinking companies – sixteen of them providing generous support this year, which is nearly double the number of two years ago. Brazil was represented by Hydromares, IMS, Petrobras and Umi San. A large number of foreign companies was present: AML Oceanographic, Caris, Geospectrum Technologies, ISE-ISER and Ocean Sonics (Canada), Kongsberg and Nortek (Norway), Meridata (Finland), Sonardyne (UK), Edgetech and Teledyne Reson (USA). The Office of Naval

Research Global patronized the event alongside the Belgian Fund for Scientific Research (FNRS), and the Wallonia-Brussels International (WBI) agency and its Brazilian partner CAPES. The Brazilian Geophysical Society, Association of Engineering Geology and Association for Quaternary Studies endorsed the Symposium. As in 2013, the Patron's Day was well attended by participants, creating business opportunities with end-users. The representatives demonstrated new equipment features and innovative technologies through the presentation of case studies on the use of acoustic remote sensing for geophysical and geotechnical investigation. The students did not miss this occasion to familiarize themselves both with the technology and with the job market. The industrial participants attended the regular sessions and evidently found them to be a good opportunity to forge closer contacts with researchers, exchange ideas and promote demand for their equipment. WBI's representative Ms. Julie Dumont presented funding opportunities for scientific co-operation in the EU H2020 Blue Growth area.

With the wide spectrum of its regional and international attendance; the broad scope of its technical programme; and, the support of its numerous patrons, the 2nd edition of RIO Acoustics was a significant success. It was also an outstanding demonstration of how the IEEE Oceanic Engineering Society helps the development of scientific and technical communities around the Globe.

Photo Gallery

Student volunteers and co-chair Arthur Ayres Neto at the reception desk.

Latin American attendees pose on top of the venue historical staircase, recently restored for the occasion.

Oral session in the main conference room of the Brazilian Geological Survey – CPRM.

The audience was eager to learn more by commenting on the papers and asking questions.

Marcia Isakson and Jim Barbera.

Lively coffee break in the poster room.

Jim Barbera; co-chairs Jean-Pierre Hermand and Arthur Ayres Neto; and Mariano Gutierrez Torero from Peru at the dinner.

Dinner at Rio's churrascharia Fogo de Chão to celebrate the enthusiastic participation and outstanding contributions from ten countries from Central and South Americas.

Lunch meeting at the foot of the Pão de Açúcar to plan the future of RIO Acoustics.

From the President *(continued from page 3)*

- Finally, I attended the Twelfth GEO Plenary and Ministerial Summit in Mexico City (http://www.earthobservations.org/geo12.php), leading a delegation of 7 IEEE and OES members, including the IEEE past President Roberto Boisson de Marca. The next 10 Year Program was at the center of the discussions with a renewed commitment and confirmation of the willingness to further leverage GEO's substantial accomplishments to improve Earth observations, as well as to increase the availability of Earth observations, data, and information to leaders in government, science, industry, civic society, and the public at large. A blog (http://earthzine.org/2015/11/07/live-coverage-of-geo-xii/) was created live during the event thanks to the help from our magazine on-line (Earthzine) writers.
- And the 2015 International Symposium on OCEAN Electronics (SYMPOL 2015) in Cochin, India (http://sympol.cusat.ac.in/) is almost underway at the time of this writing.

Clearly, we are busy! And next week from now (November 13) I will again attend the IEEE TAB (Technical Activity Board) meeting and run an OES ExCom in New Brunswick, NJ. More news in the next Beacon.

In closing, I'd like to welcome two new AdCom members who will start their office in January 2016: Philippe Courmontagne and Jay Pearlman. Four other AdCom members were reelected: John Potter, Ken Takagi, John Watson, Tom Wiener.

Concerning the officers, the AdCom renewed its support in reelecting Bill Kirkwood (treasurer), Bob Wernli (VP PA) and Sandy Williams (VP CD).

Congratulations to all.

United we stand!
René Garello,
OES President

OTC Brazil 2015

The Oceanic Engineering Society of IEEE was well represented at OTC Brazil 2015 with our IEEE/OES booth and very active participation by Liz Creed and Gerardo Acosta on the Program Committee. Gamal Hassan represented IEEE/OES on the Oversight Committee. Robert Wernli, Jr., James Barbera and Jerry Carroll were responsible for the IEEE/OES booth where we were able to sign a number of new student members. Jerry Carroll attended the OTC Brazil Society Leadership Program for our OES President, Rene Garello, who was unable to attend. Although attendance was down this year due to the price of oil and it's effect on the Brazilian economy, it was estimated that 8,000 attended 27–29 October 2015. One of the highlights of the Conference was the excellent Technical Program and, of course, seeing the lovely city of Rio de Janeiro.

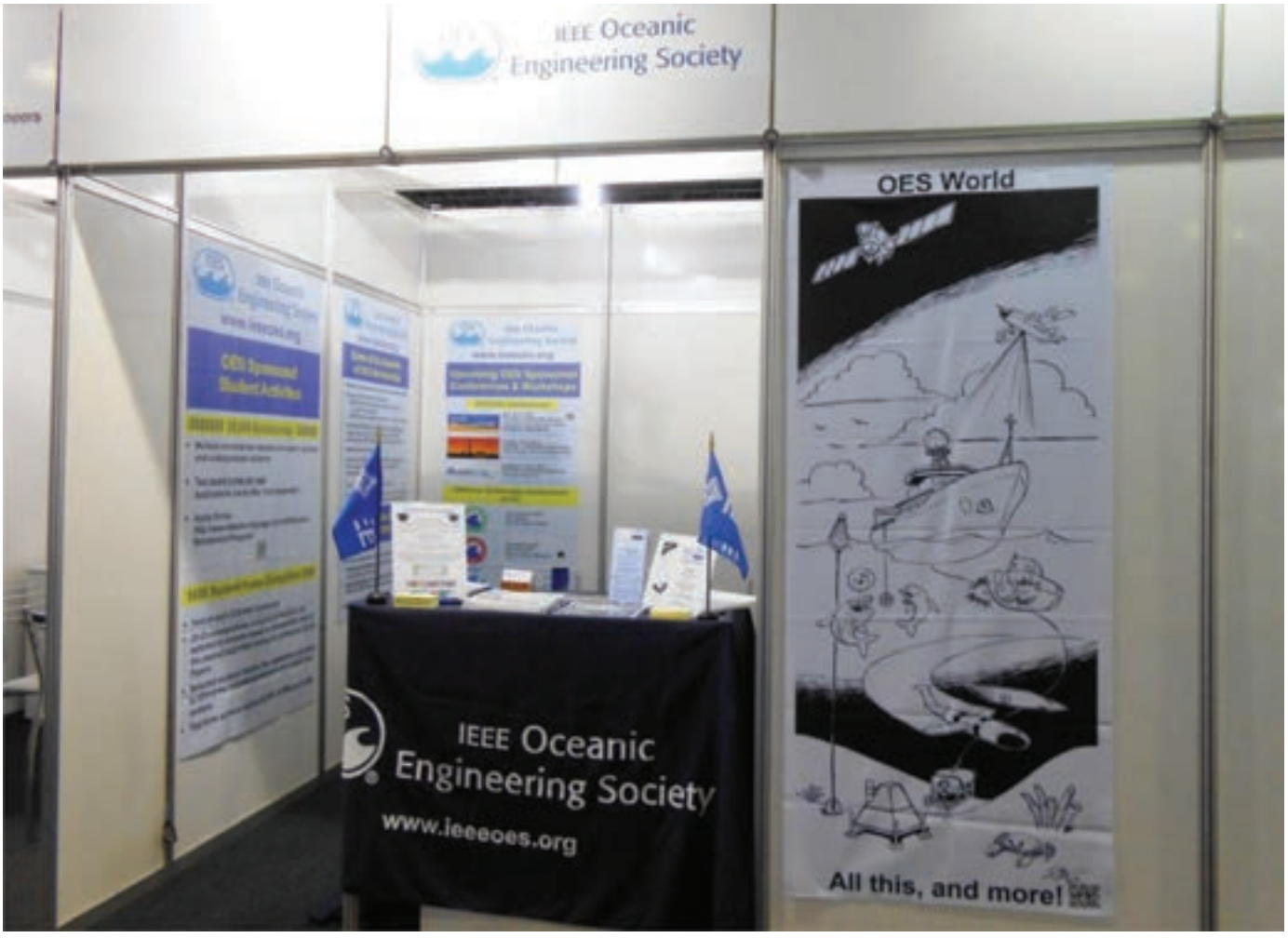
OTC Events for 2016

Offshore Technology Conference Asia 2016
OTC ASIA 2016 22–25 March 2016
Kuala Lumpur, Malaysia

Offshore Technology Conference OTC 2016
Houston, Texas

Arctic Technology Conference 2016 ATC 2016
St. John's Newfoundland & Labrador
24–26 October 2016

Jerry C. Carroll
IEEE/OES Jr. Past President



IEEE/OES Booth OTC Brazil 2015.

Call for Abstracts

Submissions related to OCEANS'16 Local and MTS/IEEE Core Topics will be considered. A list of topics is available on the website.

Abstracts may be submitted in one of three categories:

Regular Technical Program: Abstract submitted for review, technical paper presentation in technical or poster session at the conference, and publication in IEEE Xplore.

Student Poster Contest: Abstract, Paper, Poster presentation, and publication in IEEE Xplore Open to any full-time student in an accredited program. Selected applicants, based on abstract reviews, will have travel and registration expenses subsidized.

Special Sessions (Workshops and Panels): Abstract and presentation, no publication. Participation is at the discretion of the Technical Program Committee.

Call for Tutorials

Tutorials are half-day or full-day presentations that are meant to complement the technical program of OCEANS'16 MTS/IEEE Monterey by describing the fundamental element of a technology and/or rudiments of a subject in a classroom setting. All tutorial sessions will be held on Monday, September 19th, the day before the formal opening of the conference.

Deadline for Tutorial Abstracts is April 15th, 2016

techprogchair@oceans16mtsieeemonterey.org

Important Dates

Call for Abstracts January 2016
Call for Tutorials April 15th, 2016
Abstract Submissions April 2016
Tutorials Notifications June 15th, 2016
Author Notifications May 2016(sent)
Student Poster Notifications May 2016
Registration Opens June 2016
Registration Early Bird Deadline August 5th, 2016
Final Papers Due July 15th, 2015
Conference September 19–22, 2016

Sea Change – Dive into Opportunity: The OCEANS'15 MTS/IEEE Washington, DC Conference

Liz Corbin, Publicity Chair

"It was a great week for OCEANS at National Harbor," exclaimed GeneralCo-chairs Rusty Mirick of the Marine Technology Society (MTS) and Jim Barbera of the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers (IEEE/OES). "There was a lot of energy and excitement, with several Standing Room Only sessions and an exciting atmosphere in the Exhibition Hall. We heard many positive comments from attendees and that means we met our goal of providing a positive experience for MTS and IEEE/OES members and the ocean technology and engineering community."

A little over 2,000 people converged on the Gaylord National Resort and Convention Center October 19–22 for OCEANS'15 MTS/IEEE Washington, DC. They comprised a wide variety of technical professionals, researchers, industry leaders, educators, policy makers and students – all interested in sharing the latest information on how marine technology and ocean engineering can support exploring, monitoring, protecting, and wisely using the world's ocean resources.

The conference was honored to have Congressman Sam Farr, co-chair of the House Oceans Conference and Dr. Rick Spinrad, Chief Scientist of the National Oceanic and Atmospheric Administration (NOAA), as the Honorary Co-chairs. We were very fortunate to have Rear Admiral Tim Gallaudet, Oceanographer of the Navy, join Dr. Spinrad as the featured speakers for the Plenary Session. Their outstanding presentations, on the role of oceanography and its underlying technology in supporting Naval operations and the potential market for tailored information products to support the Blue Economy and mitigate coastal threats, are available on the conference website at www.oceans-15mtsieeewashington.org, along with comments by IEEE/OES President René Garello and MTS President Ray Toll.

At the end of the Plenary Session, Mirick and Barbera led a VIP Tour of the Exhibition Hall, including stops at the Student Poster Contest supported by the Office of Naval Research, where Spinrad and Gallaudet, two PhD ocean scientists, could easily have spent the entire day discussing the excellent work of the contest finalists. The tour also visited the sponsoring society booths, as well as the exhibits of OCEANS'15 Patrons, including the Government of Newfoundland and Labrador which organized the Atlantic Canada Pavilion, Kongsberg Underwater Technology, Inc., and NOAA. At the NOAA booths, the U.S. Integrated Ocean Observing System unveiled their new logo.

At the heart of every OCEANS conference is the Technical Program and OCEANS'15 Washington, DC upheld the tradition of providing a valuable opportunity for exchanging high quality technical information. Of the 644 abstracts submitted, 488 were accepted into the final program. They were organized into 106 sessions in 11 parallel tracks on Tuesday afternoon through Thursday.

Integrated into the Technical Program were a number of Special Sessions, Town Halls and Panels. These group and interactive sessions have grown in popularity and several were Standing Room Only. NOAA's IOOS program was especially active, partnering with The Maritime Alliance to organize "Ignite! A Lightning Round of Innovations, Discoveries, and Applications in Blue Tech!" and a "Town Hall Session on Marine Technology and Services in the Blue Economy." The Blue Economy theme was continued in the "Town Hall on Promoting OceanSTEM and Blue Economy Work Force Development," which was kicked off by opening remarks from Congressman Farr.

A very popular session called "OCEANS'25 (and beyond) – Envisioning the Future of Marine Technology and Ocean Engineering," was moderated by Dr. Spinrad and included a strong panel of leaders sharing their insights on future needs and trends and what we'll be seeing at OCEANS conferences in the future. The webcast of this intriguing session is available on the conference web site.

The Technical Program also was complemented by six Tutorials and four Workshops on Monday, preceding the formal opening of the conference. The Tutorials were intensive half or full day programs focused on the fundamental elements of a technology or the rudiments of a subject in a classroom setting and earned participants Continuing Education certificates. The Workshops provided a format for like-minded individuals to spend an extended period of time discussing a topic, such as the all-day XPRIZE workshop on "Catalyzing Ocean Services in a World of Abundant Data."

A lot was going on in the Exhibition Hall at OCEANS'15. In addition to the 169 booths where 129 companies, institutions and projects were featuring the latest innovations in products, services and programs, a new program was launched. The Product Theater provided exhibitors the opportunity to expand on their latest innovations in a 30-minute presentation, away from the traffic and noise of the Exhibit aisles. The 12 presentations were scheduled to occur during the breaks in the technical sessions to provide maximum exposure.

The Exhibition Hall also was home to the Student Poster Contest (SPC). The posters were displayed along one wall of the Hall, with the students present to discuss their work during published times. The Awards Ceremony on Thursday suffered a bit from a malfunctioning sound system, but that didn't dim the enthusiastic response of the crowd. Before the results were revealed, MTS President Ray Toll and IEEE/OES President René Garello presented a commemorative plaque honoring Norman Miller to Dr. Ellen Livingston of the Office of Naval Research, the long-time sponsor of the contest. The SPC was initiated and championed by Mr. Miller, who passed away in July.

The winners were announced by Liesl Hotaling, MTS Vice President for Education and Research and Philippe Courmontagne, IEEE/OES Student Activities Committee Chair. Dr. Livingston presented the awards: First Place to Jeffrey Ellen leading a team from the University of California, San Diego;

Second Place to Luke Rumbaugh, representing a team from Clarkson University in New York; and Third Place to Jie Li and a team from the University of Michigan.

The focus was also on the future generation during the K-12 Teachers Workshop held on the preceding Saturday. The free, full-day workshop provided a hands-on approach to learning and classroom resources on the following topics: ROVs, water quality sensors, buoys, and deep sea exploration. On Monday, a Career Panel acquainted students with some of the many career options in the oceans field.

As with all OCEANS conferences, there were plenty of opportunities to network and socialize throughout the week, starting off with the Ice Breaker reception on Monday night, including the Exhibitor Reception on Tuesday evening, and topped off by the Capital Casino Night Gala Dinner on Wednesday, where attendees enthusiastically tried their luck at Texas Hold'em, Blackjack, Roulette and Craps. The IEEE/OES and MTS Awards Luncheons provided members with a recap of Society activities and the opportunity to honor their outstanding leaders.

As we predicted when we chose the conference theme, "**Sea Change: Dive into Opportunity**," the week's activities shone a bright light on some of the most critical issues the world faces today and how our community can help society develop solutions to address their impacts and benefit from new opportunities. MTS and IEEE/OES are extremely proud to have sponsored this successful event. Now it's on to OCEANS'16 Shanghai and OCEANS'16 Monterey. We hope to see you there!

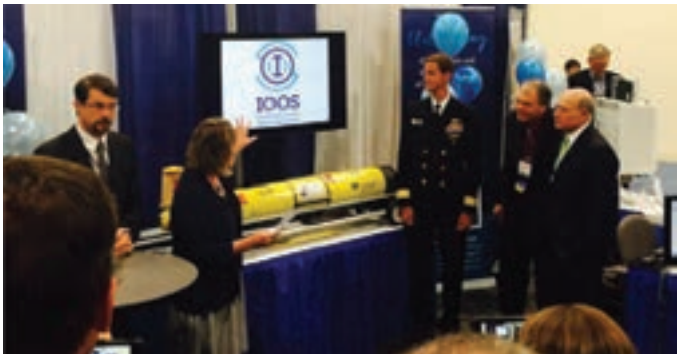
Photo Gallery

The Gaylord National Resort and Convention Center, National Harbor. Photo by Liz Corbin.

Before the Opening Ceremony and Plenary Session. L-R: Jim Barbera, Ray Toll, Rear Adm. Tim Gallaudet, Dr. Rick Spinrad, René Garello, Rusty Mirick. Photo by Stan Chamberlain.

Plenary speakers: Rear Admiral Tim Gallaudet, USN, Oceanographer of the Navy, and Dr. Rick Spinrad, NOAA Chief Scientist. Photos by Stan Chamberlain.

Congressman Sam Farr arriving for a tour of the Exhibition Hall prior to delivering opening remarks at the OceanSTEM Town Hall. Photo by Liz Corbin.



VIP Tour of the Exhibition Hall. Top: Student Poster Contest. Photo by Liz Corbin. Bottom: Unveiling of the U.S. IOOS logo at the NOAA exhibit. Photo by Mike Egan.

Special Session: Ignite! A Lightning Round of Innovations, Discoveries, and Applications in Blue Tech! Organized by U.S. IOOS and The Maritime Alliance. Photo by Stan Chamberlain.

Presentation of the Norman Miller commemorative plaque, L-R: René Garello, Dr. Ellen Livingston, Ray Toll. Photo by Liz Corbin.

First place winner of the Student Poster Contest, Jeffrey Ellen, with Phillipe Courmontagne and Dr. Ellen Livingston. Photo by Liz Corbin.

Bob Wernli enjoying the "no risk" gambling during Capital Casino night. Photo by Stan Chamberlain.

Student Poster Competition, OCEANS'15 MTS/IEEE WASHINGTON DC

Philippe Courmontagne, Student Poster Contest Committee Chair, Photos by Stan Chamberlain

This 37th Student Poster Program of the OCEANS Conferences was held at OCEANS'15 MTS/IEEE Washington, at the Gaylord National Resort & Convention Center, from October 19 to October 22. The program was organized by Liesl Hotaling (MTS SPC Chair) as local coordinator and Philippe Courmontagne, SPC Chair, from IEEE OES. The program was funded by grants from the Office of Naval Research. For this edition, 104 abstracts were received and 19 were selected for this contest, not without difficulty given the high quality of the received abstracts. Students came from China, Canada, Italy, France and the United States.

The posters were on display in the Exhibition Hall, allowing the students to exchange and describe their research work to the community. The posters were judged by a team organized by IEEE OES and MTS. The roster of students and their schools are (in order of appearance of the Program Book):

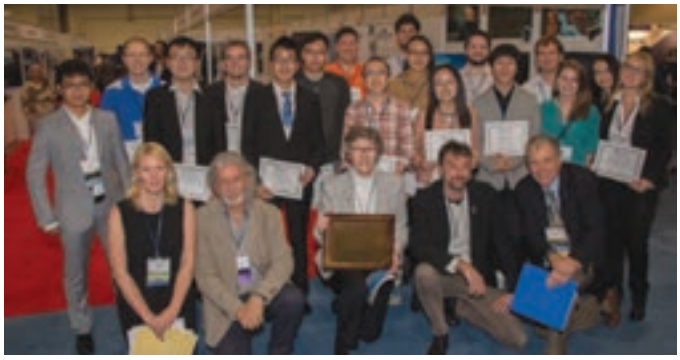
- Jeffrey Ellen, University of California, San Diego
- Jonathan Soli, Duke University
- Antonella Colucci, University of Palermo, Italy
- Yang Zhang, Ocean University of China & University of Miami
- Xiao Liu, Dalhousie University
- Thanh Huy Nguyen, Telecom Bretagne, France
- Jing Hao, Tsinghua University, China
- Vittorio Bichucher, University of Michigan
- Paul Ozog, University of Michigan
- Minjian Cai, Zhejiang University, China
- Jie Lie, University of Michigan
- Eduardo Iscar Ruland, University of Michigan
- Katherine Skinner, University of Michigan

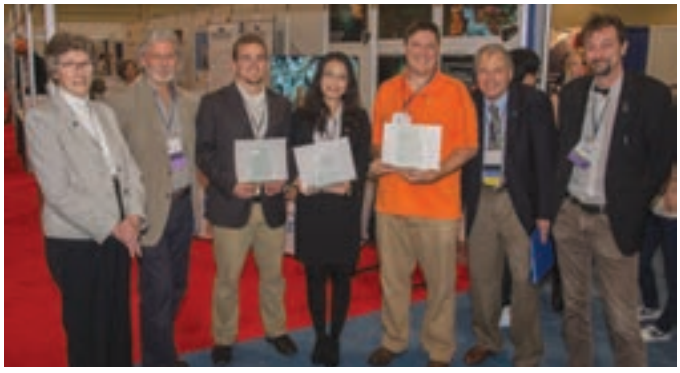
The commemorative ceremony

- Yishu Shi, Beijing Normal University, China
- Luke Rumbaugh, Clarkson University
- Yali Wang, Memorial University of Newfoundland
- Xiaoxu Cao, Zhejiang University
- Qingyun Yan, Memorial University of Newfoundland

The judging was completed by noon on Thursday and the prizes were awarded in the Exhibition Hall. The ceremony began with some few words from Liesl Hotaling, recalling the history of this Student Poster Competition, initiated and championed by Norman Miller, who passed away in July 2015. Next, Ray Toll, MTS President, and René Garello, IEEE OES President, have presented a Student Poster Competition retrospective and a commemorative plaque honoring Norman Miller to Ellen Livingston, University Research Initiatives, Office of Naval Research.

Then, Philippe Courmontagne called all of the students on stage and presented each student with a certificate for their participation in the program. Ellen Livingstone was called up to present the awards. The third prize was awarded to Jie Li, from the United States, the second prize to Luke Rumbaugh, from the United States and the first prize, the "Norman Miller's Prize" to Jeffrey Ellen, for his poster entitled "*Quantifying California Current Plankton Samples with Efficient Machine Learning Techniques*". The audience gave the students a big





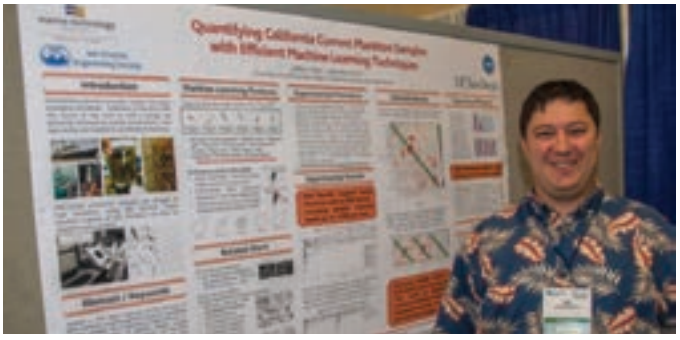
The awards ceremony

hand following the awards presentations. The session ended with a photograph session.

The roster of students and their poster titles are given below with an abstract of their paper.

Jeffrey Ellen, University of California, San Diego

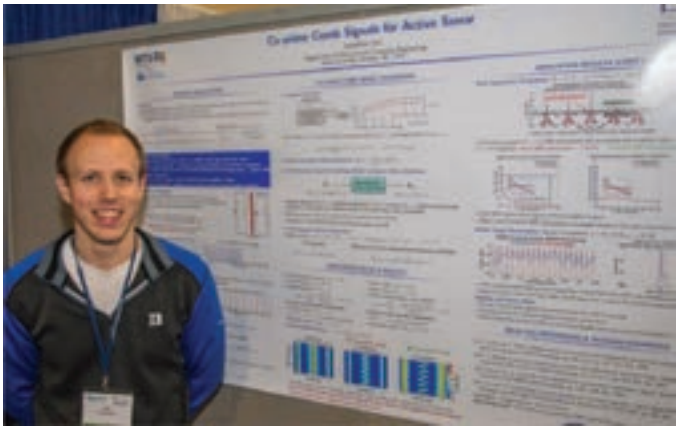
Quantifying California Current Plankton Samples with Efficient Machine Learning Techniques



This paper improves on the accuracy of other published machine learning results for quantifying plankton samples. The contributions of this work are: (1) Clarifying the number of expertly labeled images required for machine learning results. (2) Providing guidance as to what algorithms provide the best performance, and how to tune them. (3) Leveraging an ensemble of models to achieve recall rates beyond any single algorithm. (4) Investigating the applicability of abstaining. (5) Using size fractionation to learn more efficiently. (6) Analysis of efficacy of simple geometric features for plankton identification.

Jonathan Soli, Duke University

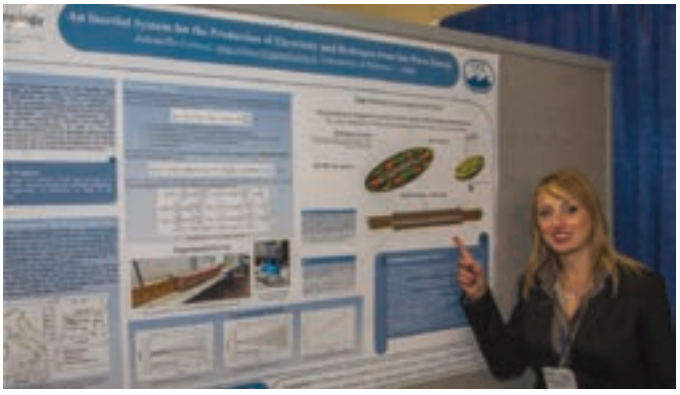
Co-Prime Comb Signals for Active Sonar



This paper presents an active sonar waveform that achieves range-Doppler performance similar to a uniform frequency comb, but uses far fewer tones to do so. The trade-off for this reduction in occupied bandwidth is a larger bandwidth extent. Co-prime comb signals consist of tones at non-uniformly spaced frequencies according to a 2-level nested co-prime array structure. Specialized non-matched filter processing enables recovery of an ambiguity surface similar to that of a uniform comb, but using fewer tonal components. This reduction in occupied bandwidth offers potential benefits such as sharing, interference avoidance, and Signal-to-Noise Ratio (SNR) improvements in both peak- and total-power-limited scenarios.

Antonella Colucci, University of Palermo, Italy

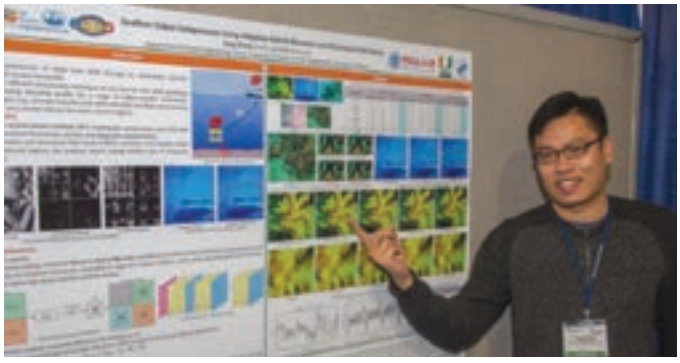
An inertial system for the production of electricity and hydrogen from seawave energy



This paper aims at describing a small scale prototype of a complete wave energy converter system for hydrogen production promoting the opportunity of installation in Sicily, in the Mediterranean Sea. The opportunity to produce hydrogen from sea-water identifies ocean wave energy as the most promising solution for electricity generation including hydrogen production and storage. Even if hydrogen is considered one of the most promising secondary sources, criticism arises from both the academic and the industrial world mainly because hydrogen production requires electricity consumption. Furthermore, safety problems concerning hydrogen storage and transport are actually the main hindrance to full commercialization. In order to overcome production issues, hydrogen production and storage plants which are fully powered by renewable sources are continuously investigated. Advantages of the proposed system mainly rely on producing hydrogen by wave energy providing for on-board storage thus avoiding transport-related issues.

Yang Zhang, Ocean University of China & University of Miami

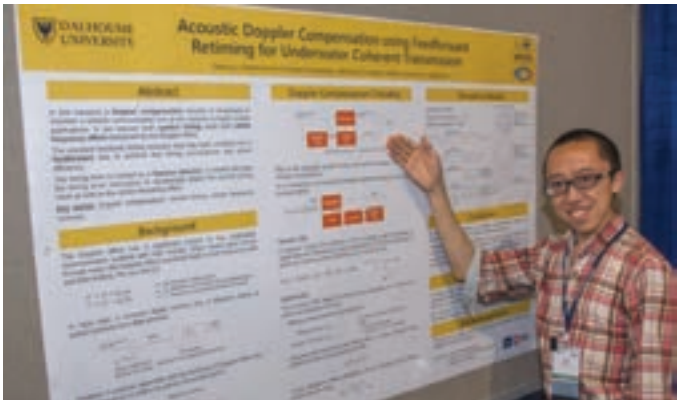
Seafloor video compression using adaptive hybrid wavelets and directional filter banks



In this paper, a new video compression technique based on adaptive hybrid wavelets and directional filter banks is proposed to achieve both high coding efficiency and good reconstruction quality at very low-bit rates. A key application is the real-time transmission of video from an autonomous underwater vehicle to a surface station, e.g., for man-in-the-loop monitoring and inspection operations, through acoustic channels that have limited bandwidth. The proposed method can maintain details in texture regions at relatively low bit rates, while overcoming the ringing artifacts within smooth regions, for intra-frame coding. For inter-frame coding, improved efficiency is achieved by making use of: 1) a new spatio-temporal just-noticeable-distortion model to remove perceptual redundancy; 2) motion interpolation to reduce bit rate; 3) variable-precision in quantizing the residual error; and 4) block inter-leaver to reduce transmission errors. Experiments with underwater video sequences are presented to assess the effectiveness of the proposed approach, in comparison to traditional wavelet-based techniques.

Xiao Liu, Dalhousie University

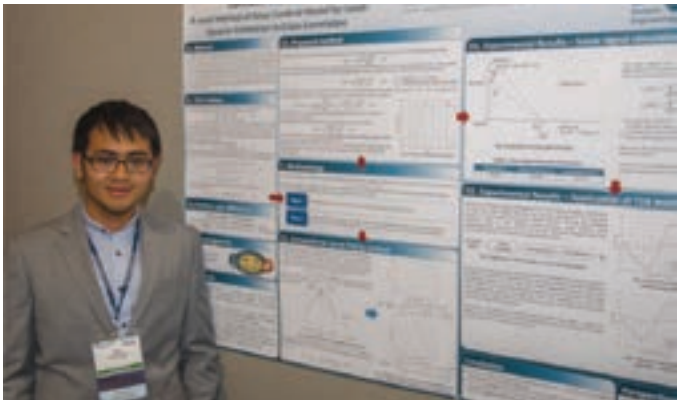
Acoustic Doppler Compensation using Feedforward Retiming for Underwater Coherent Transmission



This paper presents a Doppler compensation architecture to maintain a reliable communication link at the receiver in highly mobile applications. It can recover both symbol timing and carrier frequency offset introduced by the Doppler effect. The standard feedback timing recovery loop has been modified into a feedforward architecture to achieve fast timing convergence and power efficiency. The timing error is tracked by a Gardner detector through all samples before decimation. Further, a control unit uses the timing error information to dynamically adjust the sampling time as well as the carrier frequency offset such that the Doppler shift is fully compensated.

Thanh Huy Nguyen, Telecom Bretagne, France

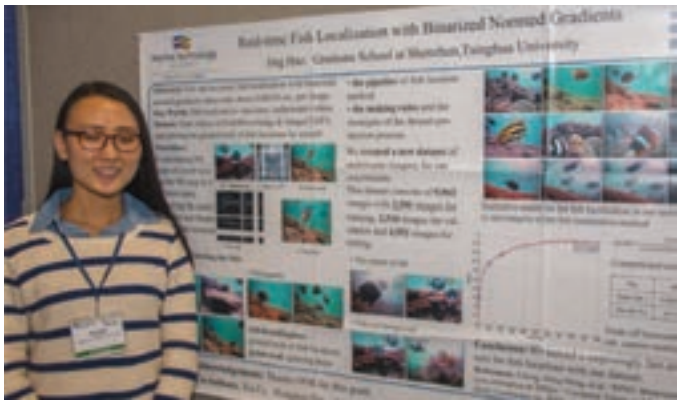
Correlation bias analysis – A novel method of sinus cardinal model for least squares estimation in cross-correlation



On the subject of discrete time delay estimation (TDE), especially in the domain of sonar signal processing, in order to determine the time delays between signals received by two separate sensors, TDE techniques involve in locating the peak of cross-correlation function (CCF) between these signals. In many widely used applications of TDE, bias errors of delay estimate can occur when we try to fit the correlation function with a curve that may have an irrelevant shape, for example a parabola or a cosine. This paper thus addresses an analysis of correlation bias in estimating the time delay between a reference signal and a delayed signal by their CCF. Furthermore, we will also introduce a novel bias reduced approach for discrete TDE based on a sinus cardinal model fitting on the CCF of these two sampled signals. The experimental results have shown that the proposed method can provide relevant detection on simulated signals.

Jing Hao, Tsinghua University, China

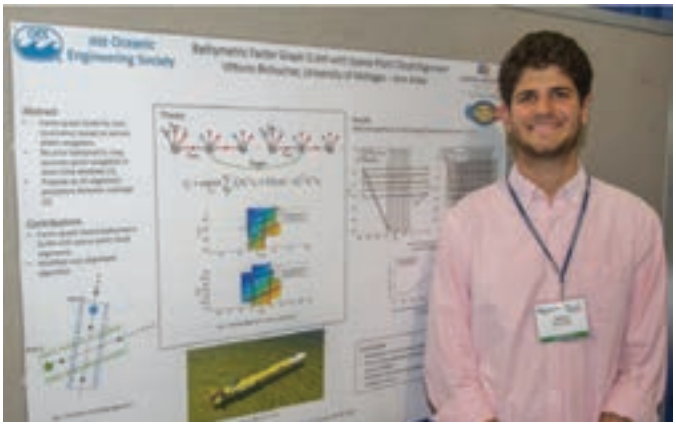
Real-time Fish Localization with Binarized Normed Gradients



Fast and accurate fish localization is an important step for fish detection, identification, counting and tracking. In this paper, we introduce how to localize the fish with an efficient way, which can capture almost all fish locations in an image. First, we exploit the normed gradients (NG) feature of 8×8 image windows to discriminate the fish from the background, and then we binarize the NG feature to accelerate the fish localization. As there is no existing appropriate dataset, we make a dataset of underwater imagery to achieve fish localization. The dataset contains 9,963 images of underwater videos for training, validation and testing. The details about how to label the fish of this dataset further be showed. Last, we evaluate our method on this dataset. Experiments show that our method is fast and efficient, and fish localization takes only about 0.00234 sec. per image (400 fps on an Intel i5-3540 CPU) and achieves 97.1% recall with 1000 proposals. This method satisfies computational efficiency and high detection rate simultaneously.

Vittorio Bichucher, University of Michigan

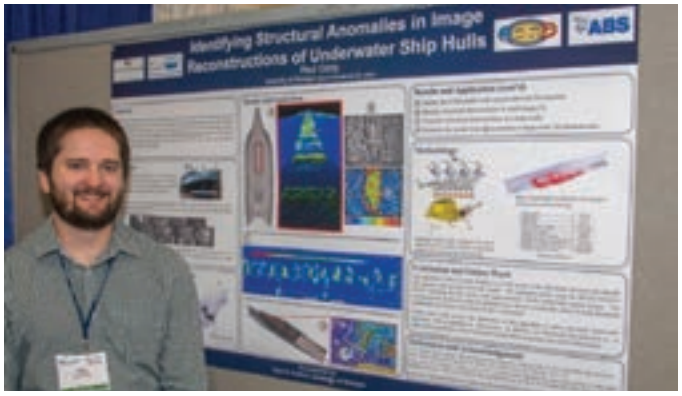
Bathymetric Factor Graph SLAM with Sparse Point Cloud Alignment



This paper reports on a factor graph simultaneous localization and mapping framework for autonomous underwater vehicle localization based on terrain-aided navigation. The method requires no prior bathymetric map and only assumes that the autonomous underwater vehicle has the ability to sparsely sense the local water column depth, such as with a bottom-looking Doppler velocity log. Since dead-reckoned navigation is accurate in short time windows, the vehicle accumulates several water column depth point clouds – or submaps—during the course of its survey. We propose an xy-alignment procedure between these submaps in order to enforce consistent bathymetric structure over time, and therefore attempt to bound long-term navigation drift. We evaluate the submap alignment method in simulation and present performance results from multiple autonomous underwater vehicle field trials.

Paul Ozog, University of Michigan

Identifying Structural Anomalies in Image Reconstructions of Underwater Ship Hulls

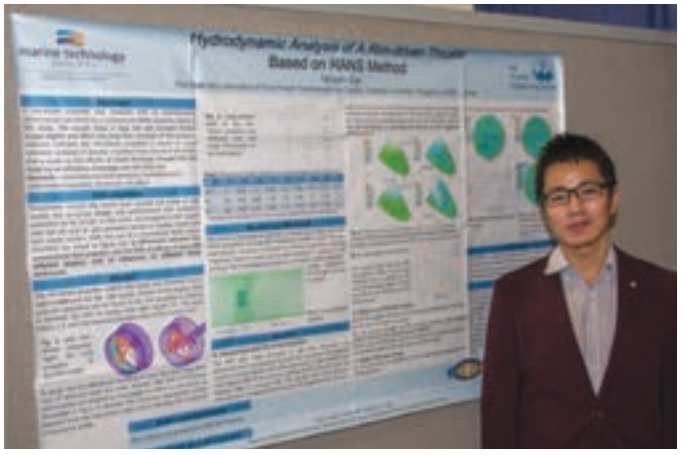


This paper reports on an algorithm enabling an autonomous underwater vehicle (AUV) to localize into a 3D computer aided design (CAD) model of a ship hull in situ using an optical camera and Doppler velocity log (DVL). The precision of our localization algorithm allows the identification of structural deviations between 3D structure inferred from bundle-adjusted camera imagery and the CAD model. These structural deviations are clustered into shapes, which allow us to fuse camera-derived structure into a CAD-derived 3D mesh. This augmented CAD model can be used within a 3D photomosaicing pipeline, providing a visually intuitive 3D reconstruction of the ship hull. We evaluate our algorithm on the Bluefin Robotics Hovering Autonomous Underwater Vehicle (HAUV) surveying the SS Curtiss, and provide a 3D reconstruction that fuses the CAD mesh with 3D information corresponding to underwater structure, such as biofouling.

Minjian Cai, Zhejiang University, China

Hydrodynamic Analysis of A Rim-driven Thruster Based on RANS Method

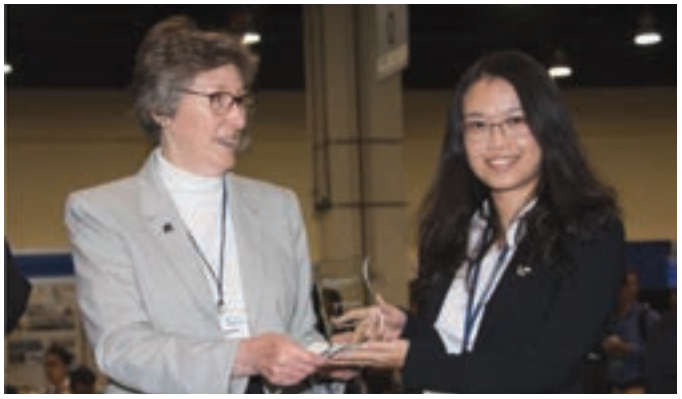
Rim-driven thruster is gaining wide attention in applications such as underwater vehicles and low-speed vessels. Literature on the influence of rotating rim and the rim-fixed blades on performance is scanty. In this paper, a rim-driven propeller was modeled with its hydrodynamic performance numerically simulated by a commercial Reynolds-averaged Navier-Stokes equation solver. The influence of rim on the wake field and friction loss was studied by simulations using rims of different lengths. The results show a long rim will increase friction



torque slightly and will induce a circumferential velocity to the local flow, which means at blade tip region the relative tangential velocity of inflow to the blade section reduces and the pitch angle increases. Analysis of the pressure contours indicates the rim-driven propeller is easier to cause cavitation problem if directly modified from Ka-series. In addition, a following blade thickness study shows the thin blade has an efficiency advantage over the thick one.

Jie Lie, University of Michigan

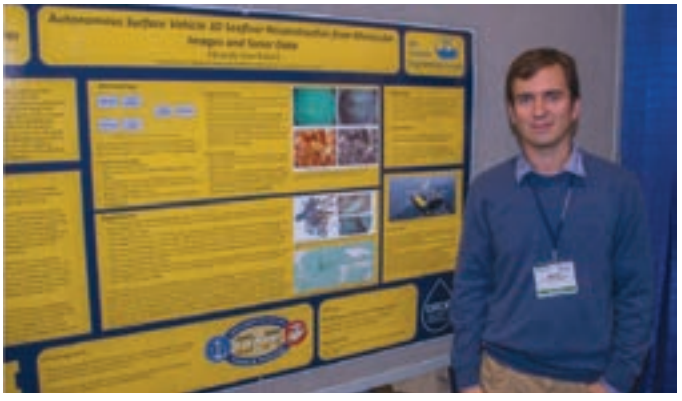
Underwater Robot Localization in the Presence of Dramatic Appearance Changes



This paper reports on an algorithm for underwater visual place recognition in the presence of dramatic appearance change. Long-term visual place recognition is challenging underwater due to biofouling, corrosion, and other effects that lead to dramatic visual appearance change, which often causes traditional point-based feature methods to perform poorly. Building upon the authors' earlier work, this paper presents an algorithm for underwater vehicle place recognition and relocalization that enables an autonomous underwater vehicle (AUV) to relocalize itself to a previously-built simultaneous localization and mapping (SLAM) graph. High-level structural features are learned using a supervised learning framework that retains features that have a high potential to persist in the underwater environment. Combined with a particle filtering framework, these features are used to provide a probabilistic representation of localization confidence. The algorithm is evaluated on real data, from multiple years, collected by a Hovering Autonomous Underwater Vehicle (HAUV) for ship hull inspection.

Eduardo Iscar Ruland, University of Michigan

Autonomous Surface Vehicle 3D Seafloor Reconstruction from Monocular Images and Sonar Data

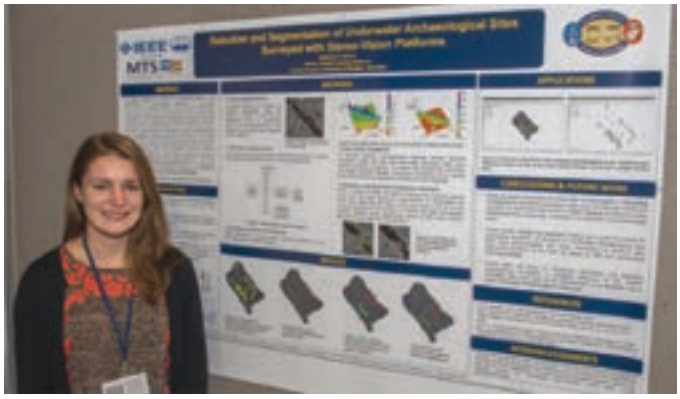


Traditionally seafloor surveys have been conducted with research vessels, divers or with an autonomous underwater vehicle (AUV) and are time consuming, expensive and high risk. In this paper we present an approach to merge sonar and monocular images to perform large scale mapping of shallow areas from an autonomous surface vessel (ASV), reducing the mission time, cost and risk. Our method uses multibeam sonar data to generate a mesh of the seafloor. Optical images are then blended and projected onto the mesh after a color correction process which increases contrast and overall image quality. In applicable scenarios, ASVs offer an alternative approach to AUVs for autonomous acoustic and optical site mapping. ASVs are typically less expensive than AUVs and often offer easier deployment and recovery logistics. Also, the mechanical requirements are less demanding because they do not have to withstand increased atmospheric water pressure at depth.

Katherine Skinner, University of Michigan

Detection and Segmentation of Underwater Archaeological Sites Surveyed with Stereo-Vision Platforms

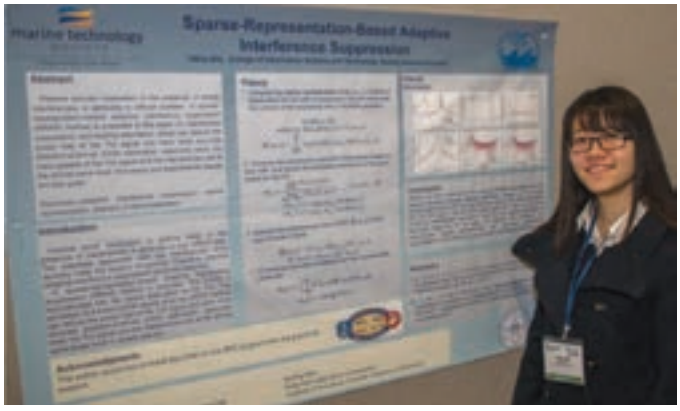
This paper proposes a method for automating detection and segmentation of archaeological structures in underwater environments. Underwater archaeologists have recently taken advantage of robotic or diver-operated stereo-vision platforms to survey and map submerged archaeological sites. From the



acquired stereo images, 3D reconstruction can be performed to produce high-resolution photo-mosaic maps that are metrically accurate and contain information about depth. Archaeologists can then use these maps to manually outline or sketch features of interest, such as building plans of a submerged city. These features often contain large rocks that serve as the foundation to buildings and are arranged in patterns and geometric shapes that are characteristic of human-made structures. Our proposed method first detects these large rocks based on texture and depth information. Next, we exploit the characteristic geometry of human-made structures to identify foundation rocks arranged along lines to form walls. Then we propose to optimize the outlines of these walls by using the gradient of depth to seek the local minimum of the height from the seafloor to identify the ground plane at the base of the rocks. Finally, we output contours as geo-referenced layers for geographic information system (GIS) and architectural planning software. Experiments are based on a 2010 stereo reconstruction survey of Pavlopetri, a submerged city off the coast of Greece. The results provide a proof-of-concept for automating extraction of archaeological structure in underwater environments to produce geo-referenced contours for further analysis by underwater archaeologists.

Yishu Shi, Beijing Normal University, China

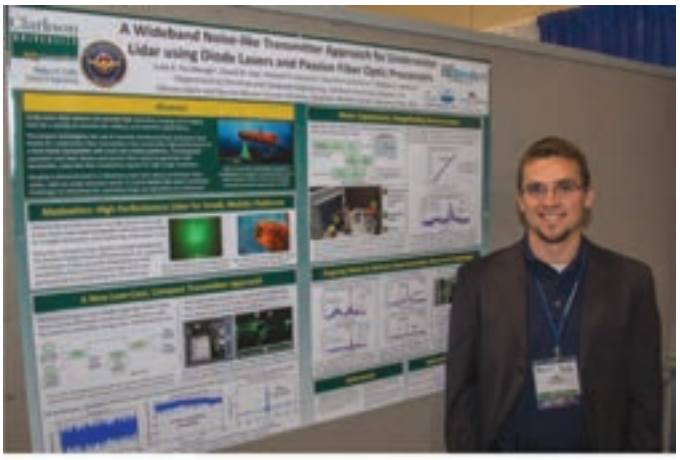
Sparse-Representation-Based Adaptive Interference Suppression



Passive sources localization in the presence of strong interferences is generally a difficult problem. A sparse-representation-based adaptive interference suppression (SRAIS) method is proposed in this paper for interference suppression and bearing estimation, which can reduce the power loss of the TOI signal and have more accurate direction-of-arrival (DOA) estimation, especially when the input powers of the TOI signal and the interferences are at the almost same level. Simulation and experimental results are also given.

Luke Rumbaugh, Clarkson University

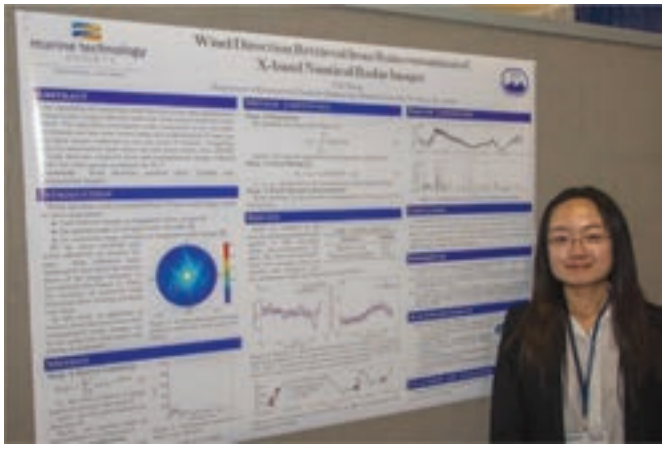
A Wideband Noise-like Transmitter Approach for Underwater Lidar using Diode Lasers and Passive Fiber Optic Processor



A new wideband noise-like transmitter approach is presented for high resolution underwater lidar sensing. The transmitter approach is based on small-footprint, low-cost components, using low coherence time laser diodes and passive fiber processors to generate wideband noise-like intensity modulation signals in the blue-green optical spectrum. Prototype transmitters are demonstrated using both blue and green laser diodes with passive fiber interferometer structures. Laboratory water tank experiments using a two-diode 516/518 nm prototype transmitter show centimeter range error and 30 cm range resolution while detecting a submerged gray target in up to ten attenuation lengths of turbid water. Experimentally observed challenges for target rangefinding are discussed, including shot noise, backscatter returns, and self-clutter. Strategies are proposed to mitigate these challenges and enhance performance when operating at long standoff distances in turbid waters.

Yali Wang, Memorial University of Newfoundland

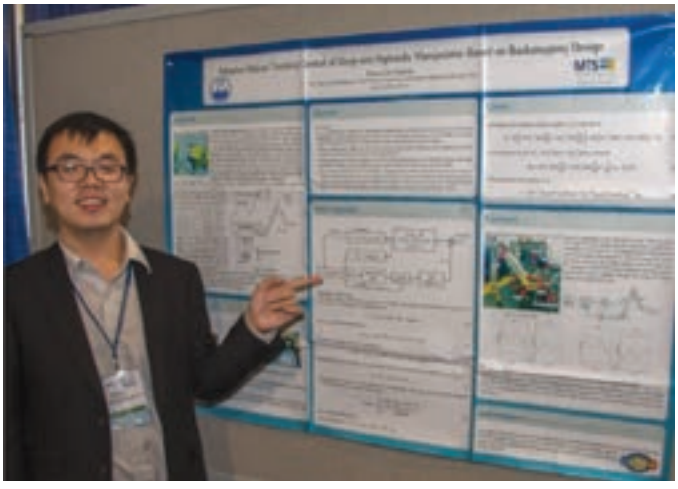
Wind direction retrieval from rain-contaminated X-band nautical radar images



In this paper, an algorithm for retrieving wind direction from rain-contaminated radar images collected under low wind speed conditions is presented. The algorithm investigates radar backscatter in the wavenumber domain and determines wind directions based on spectral components with wavenumbers of [0.01, 0.2]. The algorithm has been tested using rain-contaminated X-band marine radar images and shipborne anemometer data collected on the east coast of Canada. Comparison with the anemometer data shows the root mean square error of wind direction retrieved from rain-contaminated images collected under low wind speeds is reduced by 25.2.

Xiaoxu Cao, Zhejiang University

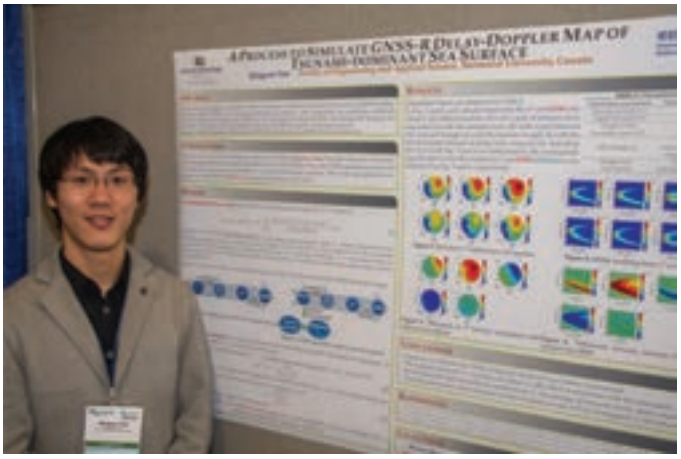
The adaptive robust tracking control of deep-sea hydraulic manipulator based on backstepping design



In this paper, design and experiments of the 4500m deep-sea manipulator are introduced. With the extreme working condition, the deep-sea manipulator is more complex and the study is more challenging. The design highlight is stressed, including the double screw pairs elbow joint which could transmit large torque with a compact size, principle of pressure compensator which could balance the water pressure and so on. To achieve high tracking performance, the adaptive robust tracking control based on backstepping algorithm is proposed. The unknown parameters are estimated to enhance the tracking precision. Simulations and experiments based on this algorithm has been performed to verify the controller, the results show that the joint tracking control is fast and smooth, the overshot is small.

Qingyun Yan, Memorial University of Newfoundland

A Process to Simulate GNSS-R Delay-Doppler Map of Tsunami-dominant Sea Surface



In this paper, a process is presented to simulate Global Navigation Satellite System-Reflectometry (GNSSR) delay-Doppler maps (DDMs) of a tsunami-dominant sea surface. In this method, the bistatic scattering Z-V model, the sea surface mean square slope model of Cox and Munk and the tsunami-induced wind perturbation model are employed. By taking advantage of the first two models, the DDMs of tsunami-free region can be simulated. In order to accomplish the DDM simulation of tsunami-dominant surface, the tsunami induced wind perturbation model is utilized on top of that. The simulations of the scattering coefficient distribution and the corresponding DDMs of a fixed region of interest before and during the tsunami are exhibited. On the final stage of analysis, by subtracting the simulation results that are free of tsunami from simulations with presence of tsunami, the tsunami-induced variations can be clearly observed. The process is implemented based on the 2004 Sumatra-Andaman tsunami.

Winning Poster Paper

Quantifying California Current Plankton Samples with Efficient Machine Learning Techniques

Jeffrey Ellen, Hongyu Li
Department of Computer Science and Engineering
University of California, San Diego
La Jolla, CA 92093-0404
Email: jellen@ucsd.edu, holi@ucsd.edu

Mark D. Ohman
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-0218
Email: mohman@ucsd.edu

***Abstract*— This paper improves on the accuracy of other published machine learning results for quantifying plankton samples. The contributions of this work are: (1) Clarifying the number of expertly labeled images required for machine learning results. (2) Providing guidance as to what algorithms provide the best performance, and how to tune them. (3) Leveraging an ensemble of models to achieve recall rates beyond any single algorithm. (4) Investigating the applicability of abstaining. (5) Using size fractionation to learn more efficiently. (6) Analysis of efficacy of simple geometric features for plankton identification.**

Keywords—machine learning; image analysis; zooplankton; Zooscan

I. Introduction

Quantifying plankton is important, requires a high level of taxonomic skill, and is expensive. Automation of plankton sample enumeration can enable higher throughput, more efficient processing, and improved scientific understanding., Specific applications of interest include understanding plankton spatial distributions, parameterizing oceanographic models, and investigations of population ecology. In this paper, we address methods to improve automatic classification of images from preserved plankton samples.

II. Machine Learning Experimentation

A. Data Set Description

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) is a field program that has been sampling the ocean, including plankton, since 1949 [1]. The CalCOFI plankton samples are collected at sea according to a standardized bongo net protocol [2] and immediately preserved. Substantial portions of the preserved CalCOFI samples recently collected in conjunction with the California Current Ecosystem Long Term Ecological Research site have been scanned with ZooScan [3]. The resulting grayscale images are very accurately controlled in terms of contrast, noise, and other variations (Fig. 1).

Contribution from the National Science Foundation–supported California Current Ecosystem Long Term Ecological Research site. Plankton sample analysis supported by NSF grants to M.D. Ohman, and by the SIO Pelagic Invertebrates Collection.

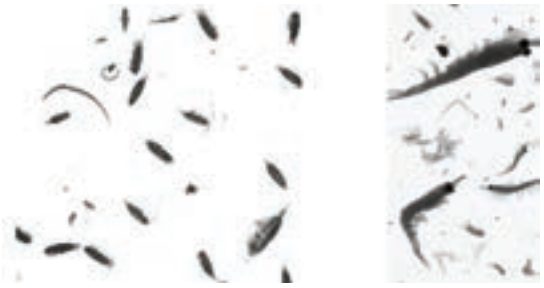


Fig. 1. Parts of two different scanned images of plankton samples, illustrating variety of ROI shapes and sizes, as well as the relative ease of ROI segmentation.

Because of the controlled conditions, the Regions of Interest (ROIs) are readily segmented from the larger image, which contains 1,000-2,000 ROIs. Figure 2 (upper row) shows two examples of animals scanned by the ZooScan, with photographs of similar animals for comparison (lower row).

Fig. 2. Left: *Nyctiphanes simplex*, a euphausiid common off the California coast. Right: a chaetognath. Both are relatively large for CalCOFI plankton: the scale bar in all 4 images is 1mm. Both have substructures and opacity differences that are preserved in ZooScan images. Photos from SIO Pelagic Invertebrates Collection [4].

Not all of the classes are so easily recognized. Figure 3 shows three more categories of varying size, shape, and

contrast. Some plankters are inherently more fragile, with gelatinous parts or thin appendages that are frequently damaged by net collection. Transparency is more variable in preserved samples than in live ones. Less rigid animals also have a less consistent posture and orientation. Some classes have a wide variety of sizes, and the smallest plankters have a lack of detail due to the limits of the scanning resolution. These identifications can be challenging for a human.

These challenges are not unique to plankton imaging, but are different from mainstream image processing/classification tasks, such as the ImageNet competition.

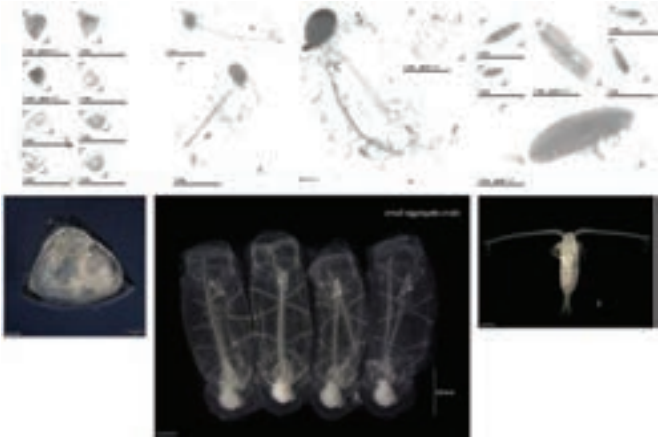


Fig. 3. Left: bryozoan larvae, of relatively uniform size and shape. Middle: a small chain of the salp *Pegea socia*, a gelatenous pelagic tunicate whose ZooScan samples exhibit some variation of scale and irregular shapes. Right: copepods, which have an even larger size range and variation within the image, despite being relatively rigid compared to the gelatinous tunicates. All ZooScan images have a scale bar of 1mm, the bryozoan larvae photo has a scale bar of 0.2mm, and the tunicate photo has a scale bar of 5mm. Photos from SIO Pelagic Invertebrates Collection [4].

The data used in this paper consists of 725,516 individual ROIs taken from samples collected during 46 different ocean transects from July 2005 to July 2012. The transects are line 80 and line 90 in the CalCOFI grid (Fig. 4), and samples are taken quarterly. Most ROIs contain a single entity, and are labeled with one of 24 categories of organisms such as 'siphonophore' or 'calanoid copepod'. There are also categories for 'detritus', 'multiples', and 'others'. The splits are functional rather than biological or genetic. A complete list is provided in Appendix A.

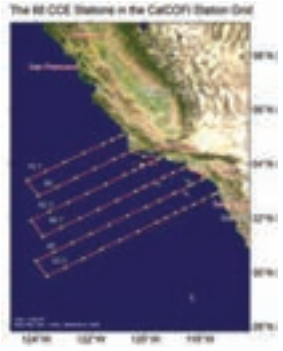


Fig. 4. The CalCOFI grid has been sampled for 67 years. Samples from line 80 and line 90, from July 2005 to July 2012 were used in this data set.

The data described in this paper will shortly be made available through the CalCOFI DataZoo website (http://oceaninformatics.ucsd.edu/datazoo/)

B. Machine Learning Features

The ZooScan software can generate low level geometric features and grayscale features for the purposes of biological object identification [5]. ZooScan has been used to count the abundance of both zooplankton [3] as well as fish eggs [6].

We used a subset of 51 of these features in the experiments described in this paper. Each feature is computed on the pixels within the ROI only, not the bounding rectangle. Features used include 19 size/shape measurements, such as area, circularity, major/minor axis length, feret diameter, and some ratios of these values. Also included are 17 grayscale distribution measurements, such as the min, max, mean, standard deviation, quartiles, skew, and cumulative histogram slope. The remaining features are positional, such as the centroid location, or more derived, such as the fractal dimension or the symmetry. Complete descriptions of the referenced features are on the ZooScan website at http://www.zooscan.obs-vlfr.fr/, and the complete list of features and some illustrations are provided in Appendix B.

C. Experimental Procedure

We conducted a series of machine learning experiments. We carried out two different 8-way classification experiments in order to compare our efforts with contemporary results. We also conducted two different 16-way classification experiments in order to examine the tradeoff between complexity and performance.

For each of the 8-way experiments, we varied the data set size from 500 to 76,800 ROIs. For the 16-way experiments, we used data set sizes from 6,000 to 725,516 ROIs. We formed balanced data sets (equal types of each image class) to facilitate experimental design in addition to interpretation of results. For example, when evaluating the impact of adding classes, or which class is the most difficult, it is important that those be held constant. Also, balanced classes allow for more simple summary statistics, such as recall, to be used to measure performance.

We built our classifiers using Python's Scikit-learn [7]. We evaluated 2 types of support vector machines (SVM), 3 types of random forests (RF) including an extra trees ensemble (XTR) and a gradient boosted random forest classifier (GBC), stochastic gradient descent with two different types of loss functions (SGD), 2 types of k-nearest-neighbor algorithms (standard (kNN) and nearest neighbor Ball Tree (nnBT)), and neural nets (implemented as a multi-layer perceptrons with a single hidden layer - MLP). For each algorithm mentioned, we experimented extensively with hyperparameters, including hundreds of combinations for SVMs to thousands of combinations for RFs as described in Section III.B and

Appendix C. We consistently used an 80/20 split for training data vs testing data, with the exact same ROIs made available to each algorithm for training.

III. Experimental Results

Our experiments were designed to provide insight into six important facets of this machine learning problem: how many data to use, which algorithm, whether ensembling helps, whether abstaining helps, whether size fractioning the data helps, and the effectiveness/efficiency of using geometric features. The results presented are a representative sample, not an average. Each experiment was repeated multiple times.

A. Determining Data Set Size Requirements

Since machine learning algorithms can be computationally expensive, and obtaining training data can be expensive, we want to quantify the 'rate of return' on hand-labeled training data. To investigate, we trained suites of classifiers with different numbers of examples per class. Each point in Fig 5 represents an independently trained 8-way classifier. 500 examples per class seemingly provides asymptotic performance. However, we continued to conduct experiments and found continued improvement as training set size increased to ~4,000 (Fig. 6).

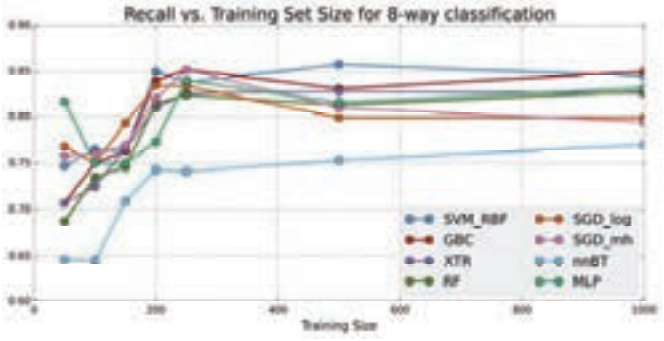


Fig. 5. Performance grouped by algorithm, shown with respect to training set size. Small data set sizes are noisy. The increase in performance apparently levels off after 500 examples per class. SVM_RBF is an SVM with a radial basis function for a kernel. SGD_log is stochastic gradient descent with log loss (logistic regression), and SGD_mh is SGD with 'modified huber' as a loss function. GBC,XTR,RF,nnBT, and MLP correspond with the descriptions in Section II.B.

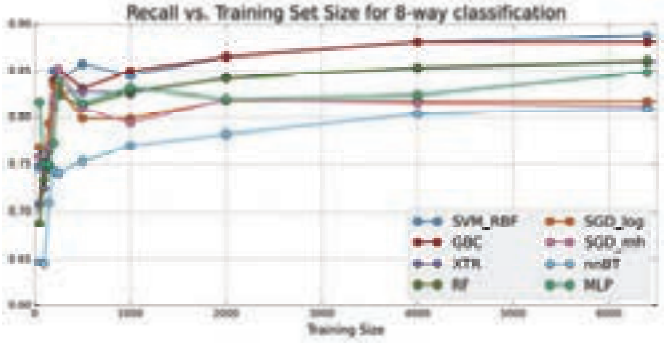


Fig. 6. Performance grouped by algorithm including larger training set sizes. Performance levels off after 4,000 examples per category for most algorithms.

For the numeric results summarized in Table I, the following holds regardless of algorithm: initially, doubling the training set size provides a 3-5% increase in performance; this rate decreases to a 1-2% improvement at larger training set sizes. The number of available expert-annotated ROIs in the 8 classes limited us to 7,680 training examples.

TABLE I. Recall Results for 8-way classification Task

Training Size	SVM RBF	GBC	RF	SGD	nnBT	MLP
50	0.747	0.707	0.687	0.768	0.646	0.817
100	0.765	0.750	0.735	0.750	0.645	0.750
150	0.763	0.763	0.746	0.793	0.709	0.750
200	0.850	0.840	0.815	0.835	0.743	0.773
250	0.838	0.852	0.824	0.834	0.741	0.840
500	0.858	0.831	0.813	0.799	0.753	0.816
1000	0.845	0.850	0.828	0.799	0.770	0.832
2000	0.865	0.865	0.842	0.819	0.782	0.820
4000	0.880	0.880	0.854	0.818	0.804	0.824
6400	0.887	0.880	0.861	0.818	0.809	0.849
7680	0.888	0.883	0.864	0.818	0.811	

Figure 7 illustrates performance with respect to individual classes for the 8-way classification problem. Only four algorithms are shown: the results were consistent across all classifiers. In small sample sizes, the data are noisy, but as the training set size grows sufficiently large, calanoid copepods were consistently the most difficult category to classify, and eggs were the easiest. Not surprisingly, the more difficult classes also had the largest performance gain from additional training examples.

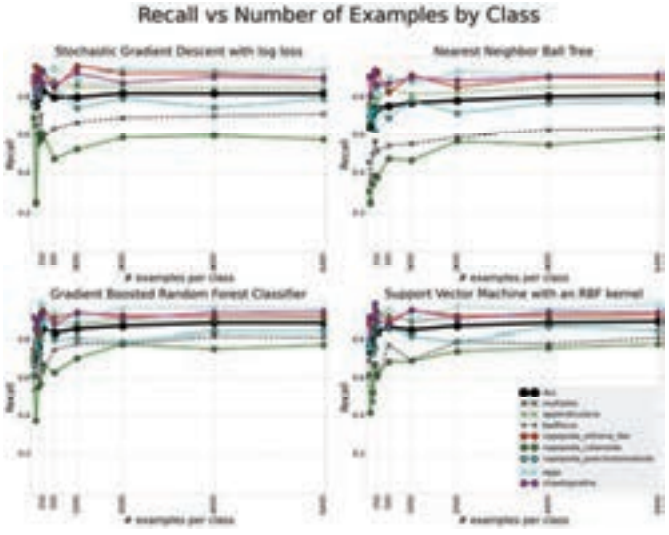


Fig. 7. Difficult classes tended to remain difficult, regardless of algorithm or data set size.

We consistently found SVM with an RBF kernel (SVM-RBF) and GBC to provide ~1-2% better accuracy than other methods.

Our overall results compare favorably with previous results. Our 8-way classification algorithm consisting of an ensemble of the GBC and SVM has an overall recall rate of 88.6%, which is 10 percentage points better than the best recall rate of 78% presented in Gorsky et al. [3]. In addition, the two best performing classes in Gorsky et al. are 'Bad Focus' and 'Fibers,' two inorganic classes.

Our results are also efficient for specific individual classes. For appendicularians we have a recall rate of 96.5% and a precision of 92.9%, as illustrated in Fig. 9, which is approximately 20-30 percentage points better than the performance in Forest et al. [8]. Our task is more difficult because we are attempting 8-way classification, where Forest et al. attempted 4-way classification. Their data set was much smaller, consisting of only 2,100 ROIs. For our training set of that size, 200 each for training and 50 for testing on each of 8 classes (2,000 total vignettes) we have an overall recall of 85%. For appendicularians specifically from that smaller data set we achieve a recall of 91.5% and a precision of 88.5%.

We achieve similar results to the phytoplankton classification task in [9]; Sosik and Olson had some simple classes for which 100% accuracy was achieved, and some ''difficult classes, such as detritus'' where only 68% accuracy was achieved. These percentages are on the order of our results. For example we also found detritus to be the most difficult category in our 16-way classifier, as shown in Figure 8. Sosik and Olson also found SVM with an RBF kernel to achieve the best results.

While minimal increases are obtained with larger sets, significant gains in recall are observed up through 4,000 examples. This value is a significantly different finding from Gorsky et al., who found that their performance plateaued at ~300 examples per class [3].

A more complicated, but closer to real world example is shown in Fig 8, which illustrates a confusion matrix for our best result for the 16-way classification problem. This classifier trained on 3,600 examples per class, which was the highest number available for all 16 classes, and achieved an overall recall rate of 0.813. When we trained a classifier on only 300 examples per class, as in [3], our best effort resulted in an SVM with an overall recall of 0.741, with similar types of errors as the confusion matrix shown.

Ultimately, relative results are more important than absolute results, particularly because our ROIs are not a benchmark data set. For example, our categories of interest are often arbitrarily defined by the taxonomic resolution desired by a given lab. Note that in Fig 8, 862 of the errors are misclassifications of one type of copepod for another. Grouping all types of copepod into a single 'copepod' category

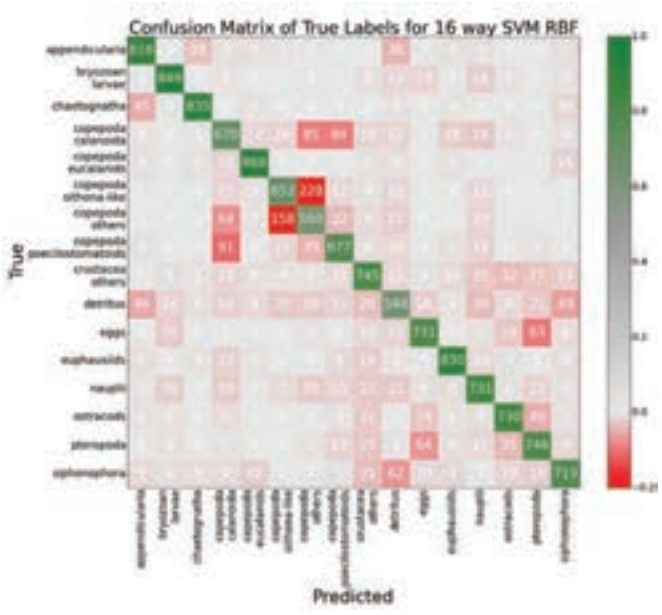


Fig. 8. Confusion matrix for our best results for the 16-way classification task. Depicted are the results for an SVM trained on 3,600 samples per class, and tested on 900 samples per class.

would then raise performance by 0.075 to 0.888 on the 16-way task. Similarly, 'multiples' and 'bad focus' are two distinct classes in our data, but since they both refer to malformed ROIs, errors confusing these classes for each other should be considered less severe than all other errors.

Our relative results are competitive with other work. Our California Current sample data were previously processed with a RF classifier developed according to the results of [1]. The algorithm's recall is poor on all rare classes (often single digit accuracy), and in the teens for some common classes. Recall only exceeded 0.60 for a single class, detritus at 0.886. For a fair comparison of the SVM algorithm used in the present paper with a RF algorithm developed according to [1], classes were removed to create one 8-way classification task. Accordingly, the previously used RF implementation performed with 0.618 recall, compared to our recall of 0.887 in the present paper. For a 16-way classification task, the previous RF implementation had a performance of 0.580, compared to 0.813 for our implementation using 3,600 training items for each of the 16 classes. This 0.23-0.27 gain gives an idea of the improved performance, but slightly overestimates it because the real-world problem is harder than the treatment presented in this paper.

The 8 most prominent classes cover 85% and the 16 most prominent classes cover 92.9% of the data. So while the models presented in this paper were not trained with balanced data and not for our full 24-way classification problem, they

are useful as is, and could not perform worse than getting every single image from the rare classes incorrect. In the case of the 8-way classifier, this would yield an effective recall rate of 0.762 (an improvement of 0.221) and the 16-way classifier would yield an effective rate of 0.756 (an improvement of 0.215). Since the effective rate of the 8-way algorithm was better, it ultimately may be more effective to use a classifier with fewer classes and higher performance, which results in the need to completely sort difficult classes by hand.

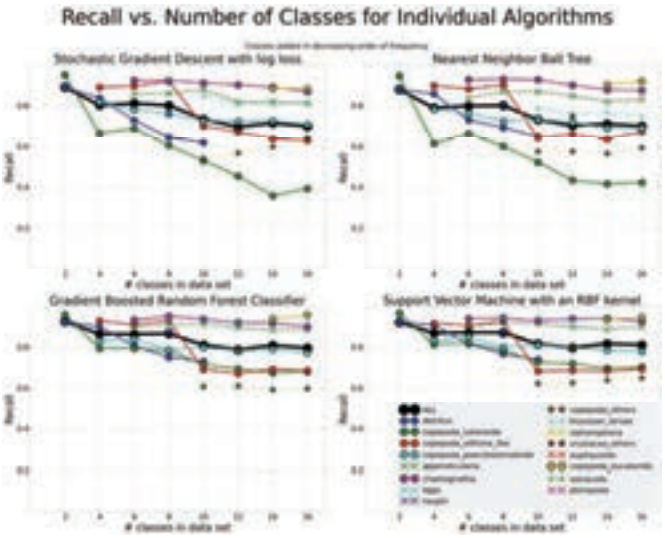


Fig. 9. An illustration of how increasing the number of classes affects recall rates. Four different algorithms are shown, and each algorithm has results for 8 different classification tasks presented. (2-way, 4-way, 6-way, 8-way, 10-way, 12-way, 14-way, and 16-way.)

Figure 9 shows how overall recall decreases when more classes are added. We trained a series of models where each algorithm had 3,600 training items, and additional classes were added to the training set in reverse order of overall abundance. Unsurprisingly, with each pair of additional classes performance decreased, although apparently more related to the difficulty of the added class than the overall number of classes. Note that improved performance on a more complex problem may be obtained by increasing the amount of training data.

B. Hyperparameter Tuning

The three algorithms with the best performance were the multi-layer perceptron (MLP), gradient boosted random forest (GBC), and support vector machine (SVM). In general, for the MLP, we found learning rate to be the most important single parameter as suggested by Bengio [11], and found that a large number of nodes in the hidden layer was not required. For the GBC, we ended up with shallow trees, a large number of samples per leaf, and moderate regularization. For the SVM, we found the regularization parameter needed to be increased on larger data sets, while the free parameter (gamma) was relatively constant.

For all experiments, cross validation consisted of a minimum of 5 folds during the hyperparameter search, but the final model was refit with the entire dataset. More information about hyperparameter tuning is provided in Appendix C.

C. Using an Ensemble to improve accuracy

Combining the results of two best performing classifiers consistently resulted in up to a 0.6% gain in recall, at no additional expense. Example results for one of our 8-way classification problems are shown in Table II. Our ensemble was done by averaging; each algorithm with the ability to returned a probability, rather than a classification. The estimated probabilities from all algorithms were then averaged pairwise, and evaluated as though they were the results of a single classifier.

Not surprisingly, the combination of the two best single-performing algorithms resulted in the strongest performance. Larger combinations of three or more algorithms sometimes achieved better results, but not as consistently as combining the SVM and the GBC. Overall, averaging provided improved results than either individual algorithms 33% of the time. Also, while not a strictly an improvement, note that SVMs helped every single other classifier exceed the recall that the other algorithm achieved independently.

TABLE II. RESULTS FOR AVERAGING 8-WAY PREDICTIONS (4000 TRAINING ELEMENTS/CLASS)

Algorithm(s) – Trained on 4,000 each	Recall	Avg. Yields Improvement
GBC and SVM_RBF	0.8866	Y
SVM_RBF and XTR	0.8855	Y
RF and SVM_RBF	0.8835	Y
SVM_RBF	0.8805	N/A
GBC	0.8799	N/A
GBC and RF	0.8783	N
GBC and XTR	0.8780	N
SGD_log and SVM_RBF	0.8758	N
GBC and SGD_mh	0.8755	N
GBC and SGD_log	0.8751	N
GBC and nnBT	0.8744	N
nnBT and SVM_RBF	0.8733	N
SGD_mh and SVM_RBF	0.8733	N
RF and XTR	0.8546	Y
RF	0.8536	N/A
XTR	0.8528	N/A
SGD_mh and XTR	0.8450	N
RF and SGD_mh	0.8441	N
RF and SGD_log	0.8439	N
SGD_log and XTR	0.8429	N
nnBT and RF	0.8401	N
nnBT and XTR	0.8375	N
nnBT and SGD_log	0.8278	Y
nnBT and SGD_mh	0.8276	Y
SGD_log and SGD_mh	0.8185	Y
SGD_log	0.8184	N/A
SGD_mh	0.8155	N/A
nnBT	0.8036	N/A

In addition, the improvement is primarily in the most difficult class, Chaetognatha, and improvement is consistent across numerous examples. The full impact of the best ensemble is shown in Fig 10.

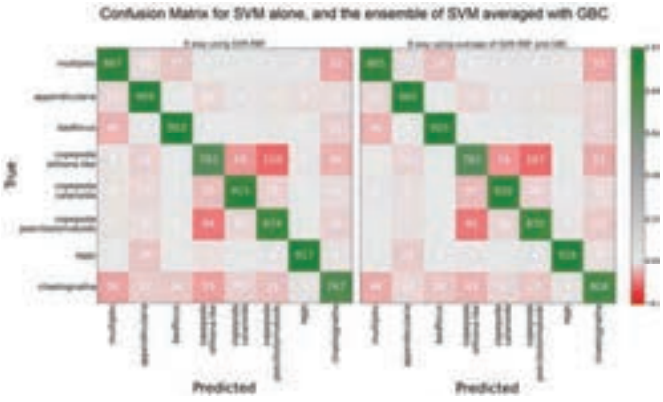


Fig. 10. The two confusion matricies shown illustrate the modest gains to be had by averaging the two best performing algorithms. The improvement is slight, 49 net additional correct classifications out of 8000, for an improvement of 0.61%

D. Improving Abundance Estimation Through Abstentions

By changing our classifier to output probabilities rather than labels we can allow abstentions. We allow for abstentions for ROIs with low confidence by ignoring guesses below a particular probability threshold. This technique eliminates false positives at the expense of some images remaining unlabeled. Therefore, this approach may be useful in circumstances where there is a high penalty for a false positive, but little penalty for a false negative. Table III provides an example.

TABLE III. ALLOWING ABSTENTIONS IN THE 8-WAY CLASSIFICATION MODEL (AVERAGE OF SVM AND GBC - 4000 TRAINING ELEMENTS/CLASS)

Confidence Threshold	% Labeled	Recall	% Labeled Correctly
0.3	0.9995	**0.8868**	0.8864
0.4	0.9941	**0.8904**	0.8851
0.5	0.9746	**0.8987**	0.8759
0.6	0.9279	**0.9196**	0.8533
0.7	0.8674	**0.9412**	0.8164
0.8	0.7943	**0.9600**	0.7625
0.9	0.6755	**0.9782**	0.6607
0.95	0.5445	**0.9867**	0.5372
0.99	0.2375	**0.9953**	0.2364

For example, setting the confidence threshold at 0.95 results in 0.9867 recall. This threshold results in the correct labeling of 4,299 of the original 8,000 ROIs and only 57 incorrectly labeled ROIs, as shown in Fig 11.

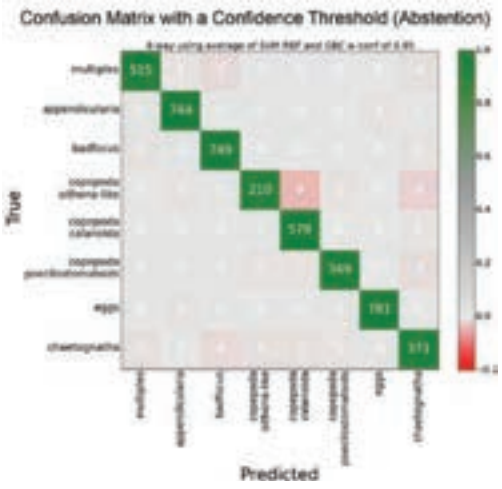


Fig. 11. Confusion matrix when the classifier is allowed to abstain from labeling images andonly classifying when probability exceeds 0.95. This approach greatly reduces the number of false positives compared to other classifiers.

If only some labeled images are required, and not a complete census, this technique may be useful for quickly labeling some images without incurring the expense of extensive manual resorting. We did not investigate whether the ratio of true positives to false negatives was more stable when allowing abstentions, but if so, an estimate of total abundance could be achieved through simply scaling these results.

E. Efficiency Through Size Fractionation

More examples in a training set improve recall but algorithm training times grow non-linearly with respect to the number of examples SVMs, for example, usually have a runtime of $O(n^2)$. According to Bottou [10], "(Runtime) grows at least like n^2 when C is small and n^3 when C gets large."

We show that size fractioning the data set can combat this penalty, and potentially allows accuracy beyond what the hardware could not otherwise achieve.

We performed a series of experiments creating specialist classifiers on different sizes of ROI. For example, we split the ROIs into quartiles by pixel area, and trained four independent classifiers. One model was trained on the smallest quartile of the ROIs, a second, independent model was trained on the next quartile larger ROIs, etc. The effect on recall was negligible. But most importantly, training four smaller classifiers is markedly faster than training one larger classifier. Completing the initial, coarse-grid search with cross validation on the single large model took 48 hours on our hardware. Training 16 specialist classifiers on size fractions of the ROIs, each over the same grid search, took 2 minutes per classifier, for a 100x speedup over the single classifier.

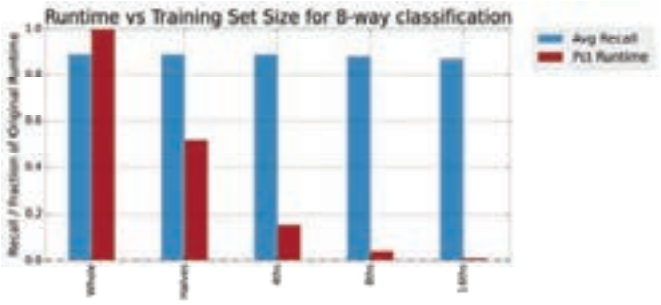


Fig. 12. Size fractioning the data results in significant time savings. Halving the data by size had minimal or no impact on recall, but drastically reduced execution time. Fraction of original runtime includes all classifiers from the group.

In one of our 8-way classification problems, size fractionating did not result in an overall gain, as none of the ensemble specialists is better than the baseline classifier on the whole data set. However, training multiple size-fractionated classifiers provides slightly better results than training a single, smaller classifier on all of the data, as shown in Fig.13.

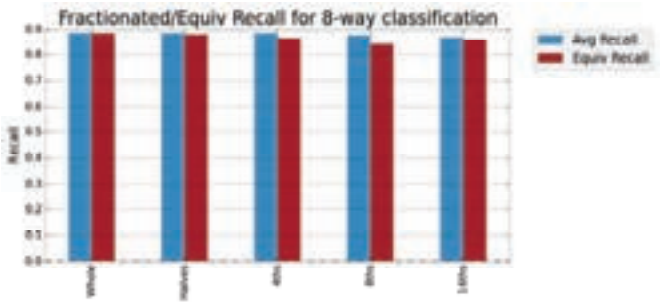


Fig. 13. The bar on the left is the baseline, a single classifier. The average of each ensemble (blue bars) is slightly higher than the recall of a single classifier of equivalent size (red bars).

To achieve maximum accuracy for our ROIs, creating a single large classifier slightly outperforms ensembles of size-fractionated models. However, size fractionating the data greatly reduces the training time, and in cases where the machine resources are limiting, creating multiple size-fractionated models will improve accuracy beyond creating a single classifier containing a selection of all of the data, as shown in the table below. In Table IV, if 8,000 examples per class are available then training a single 8-way SVM with 8,000 training examples per class yielded the best results. However, if the largest model able to be trained given hardware constraints is 1,000 examples per class, the results would be 0.02-0.03 better by training 8 models on various size fractions than trying to train a single model on data encompassing all size ranges. Size is a deterministic, objective criterion that does not require any human prescreening, and has a basis in the problem space (animals generally fall within certain size clusters per species) and therefore makes a reasonable separation criterion.

TABLE IV. SIZE FRACTIONATED RECALL VS. EQUIVALENT RECALL

Split	Recall			
	8-way classification Task		16-way classification Task	
	Split Avg	*Equiv Recall*	*Split Avg*	*Equiv Recall*
Whole	0.8869	N/A	0.8131	N/A
Halves	0.8856	0.8805	0.7948	0.775
4ths	0.8857	0.8650	0.7902	-
8ths	0.8770	0.8445	0.7843	-
16ths	0.8684	0.8580	0.7654	0.74

F. Efficiency and Feature Set Size

We use a set of only 51 features, and our algorithms learn on the order of thousands of parameters (weights) depending on the algorithm. 'Deep Learning', which usually means convolutional neural networks, has performed well in many image competitions and publications. In deep learning architectures, hundreds of millions of weights are learned, for example 133M to 144M weights were learned for 224x224 pixel images in [12].

Even with our much simpler features, our grid search and cross validation for some individual models took multiple days to complete on a system with 50 available CPU cores. While a few days may be an acceptable wait, the first model will not be the one ultimately used, and many will need to be trained before results are reliable. Deep Learning algorithms can take advantage of the high level of parallelism to utilize GPUs, but the computational cost of deep learning algorithms is still orders of magnitude above our method. While the cost of computing is cheap and classification accuracy frequently is maximized above processing costs, the number of parameters required for such networks is substantial.

To alleviate some of the computational expense of deep learning approaches, many researchers are using networks where the first set of filters has been copied from, or 'pre-trained' on a different data set, such as ImageNet data [13] (UCSD students, SciPy attendees, US Navy Scientists, personal communications, 2014-2015). Even copying filters still requires training millions of parameters in the later stages of the network.

However, in cases such as embedded systems, extremely large data sets, or initial investigations, a smaller set of features, such as the ones presented here is sufficient.

IV. CONCLUSION

In order to more effectively quantify our plankton samples, we executed a series of experiments to determine how to improve classification accuracy.

Carefully tuned support vector machines slightly outperformed gradient boosted random forest and multi-layer perceptron neural networks. Regardless of algorithm, performance increased until at least 4,000 training examples

per class, although performance continued to increase with more data. Data set size impacted performance and had a bigger effect than choice of algorithm. In Table I, the first few rows of data with smaller training sets have a 10 percentage point range between the lowest and highest performing algorithm. However, the columns show that training set size has an even bigger impact; the gain between an algorithm with less training data and the same algorithm with more data boosts recall by 15 percentage points or more. Correct hyperparameter tuning is also an important consideration. We share our methodology in Appendix A.

Our results are consistent across classes and algorithms. SVMs almost always performed best. Most hyperparameter searches ended up in the same narrow ranges across experiments. We found that creating an ensemble of our two best performing classifiers also increases performance at no additional computation or training cost.

Geometric features are inherently efficient compared to other approaches, and size fractioning the ROIs increases run time efficiency further. Our best results improve upon our previous random forest implementation by 22 percentage points. We found that our simple geometric features can achieve a recall of 0.887 for our best ensemble.

V. Appendix

A. Classification Labels

The 24 classification labels present in our data are: ['detritus', 'copepoda_calanoida', 'copepoda_oithona_like', 'copepoda_poecilostomatoids', 'multiples', 'badfocus', 'appendicularia', 'chaetognatha', 'eggs', 'nauplii', 'copepoda_others', 'bryozoan_larvae', 'siphonophora', 'euphausiids', 'crustacea_others', 'copepoda_eucalanids', 'ostracods', 'pteropoda', 'doliolids', 'others', 'radiolarians', 'polychaete', 'bubbles', 'copepoda_harpacticoida']. This list is sorted in order of frequency of occurrence.

B. Machine Learning Features

The 51 features we used for learning, spelled as provided by ZooScan are ['Angle', 'Area', 'Area_exc', 'CDexc', 'CV', 'CentroidsD', 'Circ.', 'Circexc', 'Convarea', 'Convperim', 'Elongation', 'Feret', 'FeretAreaexc', 'Fractal', 'Height', 'Histcum1', 'Histcum2', 'Histcum3', 'IntDen', 'Kurt', 'Major', 'Max', 'Mean', 'MeanPos', 'Median', 'Min', 'Minor', 'Mode', 'Nb1', 'Nb2', 'Nb3', 'Perim.', 'PerimAreaexc', 'PerimFeret', 'PerimMaj', 'Range', 'SR', 'Skelarea', 'Skew', 'Slope', 'StdDev', 'Symetrieh', 'Symetriehc', 'Symetriev', 'Symetrievc', 'ThickR', 'Width', 'X', 'XM', 'Y', 'YM'] [ref. 1]

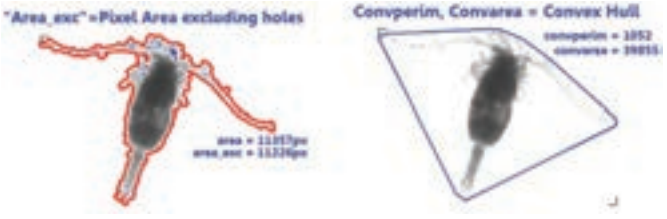


Fig. 14. Illustrations of how some of the feature values are calculated for actual ZooScan images.

C. Hyperparameter Optimization

For the multi-layer perceptron, a single hidden layer of 50 nodes often provided the best results. More nodes, even thousands, did not provide improved results. Learning rate was the most extensively searched hyperparameter, as it is reportedly the most important [11]. Initial searches covered many orders of magnitude. The final searches were fine-grained, with spacing of 2x (e.g. 0.05, 0.025, 0.0125). The optimal learning rate varied with training set size, and was most frequently 0.025 for smaller data sets with less than 500 examples per class, and decreased to 0.0025 for our largest data sets. The optimal L1 and L2 regularization hyperparameters were searched independently and consistently found to be 10^{-5} or 10^{-6}, with larger values found to be detrimental to performance.

For the Gradient Boosted Random Forest Classifier we evaluated four hyperparameters. For the maximum tree depth we tried values up to 25, but frequently a low value, such as 6, was optimal. We tried the odd-number values 3, 5, 7, 9 for the minimum samples per leaf, and the larger values, such as 7 or 9 provided the best performance. Maximum features were evaluated on deciles from 0-1, and intermediate values such as 0.3 performed best. Values of the number of estimators up to 2,500 were tried, and there was little discernable pattern.

For the support vector machine, the radial basis function with degree=3 was used for all reported results. For the regularization parameter, *C*, we experimented with various orders of magnitude from 1 to 100 million, but all results were obtained with values in the narrow range of 10,000, 100,000, or 1,000,000 with stronger regularization consistently providing better results on the larger datasets. For the free parameter, *gamma*, we again experimented with various orders of magnitude from 0.1 to very small, and found that except for very small sized data sets, gamma of 0.001 or 0.0001 was optimal.

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First Flight High School Participates in OCEANS’15 DC

Archie Todd Morrison III

For nearly a decade now, OES has provided financial and mentoring support to the Phytofinders, a student run organization at First Flight High School, located near Kitty Hawk on the Outer Banks of North Carolina. The work of these young citizen scientists was described in the Fall 2014 issue of the Beacon (http://www.ieeeoes.org/pubs/newsletters/oes/html/fall14/StudentPhytoplankton.html).

The five students pictured have now taken the next step toward careers in science and engineering. Their papers, which were subject to the full OCEANS review process, were accepted for publication in the Proceedings of OCEANS’15 IEEE/MTS Washington. As all OCEANS authors are required to do, the students presented their work in a very well received technical session at the conference.

Drs. Todd and Hilary Morrison co-chaired the session. Todd happily accepts the blame for starting OES involvement with the Phytofinders some years ago and now for dragging in Hilary, a noted molecular biologist, who has volunteered to teach the students how to sequence the DNA of the phytoplankton populations they are collecting.

The papers presented in Washington investigated the seasonal and geographic variability of the phytoplankton populations on the Outer Banks and also described the emergency response of the FFHS team when a potentially toxic algal bloom appeared near Cape Hatteras in October of 2014. This was the second time students from FFHS, with the support and encouragement of OES, have published papers at OCEANS. The first time was OCEANS’12 Hampton Roads, when four papers were presented, including one by FFHS science teacher and Phytofinders faculty advisor, Katie Neller.

Based on the continuing performance of the student authors and their fellow Phytofinders, OES has elected to continue annual funding and mentoring support for the program. Paper topics for OCEANS’18 Charleston are already under development. The students are well into their 2015/2016 sampling season and an OES mentoring trip is planned for the spring of 2016.

Shown left to right after the presentations are Katie Neller, science teacher at First Flight High School and the Phytofinders faculty advisor, Dr. Hilary Morrison, Senior Research Scientist at the Marine Biological Laboratory, Sam Weybright, Nathan Butcher, Parks Kelly, Jodi Awtrey, and Joseph Sawin, all members of the Phytofinders at FFHS and now published authors, and Dr. Todd Morrison, Senior Ocean Engineer at the Woods Hole Group.

Presentations at the technical session – Sam Weybright, Parks Kelly, Joseph Sawin, Nathan Butcher, and Jodi Awtrey.

On the Future of OCEANS

Malcolm Heron

There is a feeling in the air that it is a good time to be talking about the future of OCEANS Conferences. This is brought about by the recent signing of a long-term partnership between IEEE/OES and MTS to jointly run OCEANS. That brings the need to re-assess where it all should be going. But there is more than that because the large (and funded) data archives like IOOS and IMOS are changing the way we approach ocean science and engineering.

Both of the plenary speakers at OCEANS15 Washington looked into this particular crystal ball. In answer to a question about what the navy needs in the future, Rear Admiral Tim Gallaudet said that the navy has the technology; what is needed is acquisition and delivery so that every platform is sensing the environment and returning data to improve precision and accuracy of ocean and atmospheric models. Dr Rick Spinrad followed up with his vision of the New Blue Economy which will be based on the growing archive of environmental data. The opportunities that he sees are in tailoring solutions for specific services using data available from archives like IOOS. This takes the physical data and understanding and value-adds to provide services for social and economic users.

If we project forwards in these directions we might see more emphasis in OCEANS Conferences on the provision of services. Maybe we can anticipate special sessions for papers jointly authored by physical and social scientists. And the exhibition will lean more towards the service providers. I came away with the feeling that we need to be careful to not fall into Lord Kelvin's bold prediction (see box) some 5 years before Einstein's paper on the electrodynamics of moving bodies. We might be wise to not ignore the potential for new sensors, and even new physics in a move towards more commercially driven science.

> In his plenary address Rear Admiral Tim Gallaudet recounted a story about Lord Kelvin, saying in 1900 that we've discovered all there is to discover in science, and from now all future discoveries will really be just a matter of making more and more precise measurements.

IEEE/OES and MTS have set up a joint Future of OCEANS Committee (affectionately known as FOOC) to look at issues like these and to make recommendations about steering OCEANS towards a strong and viable future. If you have any insights into the future of OCEANS conferences, please email mal.heron@ieee.org with the words 'FOOC Feedback' in the subject line.

Mal Heron is representing OES on FOOC, along with Stan Chamberlain and Philippe Courmontagne.

"OCEANS'25 (and beyond) envisioning the Future of Marine Technology and Ocean Engineering" session chaired by Dr. Rick Spinrad.

Behind the Scenes at OCEANS

Liz Corbin – MTS Past President and Chair of OCEANS'15 Publicity

This is Part 1 of an article written by Liz Corbin for the MTS Currents newsletter. It provides an in-depth look at the history, planning and operation of an OCEANS conference. Thanks to Liz and MTS for allowing us to reprint the article. Part 2 will be in the March issue of the Beacon. Enjoy.

Have you ever attended one of the OCEANS conferences co-sponsored by the Marine Technology Society (MTS) and the IEEE Oceanic Engineering Society (IEEE/OES)? Did you wonder what it takes to pull together all the moving parts? There's the technical program with hundreds of presentations, the exhibit hall featuring the latest products and services, social events and networking opportunities, student programs, and much more. How does it all come together?

I thought I'd take a shot at giving you a peek behind the scenes at OCEANS. I went to my first OCEANS conference in 1989 at the Seattle Convention Center. I was working in the Ocean Resources Branch of the Hawaii economic development agency and one of our target industries was ocean R&D. That started a 20-year history of taking Hawaii companies to tell their story to the highly qualified audience that attends each of the OCEANS conferences.

I've also seen OCEANS from the other side, having been involved on the organizing committees for three OCEANS conferences: as General Co-chair in 2001 and Patrons Chair in 2011 (both in Hawaii), and now as Publicity Chair for 2015 in Washington, DC; and as a member of the MTS Board of Directors.

History: The Origins

So, what's the story on OCEANS? First, a bit of history. There are two OCEANS conferences each year jointly sponsored by MTS and IEEE/OES. The two societies each held their own general conferences until they joined forces in 1975 to co-sponsor the annual Fall OCEANS conference in North America which has taken place for the past 40 years, except for a few years when they held separate events. In 1995, the presidents of the two Societies signed a memorandum of understanding that paved the way for joint sponsorship that is still in effect. The annual conference became known as OCEANS 'YY MTS/IEEE and attracts ocean engineers, scientists, industry leaders, policy makers and educators.

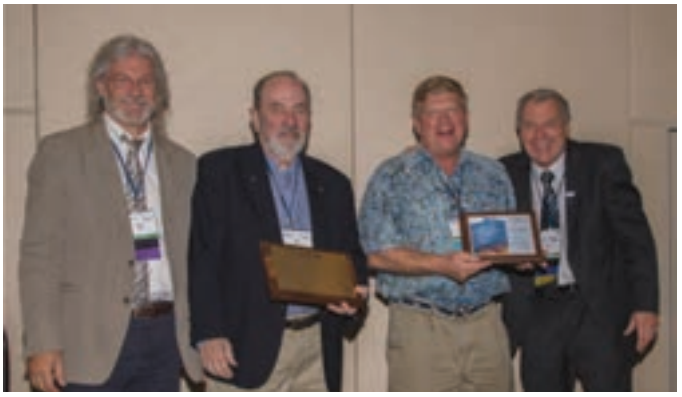
Starting in 2005, IEEE/OES regularly has held an OCEANS outside of North America, with alternating April/May/June conferences in Europe and Asia-Pacific. OCEANS was finally becoming international, in location as well as attendance. As the frequency of these Spring OCEANS increased, the location was added to the end of the standardized conference name to avoid confusion. Over the years, MTS began to provide various levels of support for the Spring OCEANS conferences, varying from full partnership, to technical program support, to having a presence, depending on the location. In 2012, MTS became a full partner in the Spring OCEANS, which alternates between Europe in odd years and Asia-Pacific in even years. Each year, the two Societies now produce the event in the Spring which is smaller and more regionally focused; and the North America event in the Fall which is larger, attracting a broader audience and a stronger exhibition component.

Conference Make-Up: What It's All About

A typical OCEANS North America lasts four days, Monday through Thursday, with Monday devoted to Tutorials, society business meetings, and setting up the exhibition hall. The opening plenary session is held on Tuesday morning, with welcome remarks and one or more keynote addresses. Following the plenary, the technical sessions begin and last through Thursday afternoon. There are approximately 12 concurrent sessions with about four presentations in each.

The second major component of OCEANS North America is the Exhibition, comprising 100-200+ booths featuring the latest products and services related to exploring, utilizing, monitoring and protecting the world's oceans. In addition to commercial exhibits, government agencies, non-profit organizations and educational institutions can be found on the exhibit floor. The Student Poster Contest is usually located in or near the exhibition hall.

The OCEANS'15 DC exhibit hall.



LOC of the OCEANS'15 DC receives the award from both Societies Presidents.

As an exhibitor for many years, I had my share of near disasters. Perhaps the most memorable was at the 1995 OCEANS in San Diego, when our exhibit space was in the converted basement garage. The height of the ceiling beams was lower than the show decorator had indicated and there was a large portable air conditioner right in front of our pavilion. Fortunately, with a bit of exhibit redesign we managed and the exhibit space in San Diego has improved greatly for subsequent conferences.

Since we all must eat, and no one can survive a week of all work and no play, OCEANS includes a number of social functions. There's the Ice Breaker on Monday night where friends

The technical sessions provide an educational opportunity for attendees.

and colleagues reconnect or meet for the first time. Tuesday includes the Awards Luncheon for one of the sponsoring societies and the Exhibitors Reception. On Wednesday, the Awards Luncheon for the other society is held, as well as the only event that doesn't have any work purpose at all, the Gala Dinner. The Gala is often held away from the conference site, at a special venue such as a museum, aquarium or ship.

Throughout the week, there are networking opportunities at coffee breaks, in the meeting halls, and at receptions sponsored by individual organizations. The final regularly scheduled event is the Hot Wash, or after-action discussion, on Thursday afternoon. While memories are fresh, the LOC reports on what went well and what could be improved. LOC members of future conferences are invited to listen and benefit from their experience.

Often special events and field trips to local technical sites are offered. The DC section of MTS is sponsoring a Welcome Aboard Golf Tournament at Andrews Air Force base on the Sunday before OCEANS'15 gets started. OCEANS'11 in Kona provided participants with the opportunity to visit the nearby Natural Energy Laboratory of Hawaii Authority where significant OTEC research has been conducted and aquaculture and desalinating companies make use of the deep cold sea water piped to the surface.

In the Beginning: How it Gets Started

OCEANS rotates among locations with significant marine industry communities that have a concentration of members of both societies, usually in MTS Sections and IEEE/OES Chapters. Typically, a small group of society members will get together and decide to work toward hosting an OCEANS. How to do that is detailed in the comprehensive *OCEANS Conference Operational Policy Manual: How to Propose, Host and Conduct an OCEANS Conference* (Conference Manual). The current version is 98 pages long and covers every aspect of putting on a successful conference/exhibition. The version we used for 2001 was only 22 pages – we've come a long way in providing a strong foundation for the people on the ground.

The group informs the Reconnaissance Committee (RECON), which includes representatives from both Societies, of their interest in hosting an OCEANS, usually seven years before the target date. A RECON team scouts possible locations and venues and assists the local group to prepare a presentation and budget. The group presents the proposal at a RECON meeting at an OCEANS conference. Explained Bob Wernli, "RECON's main job, which starts seven years before the conference date, is to make sure that any proposed location has a venue, lodging and travel support that meets the needs of an OCEANS conference and exposition. There has to be rooms for 9–12 concurrent technical sessions and adequate space for the plenary, exhibits and social functions." Bob is IEEE/OES Vice President for Professional Activities and Chair of the OES Reconnaissance Committee.

The character and uniqueness of the location are often part of the proposal. I remember that the team from Scotland would bring small bottles of Scotch to hand out during their presentations.

The selection process can take a few years, as proposals are refined and competing proposals from other locations are evaluated. The goal is approval by RECON five years out and the final decision by the MTS Board of Directors and the IEEE/OES AdCom at four years out. At that point, the Joint Oceans Administrative Board (JOAB) takes responsibility for overseeing the conference.

It takes a team effort to plan and oversee the OCEANS conferences. The photo shows the OES and MTS RECON and JOAB team following the OCEANS'15 DC meetings.

Techno-Ocean 2016

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Venue: Kobe Convention Center (Kobe, Japan)

Call for Papers and Exhibitors

Co-organizers

The Consortium of the Japanese Organizers for Techno-Ocean2016 (CJO)

IEEE/Oceanic Engineering Society(IEEE/OES)

Marine Technology Society(MTS)

Important dates

Abstract Submission page open: April 10, 2016

Deadline for Abstract Submission: June 10, 2016

Exhibition application deadline: June 30, 2016

Deadline for Full-paper Submission: August 5, 2016

- Plenary Session
- Technical Session
- Student Poster Session
- Concurrent Session
- Underwater Robotics Competition
- Exhibition

For Inquiries, please contact: techno-ocean@kcva.or.jp

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   - 1.4 Marine mineral resource development
   - 1.5 Marine environmental monitoring and impact assessment
   - 1.6 Sensor and observing instruments
2. Ocean observing platforms and high performance computer simulations for disaster mitigation
   - 2.1 Ocean observing platforms
   - 2.2 Numerical modeling and simulation
   - 2.3 Sensor and observing instruments

And other general topics

- Fisheries engineering and resource utilization
- Offshore structure and naval architecture
- Remote sensing
- Ocean data visualization, modeling and information management
- Marine environment, oceanography, and meteorology
- Marine Law, policy, management, and education

Deadline for Abstract Submission: June 10 (Fri.), 2016

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Booth fee: L type (3m×3m) 1st booth 280,000 yen
S type* (2m×2m) 1st booth 150,000 yen
*Application for S type is limited to high schools, universities and research institutions.

For more information, please check our website: www.techno-ocean2016.jp
Inquiries to Techno-Ocean 2016 can be directed to: techno-ocean@kcva.or.jp

The GEO Plenary

Jay Pearlman

It is hard to believe that it has been ten years since the Group on Earth Observation (GEO) officially started with the vision "to realize a future wherein decisions and actions, for the benefit of humankind, are informed by coordinated, comprehensive and sustained Earth observations and information". This points to *open data* and information that can be valued by decision makers who may not be technical specialists. GEO has inspired many good changes in the way Earth observations are made and the corresponding data are made available. Prior to GEO, data were traditionally sold or had restricted distribution. In 2007, the US announced that Landsat observations of the oceans and land would be available at no cost. Brazil and China followed with a similar policy for Africa and elsewhere. Another big step was taken when Europe announced that Copernicus data would be available free. Copernicus is a European space system contribution to GEO. But it is more than observations. For example, Copernicus Marine Services provide processed information on ocean conditions with no charge to users.

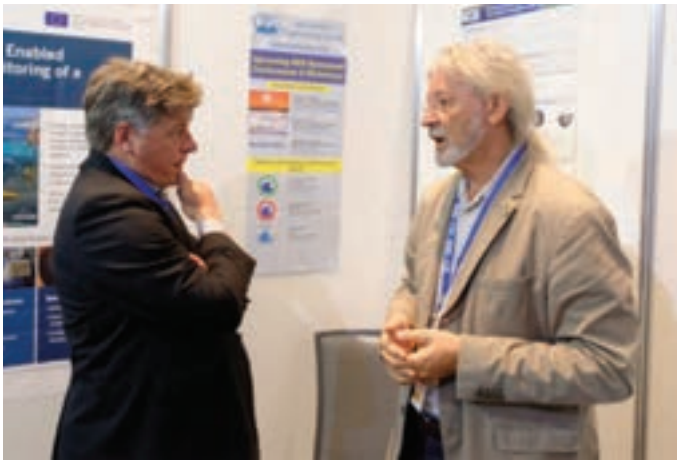
(http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Marine_services)

Further contributions to GEO were, for example, the European funding of programs in information systems (EuroGEOSS, GEOWOW) and ocean observation projects (AtlantOS). (https://www.atlantos-h2020.eu)

The concept of information for decision makers in embedded in projects called GEO initiatives. GEOBON is addressing biodiversity on a global scale (including ocean life) and GFOI is a global forest observation initiative. In 2011, oceans were recognized as a crucial part of GEO as the oceans play important roles in climate, food sustainability, natural resources (including renewable energy) and many other facets of our lives. The Blue Planet Initiative was started. In the next ten years, the Blue Planet Initiative will grow to address many of the most urgent issues relating to observations and improvements in understanding the ocean (http://www.oceansandsociety.org/aboutbp/structure.html). Blue Planet has six components:

C1 – sustained ocean observation
C2 – sustained ecosystems and food security
C3 – ocean forecasting
C4 – services for the coastal zone
C5 – ocean climate and carbon
C6 – developing capaci

Blue Planet is led by the Partnership for Observations of the Global Oceans (POGO) in collaboration with the Global Ocean Observing System (GOOS), the Global Ocean Data Assimulation Experiment (GODAE), the Committee on Earth Observing Satellites (CEOS) and others. OES President, Rene Garello, met with Blue Planet steering committee members to discuss opportunities for collaboration with Blue Planet. There is a lot of commonality between the OES technical capabilities and the capabilities needed for Blue Planet to succeed in meeting the objectives of the six components.

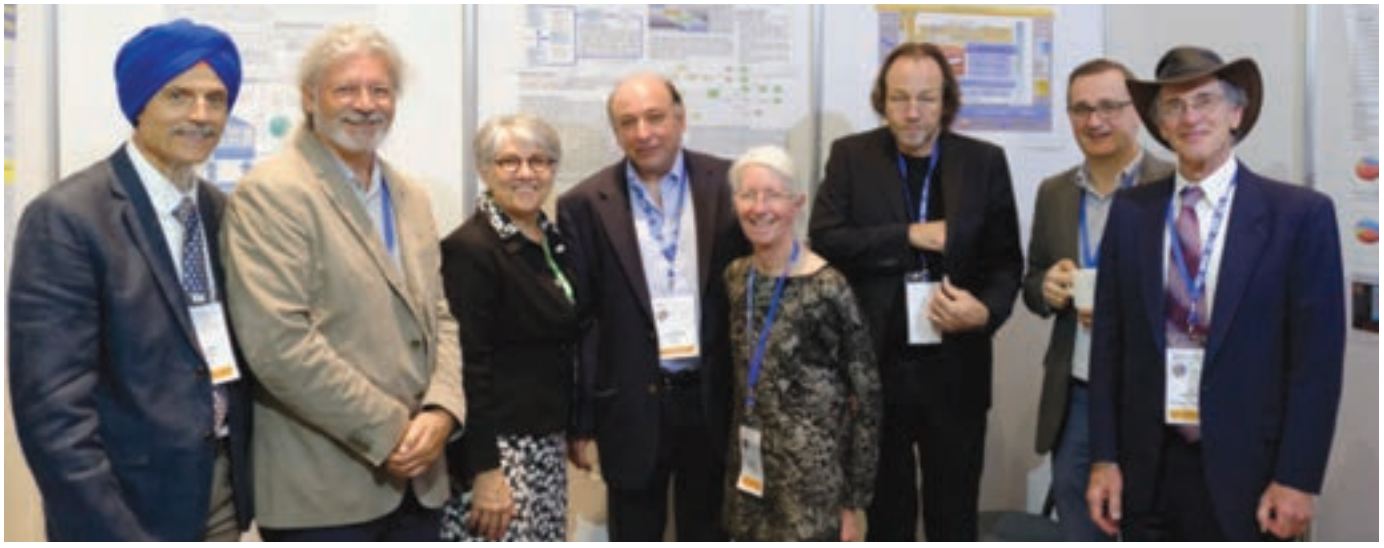


Rene Garello talks with Andy Steven of CSIRO, Australia about potential areas of common interest between OES and the GEO Blue Planet initiative.

The meeting in Mexico City was a Summit of Ministers and a plenary to review the details of the program for the next ten years. The Summit declaration stated that GEO members and participating organizations, "resolve to sustain and develop the observing systems required to provide high-quality reference data and time-series Earth observations; address observation gaps; maintain and evolve the GEOSS common infrastructure as a public good to deliver data, information, and knowledge that responds to stakeholders' requests and informs their decision-making processes."

There was emphasis on supporting the recently agreed global sustainable development (GSD) goals. (http://www.un.org/sustainabledevelopment/). The Ministers recognized "GEO's ability to foster strategic partnerships to coordinate and integrate the multifaceted resources and expertise of the GEO community and external partners." The Ministers called on "GEO to convene a stakeholder driven process to contribute to sustainable solutions to global challenges in the Societal Benefit Areas by identifying observation needs and gaps and developing knowledge and tools to enable delivery of useful services to users."

The ability of GEO to meet these challenges comes both from the participation of 100 countries and the engagement of international non-governmental organizations (participating organizations). IEEE is one of the participating organizations. So are a number of UN organizations (WMO, UNEP, etc.), standards organizations such as OGC and ocean organizations such as GOOS and POGO. IEEE and its team met with many of these organizations during the meeting. The IEEE had a booth and displayed its interests in ocean in situ sensor development, blue planet initiatives, OES conferences and impacts of observations on society. The opportunity now is to engage



Dr. Barbara Ryan (third from left) meets with members of IEEE at the IEEE Booth (left to right – Siri Jodha Khalsa, Rene Garello, Ilya Zaslavsky, Francoise Pearlman, Hans-Peter Plag, Stefano Nativi and Jay Pearlman).

further with GEO as it moves forward with its second decade. For GEO, Earth observation is understanding the whole Earth and its dynamics in the face of change and sustainability. Since seventy percent of the Earth's surface is oceans, we are a core part of GEO. More information on the meeting are available from an Earthzine blog (http://earthzine.org/2015/11/07/live-coverage-of-geo-xii/) and the GEO website (http://www.earthobservations.org).

earthzine Writing Club

Learn – Get Published – Get Paid!

Earthzine is an IEEE publication funded by NASA and IEEE's Oceanic Engineering Society. It is an online source for news, articles, information and educational materials about Earth science, Earth observations and users of Earth information for the international Earth-observing community. The publication is updated regularly with news from around the world about the Earth, Earth observations, environmental policy, and new and emerging technologies.

Science writing is challenging and rewarding. With a Writing Club for college students and young professionals, Earthzine hopes to encourage and develop aspiring writers who are interested in Earth observation and scientific communication. Effectively translating complex technical information and presenting it to the public requires patience, curiosity, and a willingness to dive into foreign territory, often without a net.

Earthzine's Writing Club will include a series of online workshops led by professional writers and experts from the scientific community in order to help participants grow and develop the skills needed to find story ideas, conduct research, interview sources, write articles, and move through the editorial process toward publication. In addition to the workshops, which will be held remotely via a blog site, Earthzine volunteers and staff will provide step-by-step assistance and conduct a review process to help club members reach the final goal: publication in Earthzine.org.

In addition to published articles, participants will be awarded a $200 stipend for completion of the program, culminating in an accepted work published on Earthzine.org.

Application

Eligibility:
The Writing Club is offered to current students enrolled in an accredited college or university degree program and to graduates who have completed a degree within the past five years.

Submit via email:
A 300-500 word essay explaining why you are interested in science writing and Earthzine's Writing Club. Please include relevant information about your professional/ academic background and your level of comfort with science writing and communication. A letter of recommendation from an instructor or mentor.

Application materials should be attached to an email with the subject heading "Earthzine Writing Club Application." In the body of your email, please introduce yourself and provide:

- Your full name
- Contact information: email, mailing address, and telephone number
- University affiliation, course of study, degree(s) sought or conferred, and graduation date
- How you learned about the Writing Club

Emails and inquiries should be sent to:
writingclub@earthzine.org

Deadline for completed application:
Friday, October 16, 2015 at 11:59 P.M. UTC

Program Details

Participants will complete a 10-week, guided course with presentations from professional writers and support from Earthzine staff. Each week, participants will have a combination of light reading, discussion and peer response, in combination with targeted goals such as generating a topic, conducting research, and interviewing sources. Expect to spend at least two hours per week on the course. Activities will be posted to a Writing Club blog site, and discussions will be moderated by Earthzine science writers and editorial staff. In addition to publication, and upon successful completion of the course, participants will receive a $200 stipend to honor their achievements and successes.

Guest Lecturers

Alun Anderson began his career as a research biologist and has been the editor, editor-in-chief, and publishing director of New Scientist from 1992 to 2005, during which time he successfully launched the magazine in the United States. Previously he was the Washington, D.C. Bureau Chief for the science journal, Nature.

Paul Collins is a writer specializing in history, memoir, and unusual antiquarian literature. His nine books have been translated into eleven languages, and include "Not Even Wrong: A Father's Journey Into the Lost History of Autism" (2004), and "The Murder of the Century: The Gilded Age Crime That Scandalized a City & Sparked the Tabloid Wars" (2011). He is a 2009 recipient of a Guggenheim Fellowship in Nonfiction.

Jeff Kart has been Earthzine's managing editor since 2011. Previous to that, he spent 20 years in the newspaper business, the last several as an environmental reporter in Bay City, Michigan. His work with Earthzine is part of his business, Enviroprose.

For more information, see Earthzine.org/WritingClub

SEALAB II Golden Anniversary

Electronics design challenges of living on the seafloor

Kevin Hardy, Associate Editor-in-Chief

Imagine this: you're on a crash development to build the next generation USN undersea habitat at the dawn of saturation diving. You have 7 months, start to finish, so OTS tech is going to have to do.

SEALAB II, Team 1 Electronic Engineer Berry Cannon discussed these challenges in January 1966, just 3 months after SEALAB II was raised from the seafloor after successfully completing its historic mission.

Here's a summary of his report, adapted from proceedings, Man's Extension into the Sea, a Joint Symposium, 11–12 January 1966, Washington, DC.

Unusual Engineering Problems In Undersea Living

Berry L. Cannon, Electronic Engineer/USN Aquanaut
U.S. Navy Mine Defense Lab., Panama City, FL

A wide variety of unusual and interesting problems are encountered when the engineering requirements for permanent manned dwellings on the seafloor are examined. The most obvious problem, increased pressure, creates special requirements for most equipment design.

An artificial atmosphere is a necessity in undersea living, and the oxygen percentage must be rigidly controlled. Also, the relative humidity has to be kept within comfortable limits. If helium is used as the primary inert gas, communications require a special approach to reduce the "Donald Duck" effect. This speech distortion is a serious problem for communications in general.

Any equipment present in the habitat must either be able to withstand the high ambient pressure or be in a pressure proof housing. Some of the new solid-state electronic components withstand pressure very well even without encapsulation. A good example of this is the PQS-lB hand held sonar that was used on SEALAB II. This transistorized sonar has a pressure-proof housing, but to permit access to the batteries while the sonar was in SEALAB at depth, the housing was opened as SEALAB was pressurized. The sonar performed normally with the components exposed to 90 psig.

Not all electronics will function normally when pressurized, however. The TV cameras used for the closed circuit TV monitors were enclosed in pressure-proof housings. After being in SEALAB for several days, some of these cameras would lose their contrast and focus capabilities. It was thought helium was leaking past the housing 0-ring seals. The resulting increased internal pressure apparently caused enough change in the characteristics of the electronic components to degrade the picture quality. To solve this problem, the TV camera was placed outside in the water with the housing viewport flush against a porthole looking in. No further problems were experienced with this camera.

The entertainment TV was an 11-inch transistorized model sealed inside a pressure-proof container. The picture was visible through a 2-inch thick plexiglas window with 0-ring seals. There was no helium leak into this housing as shown by an internal pressure gauge.

For the undersea dweller, the breathing atmosphere presents some unique problems. The oxygen content must be controlled with precision to prevent hypoxia, too little oxygen, or hyperoxia, too much oxygen. Since SEALAB II was at a depth of 205 feet, the oxygen concentration was controlled to between 3.25 and 5.25 percent. An oxygen partial pressure sensor was coupled through an amplifier and control circuit to a solenoid valve to control the makeup oxygen flow.

SEALAB II is secured to a barge for transit to San Diego, CA, August 1965. (Official Photograph, U.S. Navy)

The author, Berry Cannon, is shown using the Electrowriter during the SEALAB II Experiment. EEG sensors are adhered to his scalp. (Official Photograph, U.S. Navy)

A meter with an appropriate range marked on the face indicated the oxygen partial pressure. For safety, a separate sensor, amplifier and meter were running to provide a cross check. A cylinder of calibration gas was available for periodic checks of the equipment.

Relative humidity was controlled by four commercially available dehumidifiers, which worked well, even under high ambient pressure. In SEALAB II, the relative humidity was kept within the range of 60 to 90 percent. Cork insulation on the interior walls of the habitat helped reduce condensation.

The temperature in the habitat must be maintained near 85°F for human comfort because of the increased thermal conductivity of helium. The SEALAB II heating system used convection, radiant and deck heaters. By maintaining the deck heaters at ll0°F, the radiant and convection heaters were seldom needed.

Heating the diver in the water is much more difficult and methods are still in the development stage. One method of providing warmth to the diver's suit is electrical heating, similar to an electric blanket. The electrically heated wet suits used resistance wires imbedded between layers of foam rubber with controls to regulate the amount of heat supplied. The suit is designed to operate from an AC or DC power supply. A silver-zinc battery pack provided maximum power with minimum size. The cells could withstand pressure and operate in any position. Three hours at full power while untethered, free swimming was achieved. If a hookah breathing rig was being used by the diver, a power cord within the umbilical connected the suit to a l2-volt AC source. The rig was lighter, but had a more limited range, and presented some danger of entanglement.

The breathing apparatus offers challenging problems with room for improvement. As the operating depth increases to 600 feet, the mixed gas apparatus in its present form will be nearly useless. The swimmer at these depths requires a new approach, perhaps a closed circuit system with an oxygen sensor and regulator to replace only the amount of oxygen used by the diver. Since the oxygen percentage will be only about 1.5% at 600 feet, a precise sensor and regulator is necessary.

Helium distortion of speech presented significant communication problems. The only available equipment designed to eliminate this problem is the Helium Speech Unscrambler that was used inside the habitat on both SEALAB experiments. As a backup to ensure clear communications, an Electrowriter was provided. This device is basically a stylus and thermal paper machine servoed to another identical machine topside.

Future diver-carried communication systems must consider size, range and freedom. A voice-operated microphone in a gas-tight mouth-mask would leave the diver's hands free. A bone conduction unit could function as the earphone, and some means of eliminating the helium speech distortion should be an integral part of the circuitry.

Unique problems were encountered with the power and lighting systems. SEALAB II required 40 to 50 kW of power, brought in by cable. To minimize losses in the cable a high voltage was transformed down to useful voltage levels at the habitat.

Interior lighting used utility service bulbs, like used in a kitchen oven, which could withstand upwards of 200 psi. These bulbs could be run at higher than rated wattage in the habitat because the helium-rich atmosphere provided greater cooling. The exterior lighting was more difficult. Because of the high power levels of these bulbs, 250 to 1000 watts, their expected life is short. Changing bulbs is quite a problem on some of these lights since a waterproof splice must be made. This is time consuming, for the entire fixture must be brought inside to make the splice. The need exists for a truly versatile underwater light that is compact, inexpensive, and portable with a bulb life of at least 1000 hours and be capable of wet bulb changing.

In conclusion, the two areas most important are those of atmosphere control and communications. The need exists for a completely automatic atmosphere control with great reliability. And at the increasing depths planned for future man in the sea ventures, where surface divers will be useless, communications will play an even more vital role.

The Sea and OCEANS 2016/Shanghai

Kevin Hardy, Associate Editor-in-Chief

OCEANS 2016 International travels to Shanghai, China in April 2016. Shanghai is home to the China Maritime Museum, which is built around a full-scale recreation of one of the ships captained by China's most famous nautical explorer, merchant, and ambassador, Zheng He. He made seven voyages throughout Southeast Asia, India, Arabia and eastern Africa with his great fleet of ships between 1405 and 1433. The architecturally inspiring museum also contains model boats, historic relics, and interactive displays. Travellers to this next international Oceans conference are encouraged to add a day on the front or backside to visit this important museum of world maritime history.

The Chinese history of maritime exploration and regional trade is quite extraordinary, with Zheng He playing a very prominent role during the great Ming Dynasty. A study of the great captain, and his mastery of the Indian Ocean, leads one to also discover the presence of Islam in China, and other cultural distinctions foreign to the west.

The first Chinese oceangoing trade ships were built during the Song dynasty (c. 960-1270), likely as a result of the invention of the magnetic compass, growing confidence in shipbuilding techniques including V-hulls, and the emergence of the art of cartography. The following Yuan dynasty (c. 1271-1368) commissioned the first trading fleets and founded outposts in Sumatra, Ceylon, and coastal India. Marco Polo described large four-masted junks with 60 cabins, compartmentalized watertight bulkheads, and crews of 300.

If the reported size of Zheng He's largest ships at over 400-ft (120 m) are true, they would be the largest all-wood vessels ever built. While some shipwrights argue this must be an exaggeration, in 2001, Evan Hadingham, then NOVA's Senior Science Editor, wrote "in 1962, the rudderpost of a treasure ship was excavated in the ruins of one of the Ming boatyards in Nanjing. This timber was 36 feet long. Reverse engineering using the proportions typical of a traditional junk indicated a hull length of around 500 feet (150 m)." (Ref: "Ancient Chinese Explorers". <http://www.pbs.org/wgbh/nova/ancient/ancient-chinese-explorers.html>)

Zheng He's mid-13th century treasure ship compared to Columbus's vessel of discovery, Santa Maria. (Display in the China Court of the Ibn Battuta Mall, Dubai.)

Toward the end of his seventh voyage in 1433, Zheng He, then a 62-year-old, died and was buried at sea. The Confucian perspective of isolationism began to dominate Chinese thinking, and along with other important factors, maritime trade routes were abandoned. By 1525, the largest vessels were gone.

But the intrigue doesn't end there. In 1975, while diving for lobster off Los Angeles, CA, two buddies, Bob Meistrell and Wayne Baldwin, discovered more than 30 circular, flat stones with a center hole scattered over an area roughly the size of a football field. Bob and his twin brother Billy would later found the wetsuit company BodyGlove. Academics, archaeologists,

The China Maritime Museum in Shanghai.

Bob Meistrell in 2010 with two of the circular stones he found while diving off Los Angeles, CA, in 1975. (Photo by Dave Rees, courtesy of asiaticfathers.com)

geologists, oceanographers, and historians, including James R. Moriarty III, then a professor at the University of San Diego, have studied their discovery, and offer widely different theories. Some with respected credentials say they can show the stones were mined from a Chinese quarry, and resemble anchor stones used by ancient Chinese mariners perhaps as much as 2000 years ago. Others offer far different assessments.

A few other relics of apparent archaic Chinese origin have turned up over time in North America. Not enough to conclusively prove a trans-Pacific voyage by Chinese mariners, but enough to raise eyebrows for those who like a good puzzle. An ancient Chinese legend spoke of a land called "Fu Shang" that existed across the sea. Maybe it's Monterey, next up, in Fall of 2016.

Member's Highlights

Contact the editors if you have items of interest for the society

Stan Chamberlain – L'Hermione in a three months trip to America

René reported the L'Hermione arriving back in Brest, returning from a three months trip to America in the last Beacon issue. Here, we introduce the photos of L'Hermione arriving in Newport, RI, Harbor on Jury 8, 2015 during that trip. And the ship sails on.

Jenhwa Guo – Campus life at the University of Tokyo in Kashiwa

Jenhwa Guo of National Taiwan University visited Professor Ken Takagi's laboratory at the Department of Ocean Technology, Policy and the Environment, at the University of Tokyo in Kashiwa City between June 17 and October 17, 2015. At Takagi's lab he focused on the engineering aspects of the deployment of the Kuroshio turbine array. The Kuroshio current flows strongly along the eastern coast of Taiwan and follows a stable course to Japan. The deployment of hundreds of turbines in deep waters, anchored stably to the sea bed, will raise new challenges in the design of turbines and anchorage systems, and in the configuration and maintenance of the associated power plant. A three-year project, supported by the NEDO (New Energy and Industrial Technology Development Organization), IHI, Toshiba, and the Mitsui Global Strategic Studies Institute, to deploy a prototype turbine with a capacity of 200kW close to the Kagoshima, Japan, has been undertaken. Professor Takagi has been involved in the study of the safety, environmental impact, and maintenance of the turbine array; the social acceptance of the power plant to be constructed, and the extension of the developed technologies into international markets.

Following these efforts in Japan, Taiwan is exploring the possibility of building a Kuroshio power test plant on Green Island off the east coast of Southern Taiwan. During Jenhwa's visit, he met his office mate, the legendary Yukio Kadomoto. Mr. Kadomoto has managed or participated in projects that involve many globally renowned unmanned underwater vehicle systems, such as the AUV R-ONE, the AUV AQUA EXPLORER 2000, the ROV DOLPHIN 3-K, the ROV KAIKŌ, and others. He is now a researcher at the University

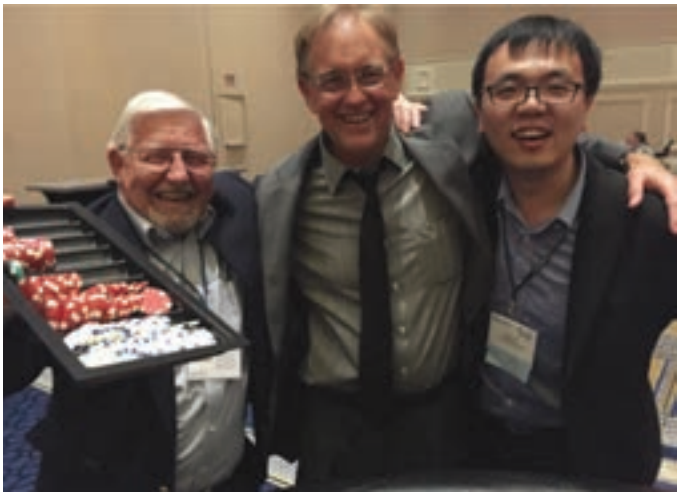
OES member Jenhwa Guo (left) and Mr. Yukio Kadomoto have their lunch at a campus "Sushi" restaurant.

of Tokyo, focusing on the marine engineering of the Kuroshio turbine system. Under the guidance of Mr. Kadomoto, Jenhwa developed his ideas concerning turbine deployment at Taiwan's test site. Jenhwa also attended regular meetings and interacted closely with students and researchers in the lab - Summer, Ram, Jay, Fujimoto, Yasuike, Kamizawa, Fukumitsu, Kita, and Hatanaka. With Prof. Waseda and Prof. Wada's students, they visited Izu Ōshima (the large island) in the Pacific Ocean, interviewing fishermen to elicit their opinions of renewable marine energy.

The name of the campus location, Kashiwa-no-ha, means "leaves of the Japanese Emperor Oak". The place was named quite recently, although the patterns on Kashiwa leaves can be seen in many ancient artifacts, and the decoration on one of the local farms, which belongs to Yoshida's family and was built 200 years ago. This leaf is popularly used for making Japanese cakes for seasonal events. In ancient times, the place was famous for horse-breeding; during the Korean War, it was a military communications base, and later it became a golf course. The University of Tokyo opened the Kashiwa campus in 2000, when the Institute of Cosmic Ray Research, Solid State Physics, Biosciences, Transdisciplinary Sciences, Environmental Studies, Atmosphere and Ocean Research, Information Technology, and Gerontology begun slowly to move into it to form a family of 3,000 people. New testing facilities and water tanks for ocean research are now being constructed. This campus is constantly growing. In October 2015, the campus welcomed Kashiwa's Nobel Prize winner in Physics. Jenhwa thoroughly enjoyed living on campus, enjoying the fast pace in a beautiful natural environment and a friendly, culture-rich atmosphere for international scholars.

Bob Wernli – The Gaylord is Mine!

OES VP for Professional Activities, Bob Wernli, is considering becoming VP of Casino Blackjack after breaking the house during the OCEANS'15 DC gala and casino night. Bob and his two associates, shown below, had hot hands at the Blackjack table all evening. Bob won his final bet, well over $2,000,000 (wish it was real!) and broke the bank, which was passed to him at the end of the evening.



Bob Wernli, holding the table's bank, which he won on the final bet of the evening. Thanks to Xiaoxu Cao from China, shown on the right, for his teamwork and great photo.

Who's Who in the OES

Barbara with Nai'a

Barbara Fletcher and her Water Dogs

Sometimes working in the ocean isn't enough. We need to play in it too! When Barbara Fletcher isn't working or volunteering on the IEEE OES AdCom, you can often find her training her Portuguese Water Dogs with her husband Walt Aviles. The Portuguese Water Dog was originally developed to work on fishing boats, retrieving over-

Nai'a pulling the net from Barbara to Walt.

board articles, carrying messages between boats, setting nets, and even herding fish! Even though there are few opportunities on fishing boats these days, the dogs (and their handlers) may demonstrate their working abilities by earning titles at water trials. Barbara's dogs Nani and Nai'a (Nani means "pretty" and Nai'a means "dolphin" in Hawaiian) have progressed through the Junior, Apprentice, and Working Water Dog levels and are now working on their Courier Water Dog titles. At this level, they must carry pouches between boats, retrieve a float line from shore (and return to the boat), retrieve 2 dummies, pull a net from one boat to another, and carry a buoy ball out past a marker and drop it upon command. These all require teamwork between the handlers and the dogs, much as their ancestors had with the fishermen in old Portugal. It's a great way to enjoy being on the water and seeing the dogs do what they were bred to do.

OES AdCom Members, Class of 2016–2018

Jerry C Carroll, Chair, Nominations and Appointments Committee

The following provides information on our newly elected AdCom members for 2016–2018. Congratulations and welcome aboard.

Also, as a reminder, beginning 1 January 2016 the Nominations and Appointments Committee will be accepting nominations for 6 positions on the ADCOM serving 2017–2018–2019. General nominations – any member of the Society may nominate a member of the Society. Nominations must be received by the Nominations and Appointments Committee by 1 March 2016 accompanied by evidence that the nominee is willing to serve if elected. Further details are in our BY-LAWS on our IEEE/OES web site. Nominations can be send to:

Jerry C Carroll
Chair, Nominations and Appointments Committee
jerrycortez@charter.net

PHILIPPE COURMONTAGNE (AM'05-M'05-SM'07) was born in 1970. He received the Ph.D. degree in Physics at the University of Toulon (France) in 1997. In 1999, he became a Professor at a French electronic engineering school: the Institut Supérieur de l'Électronique et du Numérique (ISEN Toulon, France), in the field of signal and image processing. In 2001 he joined the Provence Materials and Microelectronics Laboratory (L2MP UMR CNRS 6137), which is a unit of the French national research center (CNRS). In 2005, he obtained his Habilitation (HDR – Habilitation as Research Supervisor) for his works in the field of noisy signal expansion. In 2007, he has been elected to the degree of IEEE Senior Member in recognition of professional standing for his works in the field of signal de-noising (SAR, SAS images), signal detection in noisy environment and signal transmission. In 2008, he has been elected as a member of the IEEE OES French chapter board and became in 2013 the IEEE OES French Chapter chair. Since that time, he actively participates in the development of the IEEE OES activities by means of student actions and workshop's organization. As recognition for his involvement in the OCEANS Student Poster Competition, in 2014, he has been appointed as Student Poster Competition chair. His field of interest concerns de-noising, detection and classification of underwater signatures, with applications to sonar signal analysis, SAS images and communications in shallow water.

Statement: Since June 2005, I have participated in several OES conferences and workshops (18 Oceans Conferences and 4 workshops) and I have contributed to these conferences with 33 articles and 6 tutorials. Furthermore, for several Oceans conferences, I was member of the jury for the student poster program and, since 2014, I am the Student Poster Competition chair. All these participations allow me to assess the high quality of these conferences in terms of organization, author's contributions and social events, but also, to identify several points that could be improved or developed, in order to make new young scientists/researchers or industrials aware of the OES conferences/workshops significance, enlightening the benefits to be an IEEE OES member. Efforts have to be pursued for engineering students or young scientists to pay attention and to be aware of the IEEE OES activities.

Moreover, I have been elected in 2008 by the IEEE OES French community as member of the IEEE OES French chapter board and, since 2013, I am the chair of the IEEE OES French chapter. Since 2007, I am also a member of the association "Oceans Europe", first created to promote the venue in France of the conference "Oceans'05 Brest" and then to promote the organization of workshops linked to IEEE OES activities (such as AUV'06, Passive'08). In this context, I have participated, on one hand, to the development of new actions to encourage students to join IEEE OES and, on the other hand, to the organization of new workshops. In particular, the workshop "Passive'08 – New trends for environmental monitoring using passive systems" has been organized. I was the chairman of this workshop, but I was also involved in different positions such as technical program chair and social event chair. Moreover, currently with the IEEE OES French Chapter, I am organizing the next venue of the Oceans Conference in France (in Marseille) in June 2019 for which I will be the general chair.

All these experiences allow me to clearly identify the role of the IEEE OES Administrative committee and to propose ideas

aiming for new students to become IEEE OES student members; the student members nowadays being the tomorrow's senior members.

JAY PEARLMAN (M'84-SM'02-F'08-LF'15) is technical director of J&F Enterprise and an adjunct Professor at the University of Colorado. He received a BS from Caltech and a Ph.D. from the University of Washington. He has worked in both government and industry. He was Chief Engineer of Network Centric Operations at Boeing and a Boeing Technical Fellow, guiding development of advanced information systems. He was Co-Chair of the international GEO Architecture and Data Committee that defined and implemented the GEOSS information infrastructure.

Jay is active in ocean research and information systems in projects in the US and Europe. He is PI for the five-year NSF Ocean Observations Research Coordination Network and a Co-PI on NSF's EarthCube/BCube project. He is a work package lead for the European FP7 research project, NeXOS, which is developing a new generation of in-situ ocean sensors and is an active participant in COOPEUS (US-Europe infrastructure cooperation), the Ocean Data Interoperability Platform (ODIP) and the upcoming North Atlantic Observations System Project, AtlantOS.

Jay's interest in ocean research and engineering started in 2000 with the launch of EO-1 satellite. Jay was co-lead of the EO-1 international science team that included ocean research. He soon became involved in ocean and coastal information systems - he and his team created the data management system in 2004 for the IOOS NANOOS Regional Association; he also served on the Board of Directors for three years. Jay formed the IEEE Committee on Earth Observations in 2004 for IEEE participation in GEOSS with OES as a partner. At the same time, he formed the OES GEOSS Technical Committee, which he still chairs. As a result of this work, he was an invited speaker at the Oceans 2004 Conference, a keynote speaker at Oceans 2005 in Brest and received an IEEE Special Recognition Award 2006.

During the last decade, Dr. Pearlman served six years on the National Academies Ocean Studies Board and is currently on the National Academies Board of International Science Organizations. Jay was a member of the UNESCO GOOS Science and Technology Steering Committee and a member of IOC JCOMM panel on Industry. He served for five years as a member of the US national committee of the Scientific Committee on Ocean Research (SCOR). He was a co-organizer of the Oceanography 2025 workshop sponsored by the US ONR.

Jay has been a long time supporter of OES. He has been an active participant at AdCom meetings for nearly a decade. In addition to his service as a technical committee chair, he is currently serving as lead for the OES Policy and Global Concerns affinity group. Over the last decade, he has organized special workshops, sessions and been a reviewer for Oceans conferences with a focus on ocean observation systems. His emphasis on both ocean systems and on outreach continues also in his work with Earthzine, which is a web-based magazine on environment and earth observation that is now part of OES. He plans to take an increasing role in OES outreach as well as activities in standards.

Jay is a Fellow and a life member of the IEEE and has more than 80 publications and 25 US and international patents.

Statement: OES is a vibrant organization with a sound financial base in its conferences and publications. It is important to continue and build on this success. According to its constitution, OES focuses on "the creation of new capabilities and technologies from concept design through prototypes, testing, and operational systems …". If elected, I will work to expand the Society's role in end-to-end observations from sensors to data. This can be important in attracting new research and industry partnership opportunities for OES.

If elected as an AdCom member, I will encourage expanding three areas – *increased focus on integrated observing systems, support of standards to improve interoperability and the engagement of young professionals and new members through an expanded outreach program.* The role of oceans in grand challenges such as climate and food resources is becoming better understood. Improved monitoring of the oceans is a grand challenge in itself. Yet the changes in technology are creating opportunities. I believe OES is in a position to make important contributions though its members and as a forum for the community. It should foster a broader environment of collaboration for technology and systems.

I will work with the OES President and the AdCom to leverage new tools for outreach including increased use of social media and the new IEEE communication tools for community building. We can expand Earthzine coverage of the oceans and enhance both the Beacon and our OES web services. I mention tools, because they are an avenue for OES and oceans community building, which I believe is a very important part of our Society. Here I emphasize young professionals along with senior members in engineering and science.

For Standards, I will work to expand the Societies standard's activities through its technical committees and propose an advisory team for the Standards Technical Committee that can identify key requirements and opportunities. Interoperability in ocean measurements has been a challenge. Programs that I am working on such as NeXOS, GEO, AtlantOS and other international projects have efforts in these areas including standards and best practices that we can leverage to identify OES contributions.

With your support, as a member of the AdCom, I will work with the OES team to expand these focus areas and more.

JOHN R. POTTER (M'96-SM'98) was awarded a joint honours Mathematics and Physics Degree from Bristol UK and a Ph.D. in Glaciology and Oceanography from Cambridge studying the Antarctic ice mass balance, where he spent four consecutive summers. He was awarded the Polar Medal for this work by Queen Elizabeth II in 1988.

Dr. Potter worked in Italy on propagation fluctuations in underwater acoustics from 1986–1991, then sailed across the

Atlantic and through the Panama canal to San Diego where he worked at the UCSD Scripps Institution of Oceanography on Ambient Noise Imaging and marine mammal acoustics.

In 1995 Dr. Potter sailed with his family from San Diego to Singapore where he founded the Acoustic Research Laboratory (ARL) and joined the team that created the Tropical Marine Science Institute (TMSI). Dr. Potter headed the ARL and was an Associate Director of the TMSI for 12 years, working on passive acoustic imaging, marine mammal acoustics, distributed autonomous intelligent sensing, underwater communications networking and co-operative behaviour.

In 2004–2005 he took a year 'sabbatical' with his family to circumnavigate the Indian Ocean by sailboat on a sponsored voyage of research, public outreach and education with the aim of improving the awareness and quality of our species' stewardship of the ocean ecosystem.

After co-chairing OCEANS Singapore in 2006, Dr. Potter returned to Italy, first as a consultant, then as a Project Leader and now as Principal Strategic Development Officer at the NATO STO Centre for Maritime Research and Experimentation. Dr. Potter currently serves on the Local Organising Committee for OCEANS Genova 2015.

Dr. Potter is a Senior Member of the IEEE and has been an active member of the IEEE OES for more than 20 years, serving two terms on the Administrative Committee. He is also an Associate Editor for the *IEEE Journal of Oceanic Engineering*, a PADI Master Scuba Diver Trainer and an International Fellow of the Explorer's Club, among other things. It is no longer true that he neither owns nor operates a television.

KEN TAKAGI (M'05) received the B.Eng. degree, the M. Sc. and the Dr. of Engineering from Osaka University, Osaka Japan.

Ken is professor of the University of Tokyo, Department of Ocean Technology, Policy, and Environment. He served as an assistant professor and associate professor in Department of Naval Architecture and Ocean Engineering at Osaka University for 23 years, and he moved to the University of Tokyo in 2008. He is studying on the ocean renewable energy and underwater vehicles, and teaching the fluid dynamics and the ocean technology policy. He has published about seventy journal papers in the field of ocean engineering and naval architecture since 1985.

Ken is IEEE/OES Japan Chapter Chair since 2010, AdCom member since 2013 and Associate Editor of the *IEEE Journal of Oceanic Engineering* since 2013. He served as General Chair of OCEANS MTS/IEEE Kobe-Techno-Ocean'08, and served as an executive committee member of OCEANS MTS/IEEE 2004, UT-SSC 2011 and 2013.

Statement: I will focus my efforts on strengthening the international activity of OES, especially in Asian countries. The first OCEANS conference in Asia was held at Kobe in 2004 with the theme of "Bridges across the Oceans". Since this conference, colleagues from around the world have constructed strong international networks, and presently many Asian countries are interested in organizing OES related conferences. I will strongly support for organizing these conferences.

I will also focus on supporting student activities such as AUV competition in Asian countries, Student Poster Competition and so on. I believe that enhancing student activities and increasing number of young members are important for the transition of society's power to the next generation.

Expanding area of activity is also important to keep society's power. The ocean renewable energy is one of good examples. I will listen to members needs and find new areas to make OES more attractive to future new members.

I am pleased to serve and continue my commitment to OES.

JOHN WATSON (M'02-SM'05) Since starting a Ph.D., on laser micro-spectral analysis of steels, in 1973 at the University of St Andrews, Scotland, my professional career has been dominated by research in laser applications and optical engineering. I spent five years (from 1976) as a Higher Scientific Officer with the UK Atomic Energy Authority in Caithness, Scotland, on the development of scientific instrumentation for fuel reprocessing plant inspection, before turning to the application of holography and laser-based spectroscopy to plant inspection. In 1981, I returned to the academic world at RGIT in Aberdeen before moving to the School of Engineering at the University of Aberdeen, in 1984, a Lecturer before being promoted through Senior Lecturer and Reader to Professor of Optical Engineering (2004) before taking up the Chair of Electrical Engineering in 2007.

It was at Aberdeen University that my interests in subsea optics developed and my activities specifically concentrated on the application of holography in the subsea environment. Another interest with a specifically underwater flavour was the work on subsea laser welding. Other research activities include optical image processing, holographic interferometry and laser micro-spectral analysis (now known as laser induced breakdown spectroscopy – LIBS). I have undertaken joint research with colleagues in the USA, Russia, Ukraine and Europe.

I have published extensively on laser-related research including an undergraduate textbook on *Optoelectronics* (1988); an edited work on *Subsea Optics and Imaging* (Watson and Zielinski, 2013) and *Digital Holography and Wavefront Sensing* (Schnars, Falldorf, Watson and Jueptner, 2014).

I am a Senior Member of IEEE, and was elected to Fellowships of the (UK) Institute of Physics and the Institution of Engineering and Technology (IET) in 2001 and am both a Chartered Engineer and Chartered Physicist. I serve on the Editorial boards of several international laser/optics journals.

Statement: I wish to stand for re-election for a second term to OES AdCom in order to continue to promote the activities and presence of IEEE in the whole area of oceanic engineering and subsea sensing. I will continue to promote the OCEANS events across Europe and to the wider global community.

I have been active in the IEEE/OES since the early 2000's; and have also served as an elected member of the OES

Administrative Committee from 2007–2011. I am currently serving again on AdCom from 2013, and am also a co-opted member of the Reconnaissance Committee (ReCon) from 2010, with a specific role related to the European OCEANS conferences; I am also European convenor of the Subsea Optics and Vision professional group of OES.

Of particular relevance to my IEEE/OES activities was acting as Executive Chair of IEEE/OES OCEANS'07 in Aberdeen and will be acting as joint Executive Chair again for its return to Aberdeen in 2017.

I have recently been involved in promoting the establishment of a Student Chapter of OES at Aberdeen University which I hope will expand to the wider Aberdeen student community. This could be the precursor to establishing a Scottish wide full Chapter.

More specifically related to my own area of expertise I believe that optics in the 21st century has an increasing role to play in the subsea community. I believe that being re-elected to AdCom will enable me to promote this area more effectively within the OCEANS community.

THOMAS F. WIENER (S'55-M'62-SM'92-LS'02) is an Aerospace Engineer with over 40 years of increasing responsibility in conducting and directing high technology research and development efforts. Now the Principal of the Forté Consultancy, he was formerly a Program Manager of the U.S. Defense Advanced Research Projects Agency, serving there for a total of ten years. He served in the U.S. Navy for over 22 years, qualified in Destroyers and in Submarines. He commanded the nuclear attack submarine USS JACK. His special technical proficiencies span the fields of missile technology, inertial guidance, and automatic control, imaging and non-imaging sensors, and C3I. He has acquired substantial expertise in training and education in the Navy and in civilian life.

- Sc.B. (Engineering), Brown University; Sc.D. (Instrumentation), M.I.T. His dissertation, the first substantial work on strapdown inertial guidance, was the basis for the Apollo Guidance System.
- Sigma Xi, Tau Beta Pi, and Sigma Gamma Tau.
- AIAA (Senior Member), SPIE, USNSL, SPEBSQSA (Member)

IEEE Activities: Life Senior Member

Oceanographic Engineering Society: President (2001–2004), initiated the "Two OCEANS" program, conducting one OCEANS Conference annually in the Americas, and a second one in Region 8 or Region 10 in alternate years. Treasurer (1997–2000); Administrative Committee (1995–present).

Sensors Council: Vice President for Technical Operations (2012–2013), President (2004–2005), Secretary-Treasurer (1999–2002)

Conferences: General Chair, IEEE SENSORS 2003; Oceanic Engineering Society Liaison to OCEANS'15 MTS/IEEE Washington

IEEE Technical Activities Board: Member (2001–2005); Chair, TAB Society Review Committee (2004–2007); Chair; IEEE Committee on Earth Observation ICEO (2010–2012)

Statement: The Oceanographic Engineering Society is my IEEE home. I've been involved in its activities for the past 20 years. I had the good fortune and honor to serve as Society President for four years. During that time we initiated the practice of presenting two OCEANS Conferences each year, we rewrote our constitution, and we forged a strong, cooperative relationship with the Marine Technology Society.

For the past six months, I have been updating our Policies and Procedures. This document will capture our successful practices so that volunteers will have the benefit of past experiences. It will provide a baseline for improving the operations that are a major source of the Society's success.

I wish to continue my contributions to the Society as a Member of the Administrative Committee. My background and experience provide me with the tools to help guide the Society to continued success. I am particularly interested in assisting with member and chapter activities. I hope to help revitalize our Distinguished Lecturer program so that our eminent members can share their expertise with a wider audience, and so that industry and academia can profit from interactions with these members. As a result, I expect that our membership will increase, and that our chapters will become more active contributors to Society, the IEEE, to the Oceanic Engineering Society, and to our Members.

Welcome New and Reinstated Members

Brazil
Julio Sergio Melo Do Amaral

Canada
Xiao Liu
Seyedhabib Mirhedayati Roudsari

China
Cheng Chi
Xiaoting Jin
Rui Yang

Costa Rica
Melany Sofia Carvajal Galeano

France
Didier Caute
Gwenola Rolland

Germany
Jan C Albiez

Japan
Myo Myint
Shuhei Yoshida

Korea (South)
Sung-Hoon Byun
Hangil Joe

Byeongjin Kim
Juhwan Kim

Malaysia
Ahmadfaisal Mohamadayob

Portugal
Anibal Castilho Matos

Spain
Vicente Javier Arias Gomez

Thailand
Brooks B Wood

United Kingdom
Ceri St John Reid

USA
Shaun D Anderson
Peter Berg
Randy Casper
Anastasia Van Ryck Degroot
John Fox
J S Gerig
Ryan A Goldhahn
Ananya Sen Gupta
Amir W Habboosh
Suzanne Killey
Kriss Kirchhoff
Patrick McDaniel
Amin Mivehchi
Travis Moscicki
Kathleen M Paulson
Stephen Logan Rintoul
Thomas M Siderius
Phillip A Walsh
Stephen T. Wright
Andrew Gene Yun
Ilya Zaslavsky
Yu Zhang

New Student Chapter – Shanghai Jiao Tong University Oceanic Engineering Society Student Branch Chapter

Junliang Cao, Chair of the OES Student Branch Chapter at Shanghai Jiao Tong University

Introduction of the New Chapter

The newly formed Oceanic Engineering Society Student Branch Chapter at Shanghai Jiao Tong University has a rapid development in the past few months. New student members have been absorbed into the student branch: three new members jointed the student branch in October, they are Di LU (ID: 93648142), Chengke XIONG (ID: 93646766), and Yilin ZOU (ID: 93654539). Di LU and Chengke XIONG are first-year PhD candidates and Yilin ZOU is a graduate student; therefore, the branch is consisted of eleven student members so far. The chair of the student branch Junliang Cao has introduced the histories of IEEE OES to the new student members, then together discussed the future plans of the chapter with all of the student members during the regular academic session.

Prof. Daniel Rouseff and Prof. Lisa, M. Zurk were invited to Shanghai and communicate with student members in 14th, October. Prof. Daniel Rouseff is currently an Affiliate Scientist at the University of Washington, a Fellow of the Acoustical Society of America. His primary technical interests are in how oceanographic variability affects underwater acoustic signal processing. Prof. Lisa, M. Zurk works in the Department of Electrical and Computer Engineering at Portland State University, her research interests are primarily in the area of sensing phenomenon and have such relevant applications as remote sensing of the earth's surface, detection of explosives or bio-agents, and acoustic detection of underwater sources. She uses underwater gliders to do experiments in the ocean, which meets the further application of gliders in the student chapter, and the chapter will be looking for cooperation in the future.

The Seagull Underwater Glider from Shanghai

The chapter has been working on an underwater glider in the past few months. Now this glider finally comes to the world and is named of "Seagull", which is designed to operate in the East China Sea at a maximum depth of 500 meters. The Seagull glider is about 2 meters long, the outer diameter is 0.23 meter, and weights 62 kilograms in the air. There is no external antennas at the tail section, the communication and location modules are concealed in the rudder.

The field trial of Seagull glider was held at the Qiandao Lake between 5th and 7th of July. During the 3-days-experiment,

The chair of the student branch Junliang Cao is introducing the IEEE OES to the new members.

The Seagull Underwater Glider and some of the IEEE OES student members.

Seagull Glider and IEEE OES member Zheng Zeng

Diving of Seagull Glider in the rain

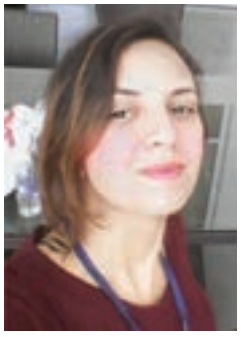
the glider completed 22 diving cycles and reached the depth of 55 meters (the maximum operating depth of the testing area is 60 m), including saw-tooth motion and spiral motion. The glider carried sensors to collect the date of ambient temperature, operating depth and glider attitudes. A GPS module was used to locate the glider at surface, while the data was transferred to a laptop through GPRS networks. The trial test was quite successful despite of some instant technical issues, the next step is to further improve the glider system and apply the glider in the East China Sea environment.

In October 28–30, the IEEE OES student members did the towing experiment of Seagull Glider at Zhejiang Ocean University, Zhoushan. The purpose of the experiment was to obtain reliable and accurate hydrodynamic coefficients to support theoretical research. A serious of operating conditions had been tested in this experiment, including angle of attack, angle of slide, and the translational velocity. The experiment proceeded smoothly in the three days, the data was then compared with simulation results and laid a foundation to the deep-going theoretical and practical studies.

Hydrodynamic experiment of the Seagull Glider

Once in a Lifetime Experience

Cyrine Selma, Women in Engineering



Cyrine Selma

The Oceanic Engineering Society offers grants for young professional members of Women in Engineering to attend the OCEANS conference. Cyrine Selma was chosen as one of the recipients this year and found the opportunity to attend OCEANS'15 in DC greatly rewarding as she discusses in the following article.

Brandy Armstrong, Women in Engineering

Thank you very much for giving me the opportunity to attend this wonderful conference. Working with the oceans is a very new concept to me. I had had no idea about the marine technology and ocean engineering until this conference. I learned more about marine life and ecosystems and autonomous underwater vehicles, and that will be helpful as I am looking ahead to a possible internship. This experience has opened my eyes to so much.

The conference included a wide range of technical sessions and an exhibitor hall, as well as some social events. I especially enjoyed perusing the exhibitor tables and learning more about ocean engineering societies as well as meeting and conversing with representatives from companies, IEEE Oceanic Engineering Society and IEEE Women in Engineering such as Marinna Martini who was very friendly and accommodating.

At the National Gallery of Art, Washington Dc

OCEANS Conference brought me to meet students, professors, and professionals from all over the world with similar interests and varied backgrounds. We have become good friends in just a short period of time.

This has been an opportunity like no other, it has motivated me to think about my future and set clear goals in my life.

OES Supports 2016 MATE ROV Competition

Bob Wernli – VP Professional Activities

IEEE/OES is again proud to be a financial sponsor of the Marine Advanced Technology Education (MATE) Center's International Student ROV Competition. This year's event was held in St. John's, Newfoundland and Labrador, Canada, at the Fisheries and Marine Institute (MI) of Memorial University and the National Research Council's (NRC) Ocean, Coastal and River Engineering facility. Photos of some of the unique facilities and viewing arrangements are show below.

Congratulations to EXPLORER class champion Jesuit High School from Carmichael, CA and RANGER class champion AMNO & CO, a home school team from Seattle, WA, along with our compliments to all

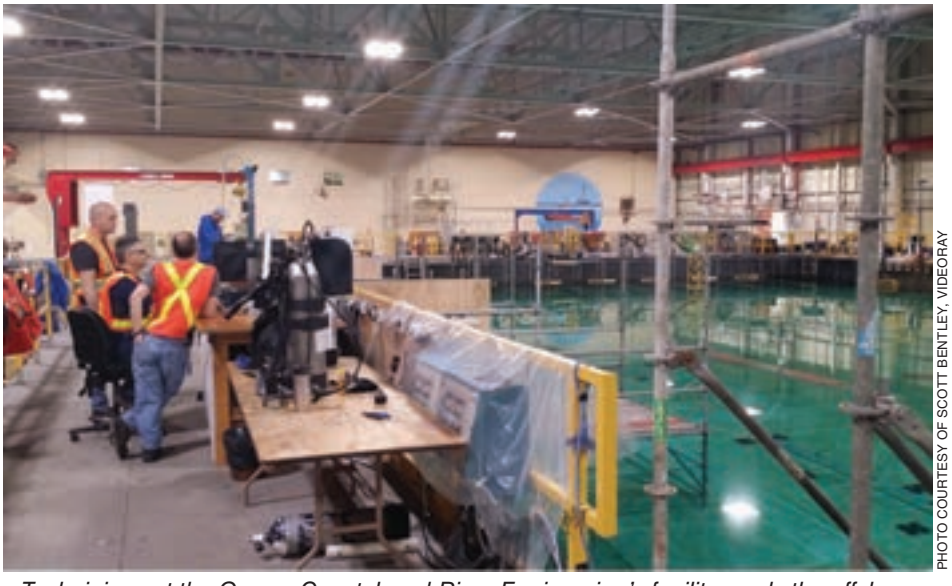


PHOTO COURTESY OF SCOTT BENTLEY, VIDEORAY

Technicians at the Ocean, Coastal, and River Engineering's facility ready the offshore engineering basin for MATE competition teams.

award winners and teams who participated in the event.

The 2016 MATE international event will take place at the NASA Johnson Space Center's Neutral Buoyancy Lab in Houston, TX, USA. OES looks forward to once again sponsoring the event.

PHOTO COURTESY OF DOUG WHITE, UNIVERSITY OF DELAWARE

Spectators wait for their teams to start competing in the Marine Institute's flume tank.

OES Awards Student Scholarship

OES recently awarded a student scholarship to Jeremiah Sullivan, who is studying Oceanic engineering at University of Rhode Island (undergraduate). The following statement was written by the scholarship recipient.

Personal Statement by Scholarship Recipient by Jeremiah Sullivan:

During high school, I was fortunate enough to have a math teacher who truly inspired me. She taught Algebra I, yet she went above and beyond the syllabus to share her love for math with us. I quickly developed that same passion while learning about Fibonacci and the Golden Ratio. Patterns within nature interest me to no end. This curiosity about the natural world ultimately led me to where I am today, double majoring in ocean engineering (acoustics focus) and Italian at the University of Rhode Island.

As a kid, I was fortunate enough to experience the Ocean hands on. My uncle taught me to SCUBA dive when I was 12 years old, exposing me to a majestic, alien environment just beneath the waves quickly nurtured a passion for the underwater world. Combining my love for math with the ocean, underwater acoustics was the natural choice.

Academic Profile

As a junior at URI, I have primarily been focused on my core engineering classes, but I have been able to supplement these classes with few interesting electives, including scientific diving and several supplementary math courses. In addition to engineering, I am working towards an Italian major. I am currently preparing to spend my next year studying abroad, as part of URI's International Engineering Program. Outside of Engineering, I row for the URI Men's Crew team and work in a machine shop on campus.

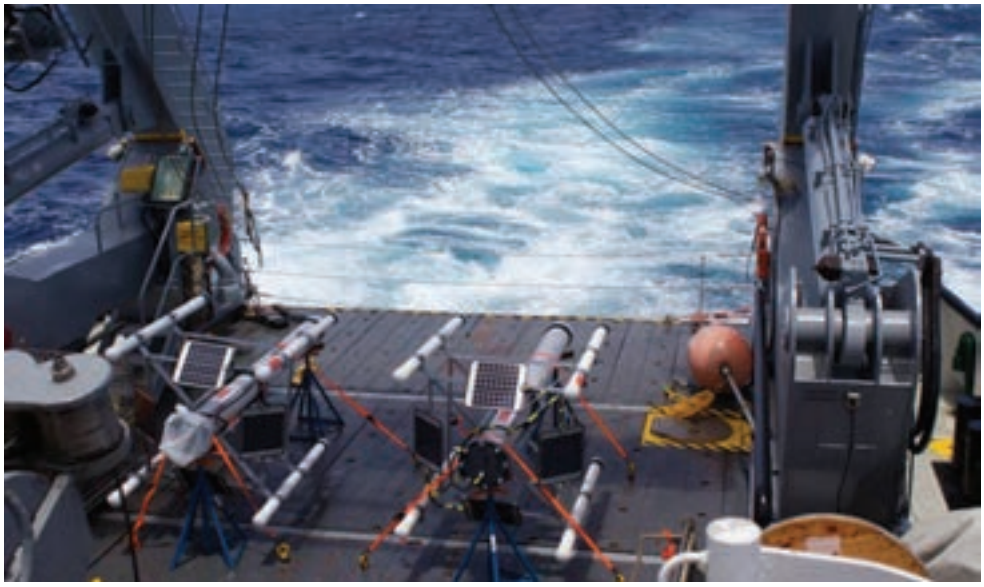
Areas of Oceanic Engeneering of Interest To You:

I am currently working with a small ocean instrumentation company which is collaborating with the Equipment Development Laboratory at URI's bay campus. I have had a chance to work on many unique ocean engineering projects in this position. One project over the past few months is our Son-O-Mermaid buoys. This project's end-goal is to create a network of low-cost sonar, drifting buoys to listen for seismic activity around the world. The purpose is not for early warning or tsunami detection, as land based stations are very good at this already. Rather, this network would be used to help map the earth's inner layers. Mermaid records exactly when and where it hears an earthquake, and by cross referencing the time and position of the epicenter (calculated through preexisting seismometers) it is possible to determine the time it took for the earthquake to cross through the earth. While land based systems can accomplish this already, there is a huge lack of data

General Call for Scholarship Applications

The IEEE Oceanic Engineering Society recognizes that the future of ocean engineering depends on the recruitment of talented, engaged young people. To encourage advanced education in ocean engineering, OES offers up to eight awards annually for $5,000 each. Graduate and undergraduate students are encouraged to apply for these grants at any time. Selections are made twice each year, with deadlines of 1 March and 1 September. Information on the application process is available on the OES website: http://www.oceanicengineering.org/page.cfm/cat/81/OES-Student-Scholarship-Program/

Applications for OES scholarships are reviewed. This requires the time of volunteer members. The following have served in 2014: Christophe Sintes, Chair; Kenneth G. Foote, Liesl Hotaling, Marinna Martini, and Sophie Scappini, André Lesaout.



SONO-Mermaid Buoys on the deck of the RV Explorer.

from the Ocean, and since the Ocean covers the vast majority of our planet, it represents a huge, untapped data source. Since these buoys drift freely, a large scale deployment would record seismic data from places never before sampled. In later versions, the buoy could also be outfitted to measure other data, such as salinity, acidification, and temperature; at various depths in the water column.

The buoys contain solar charging and satellite communications abilities to maximize deployment time and provide real-time access to data. In order to record clean, accurate signals; Mermaid's hydrophones are attached via approximately 1000 meters of faired cable. This is designed to eliminate all possible noise, especially during rough weather. The buoys therefore must be launched in full ocean depth water, which makes the operation very difficult. Luckily, we were able to join a cruise in early summer 2015 on the RV Atlantic Explorer out of Bermuda. Unfortunately we faced several setbacks while preparing to deploy the instrument, and we did not receive the data we had hoped for. But, the cruise was great preparation and has given us insight to improve many aspects of the buoy.

This project embodies several aspects I truly love about my studies. Working on a project making an actual difference in pure science is somewhat amazing in itself. It amazes me how much we do not know about our universe, or even what is just a few miles below our feet. Before working on this project, I had no absolutely no knowledge of seismology or geophysics, the way ocean engineering can facilitate research in other areas really excites me. I loved collaborating with people completely out of my expertise, and I found it innately satisfying to know we were helping to research something as fundamental as the composition of our planet.

Professional Goals

As a junior in college, am still very dynamic with my professional goals. I enjoy working hands on with projects, and using my dive experience, I have been able to assist in testing many unique projects. We are currently developing a multipurpose, acoustically-activated lift bag system that could be deployed by divers. This has the potential to improve safety when lifting unstable objects, as the diver can clear the area and does not need to tend directly to the bag. In my opinion, acoustics has so much more potential in the realm of diving and ocean research in general. Eventually, I hope to see acoustically based gear to become as integrated into everyday dive equipment, much like the modern dive computer. Unfortunately there are many challenges prohibiting this, but as an ocean engineer I hope I can help overcome a few of those challenges. Ultimately I want to work with ocean acoustics in a way that directly impacts our access to and knowledge of the underwater world.

In my eyes, the ocean contains almost limitless possibilities, and at a time where the rest of our planet has been trampled over, the ocean is relatively untouched. I hope my career can contribute to future exploration and sustainable exploitation of the ocean. I am very excited to become involved with IEEE and the Ocean Engineering Society, as this has allowed me to connect with a wide network of professionals in the engineering. I strongly encourage all ocean engineering students to become involved with OES, as they offer incredible scholarship opportunities, and also can provide empirical advice for your engineering career.

I believe we will rely on it more and more in the coming years as our population grows. Naturally Ocean Engineering will continue to grow as a field; from oil-rigs and wind farms, to commercial fishing and aquaculture.

ATTENTION OES STUDENTS

SCHOLARSHIPS

STUDENT POSTER COMPETITION

FREE TRAVEL TO CONFERENCES

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WWW.IEEEOES.ORG

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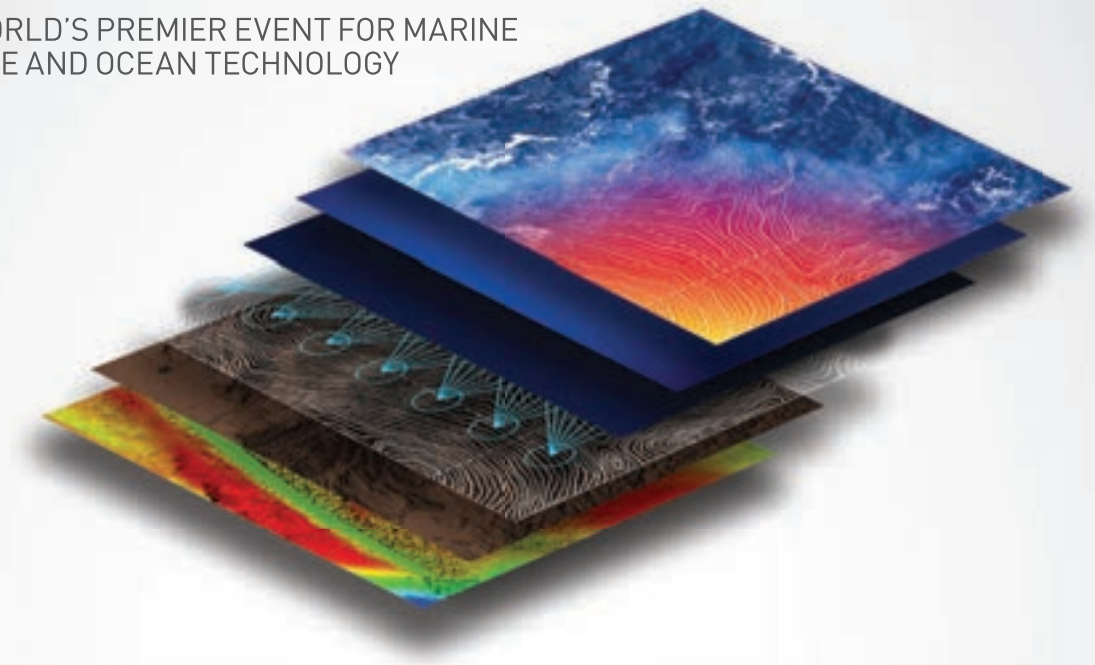

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OCEANS ’16 MTS/IEEE Shanghai
Call for Exhibitors

“Our Future is with OCEANS”

April 10-13, 2016 Shanghai China

THE EVENT & THE VENUE: Shanghai International Convention Center

Every spring, the Marine Technology Society and the IEEE Oceanic Engineering Society sponsor OCEANS Asia/ Europe, a prestigious conference/exhibition that draws hundreds of international attendees.

The Venue Shanghai International Convention Center has high reputation both at home and abroad for holding large-scale international conferences and expansive meeting and exhibition space with riverside view; and is convenient to major airports and local attractions and modern.

Oceans’ 16 Shanghai will be an excellent chance for companies and organizations to increase their market and to reach a highly qualified target audience in this international metropolitan.

Exhibitor Levels

Oceans' 16 Shanghai offers a select number of exhibitor opportunities

• **Basic Exhibitor:** includes 9 m^2 floor space, electricity and Internet, ¼ page ad in the program, and up to 1 free full registration.

Early Booking (before Oct. 31, 2015): $2800

Regular (After 1st November 2015): $2980

• **Premium Exhibitor:** includes 18 m^2 floor space, electricity and Internet, ½ page ad in the program, and up to 2 free full registrations.

Early Booking (before Oct. 31, 2015): $5500

Regular (After 1st November 2015): $5830

Note: All applications must be accompanied by 100% payment before 31st December, 2015 in order to be assigned booth space. (50% deposit will be accepted for contracts received prior to 30th November 2015)

Attendee Profile (Registration opens: January 10, 2016)

You'll be spending four days interacting with:

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• Contractors
• Project managers
• Distributors
• Public and private sector technology experts
• Media and culture influencers

Details of these opportunities can be found on the conference website: *http://oceans16.org/*. The Organizing Committee is dedicated to do their outmost to ensure you and your investment at OCEANS' 16 Shanghai will be as fruitful as possible, by facilitating an effective market place for your company and its products. If you are interested in becoming an exhibitor, then please send an e-mail to: *ExhibitsChair@oceans16.org, and hwkelong@sibs.ac.cn*

April 10 – April 13, 2016
Shanghai International
Convention Center

Exhibitor Registration Form

Exhibitor level	Cost	Qty	Total Cost
Basic Exhibitor	$2980 (Early bird: $2800)		
Premium Exhibitor	$5830 (Early bird: $5500)		
Pavilion Exhibitor	Remain to be discussed		

OCEANS' 16 MTS/IEEE Shanghai Welcomes you

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