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Newsletter of the Oceanic Engineering Society

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

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From the President

The Oceanic Engineering Society (OES) has modified its bylaws to fulfill a strategic plan adopted in 2016. Changes to the bylaws proposed by the Executive Committee (ExCom) were approved by the Administrative Committee (AdCom) on June 19, 2017, and by the IEEE Technical Activities Board on August 23, 2017. So, what changes were made and why? Let's start with why.

During its bi-annual meeting at OCEANS '16 Monterey on September 19, 2016, AdCom adopted a 10-year strategic plan with three near-term (3 years) specific objectives:

1) Develop thematic conferences, symposia, and workshops within the focus of the Society's scientific and technological domains
2) Engage OES members and potential members in these activities locally and globally
3) Inform OES members and potential members about new developments, best practices, and standards in Marine Science and Technology.

The strategic plan identified partnerships as a path to increase the Society's impact and outreach. OES has established partnerships with the Marine Technology Society (MTS) as co-sponsor of the OCEANS conferences, with the Offshore Technology Conference (OTC) as one of the founding Societies, and with the Global Earth Observations (GEO) in which OES represents IEEE's interests in ocean-related topics. A newly formed Standards committee will develop strategic partnerships with official national and

(continued on page 27)

From the OES BEACON Editors

Harumi Sugimatsu and Robert Wernli

Welcome to the September 2017 issue of the Beacon and congratulations to all of our Chapters, Committees and Members that have provided the excellent array of content included.

First of all, we'd like to thank our editorial team that includes our newest Associate EditorFarley Shane. And to ensure you know who they are and why we have put together such a diverse technical team, we've provided an introduction to all the Associate Editors with an article providing a short bio on the team members.

A theme that will appear many times in this issue is the great success of OCEANS'17 Aberdeen. Our conference chairman, John Watson, has put together a comprehensive overview of the conference and associated events. You can add to that another travelogue included in Ross Chapman's "From the Editor" article. And we also congratulate the contestants and winners of the Student Poster Competition that are covered in Philippe Courmontagne's overview of the competition and results.

Thanks again to Joe Czika for leading the team in producing the pamphlet "The OCEANS Conference—60 And Counting," which is a fantastic 48-page document on the history of the OCEANS conferences since their inception in 1971 and was passed out at OCEANS'17 Aberdeen, our 60th OCEANS conference. You can get your copy at OCEANS'17 Anchorage or view it on the OES website.

As one of the sponsors of the Offshore Technology Conference in Houston, OES again enjoyed excellent networking with the attendees and the results of the event are reported herein. In addition, our VP for Conference Development, Sandy Williams, and our VP for Conference Operations, Diane DiMassa, provide us with the status and latest plans on our upcoming events. And, as a follow-up to the last issue's article on the history of the OES Underwater Technology symposia, we've added a similar report on the Current Measurement Technology Committee's CMTC Workshops that have been held about every four years since the first one in Delaware in 1978.

Once again, the OES Chapters have been very busy hosting many meetings and workshops. Be sure to read the reports from Singapore, Malaysia, Victoria, India, Japan and Canadian Atlantic Chapters. And, from the Providence chapter, the latest on their meetings and the—Offshore Energy Storage Symposium. We hope such reports encourage other chapters to not only provide meeting reports to the Beacon, but also increase their involvement in other potential membership increasing activities.

Harumi Sugimatsu and Robert Wernli at the OCEANS'17 Aberdeen OES booth.

For those of you with a lead foot, enjoy our latest "Who's Who in OES" article on OES Treasurer Bill Kirkwood and his many racing endeavors.

This issue also includes our final two OES scholarship winners. We are redirecting our scholarship funds toward new initiatives, so students and Young Professionals should stay tuned for new opportunities to become involved in the society and the OCEANS conferences, all expenses paid. And be sure to review the newest section in the Beacon on our Young Professional Activities. Let us know what you're up to.

In closing we'd like to invite all society members, including our students and Young Professionals, to submit material for the Beacon newsletter. And, if you would like to be one of our associate editors, please contact us. We're especially trying to expand the North American team. Feel free to contact us with any comments or suggestions. Enjoy.

Introduction of Beacon Associate Editors

From Beacon Associate Editors

As the editors of the OES Beacon, we want to ensure that everyone knows the depth of support by our team of Associate Editors. And, the high level of technical expertise that they bring to our excellent publication. So, following is a listing of our Associate Editors with a photo and short biographical sketch beginning with our most recent team addition, Farley Shane.

Farley Shane—Our Newest Associate Editor

Model ROV for MBARI Exhibit at the Monterey Bay Aquarium.

Farley Shane has recently been added as an Associate Editor on the OES Beacon newsletter. He graduated in 1982 from the California State University in Long Beach with a Bachelor degree in Ocean Engineering. His first employment upon graduating was with Global Marine Development, Inc. (GMDI). GMDI was the company formed to create the Glomar Explorer, a drillship designed to be the key component of "Project Azorian," the CIA codename for a bold plan to raise a sunken Soviet Golf-II submarine from the floor of the Pacific Ocean to recover classified components. In subsequent years GMDI re- focused their efforts toward offshore oil exploration. Farley's first projects included the design of an innovative mobile Arctic drilling platform (Concrete Island Drilling System, CIDS), and the monocoque design of deep towed search vehicle, Arion. Eastport International, who had a contract to maintain and operate the Deep Drone ROV for the Navy Supervisor of Salvage, decided to open a west coast office in support of projects at the Naval Civil Engineering Laboratory in Port Hueneme. Farley joined Eastport and worked on a variety of projects ranging from the design of seawater hydraulic diver tools, to writing a manual for the expedient repair of war damaged ports. One of the highlights of his employment was acting as liaison between Eastport, the Navy Supervisor of Salvage, and NASA during the efforts to locate and recover components from the ill-fated Space Shuttle Challenger.

For the last 25 years Farley has been at the Monterey Bay Aquarium Research Institute (MBARI). Upon first joining MBARI in 1991, he worked on MBARI's first major research project, the design and build of Tiburon, an ROV designed specifically to meet the unique requirements of the scientific community. Subsequent years included design, fabrication, testing, and deployment of components for AUVs, establishing features for the Monterey Accelerated Research System (MARS) subsea node, design of experimental components for the study of the impacts resulting from ocean acidification, and design of improved components for tagging Great White Sharks. Farley also has numerous technical publications both as first author and co-author.

Having a keen desire to motivate students to pursue activities related to science, technology, engineering, and mathematics (STEM), Farley has been an advocate and active participant with the MATE (Marine Advanced Technology Education) ROV Competition. He has been a technical judge in yearly regional and international competitions for over ten years.

In addition to the new opportunities in support of IEEE OES officers, and in his new role as member of the Associate Editor team, Farley is keeping occupied with unpacking his household after recently moving to his new home in Orange, California, working with long-time friend John Darjany (IEEE Life Member) at PCE Labs on a list of interesting engineering projects, and assisting with the myriad and seemingly innumerable tasks in support of his family's trust properties. If there is any "leisure time", biking and driving his BMW Z3 are strong contenders!

Takumi Matsuda

Takumi Matsuda (S'12-M'15) received his master and Ph.D. degrees in environmental science from the University of Tokyo, Japan in 2012 and 2015, respectively. He is a project researcher at Institute of Industrial Science, the University of Tokyo. His research interests include multiple AUV survey, probabilistic robotics, and acoustic positioning and communication.

Katsuyoshi Kawaguchi

Katsuyoshi Kawaguchi (M'96) was born in Tokyo, Japan, in 1964. He received the B.E. degree in ocean engineering, the M.S. degree in marine science, and the Ph.D. degree in marine science from Tokai University, Tokyo, Japan, in 1987, 1989, and 1993, respectively.

From 1993 to 1995, he was a Lecturer at the Department of Marine Mineral Resources, Tokai University. Between 1995 and 1996, he worked at the Mechanical Engineering Department, University of Hawaii, Honolulu, HI, USA, as a Postdoctoral Research staff. From 1996 to 1998, he was a Postdoctoral Researcher at the Deep Sea Research Department, Japan Marine Science and Technology Center, Yokosuka, Japan. In 1998, he had a tenure researcher track at the Japan Marine Science and Technology Center [currently the Japan Agency for Marine-Earth Science and Technology (JAMSEC)] and became a Principal Research Scientist in 2008. Since 2008, he has been directing the technology

development group, R&D Center for Earthquake and Tsunami and became deputy director in 2016. He also acts as a Visiting Professor at Tokai University and the Institute of Industrial Science, University of Tokyo (Tokyo, Japan). His research background is underwater robotics (hardware and software design, and control) and ocean-observing system development. He is currently involved in development of the geoscientific real-time seafloor observation system and its applications.

Dr. Kawaguchi is the chairman of the IEEE Oceanic Engineering Society (OES) Japan chapter (2015/06-).

Professor Masakazu Arima, D.Eng.

Professor Masakazu Arima is Professor of Marine System Planning at Osaka Prefecture University, Japan. His research is focused on Underwater Robotics and Human Factors. He has developed several kinds of AUGs (autonomous underwater gliders) and an ASV (autonomous surface vehicle). He has also proposed physiological evaluation methods of human response to low-frequency oscillation / high-stress environments. He is a member of Japan Underwater Robot Network, IEEE/OES, IEEE/SMC, MTS, Japan Society of Naval Architects and Ocean Engineers, Japan Ergonomics Society, the Robotics Society of Japan, the Japanese Coral Reef Society, and Japan Society of Ocean Policy.

Kenichi Asakawa

Kenichi Asakawa received B.E., M.S., and Dr. Eng. degrees in Engineering from Tokyo Institute of Technology, Tokyo, Japan, in 1974, 1976, and 1979, respectively. He joined KDD Research and Development Laboratories in 1979, where he was engaged in the development of ROVs, AUVs, and other technologies related to construction and maintenance of underwater telecommunication cables. In 2002, he moved to the Japan Agency for Marine–Earth Science and Technology (JAMSTEC, formerly, Japan Marine Science and Technology Center), Yokosuka, Japan. Since then he has been involved in the development of cabled ocean observation systems and other underwater technologies including ceramic pressure-tight housings and optical salinometers. Now he has been engaged in developing a new underwater glider for long-term virtual mooring.

Blair Thornton

Blair Thornton is an Associate Prof. at the University of Southampton (adjunct Institute of Industrial Science, The University of Tokyo) with over 15 years of international research experience in marine robotics and sensing. He has participated in more that 40 scientific research expeditions, 25 of which as chief scientist, spending a total of ~350 days at sea. He specialises in the development of in-situ optical sensors and their application using underwater vehicles. This includes the development of a laser-induced breakdown spectrometer (ChemiCam), which was the first device to perform in situ multi-elemental analysis of hydrothermal fluids and mineral deposits at oceanic depths of > 1000 m, a towed gamma-ray scintillation spectrometer (RESQ hose) that has been extensively used to monitor the distribution of radioactive material in marine sediments along transects of more than 5,000 km following the Fukushima disaster. In addition to chemical sensors, Blair has expertise in machine vision and robotics and has developed a series of seafloor 3D visual mapping systems (SeaXerocks) that have been used to digitally reconstruct over 50 hectare of the seafloor at millimetre-order resolution over 85 deployments.

Toshihiro MAKI

I am Toshihiro MAKI, Associate Professor of the University of Tokyo. I received PhD from the University of Tokyo in 2008. My research topic is autonomous underwater platform systems, especially multi-AUV navigation and resident AUV system based on seafloor station. Recently I am also interested in emerging possibilities of low-profile AUVs. My favorite foods are broiled eel and ginger pork.

Hisashi SHIBA

Cheers!

I am a sonar system engineer, and a senior manager of NEC Corporation. I received Ph.D. degree from the University of Tokyo in 1995. I have experienced a variety of projects from automatic image inspection of semiconductor related devices to searching actors in videos by face recognition. I am working on sonar system signal processing, image processing, pattern recognition, and machine learning in this decade. I am also interested in various areas of physics and crime dramas in US.

Member Benefits—Did You Know?

Free Webinars

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**Please note that the vast majority of IEEE-USA's free webinars are hosted using Webex software, which may require their free plug-in player to view.*

Source: IEEE Member Benefits Bulletin: June 2017

VPTA Report

Malcolm Heron, OES Vice President for Technical Activities

There is a theory that the child of an Engineer is attracted to Physics; the child of a Physicist is attracted to Mathematics; the child of a Mathematician is attracted to Philosophy; and the child of a Philosopher becomes a Theologian. A nice idea but I am not convinced about the validation of that. However, a similar experiment has actually been done by IEEE.

We started out as IRE, the Institute of Radio Engineers (IRE) and then merged with the American Institute of Electrical Engineers (AIEE) on 1 Jan 1963 to become the Institute of Electrical and Electronics Engineers (IEEE). By the time we got to the 1980s, and the 25-year celebration, about 25% of the membership were Physicists. I am a trained physicist and I joined IEEE in the '70s because I was attracted to the diversity of technical areas and the wide options for publications. Now, with 39 Societies ranging from engineering to topics in society and humanity, IEEE has matured with the motto of Advancing Technology for Humanity.

In many ways the Oceanic Engineering Society has some distance to go along this path. We have 19 Technology Committees which, in the main, have scopes that are strongly based on technology and engineering. In practice our symposia and conferences now include science and applications that deliver to the Common Good. For these reasons the Technology Committee Chairs have decided to refresh the TCs, and at their meeting in Aberdeen in June they asked the Affinity Group Convenors (Groups of Technology Committees) to think about the scopes and names of our Technology Committees and their activities, and come up with a plan to refresh the TC structure. Their commission is to look at the Technology Committees and their alignment with the strategic goals of OES. I will be short-circuiting this process at the AdCom meeting in Alaska to introduce a new TC on Polar Oceans, to meet the emerging emphasis by IEEE on the poles. It was interesting to me that the TCCs felt no need to be aligned with OCEANS topics because they change from venue to venue; and the partnership with the Marine Technology Society brings some topics that are not central to OES. In fact, the partnership with MTS makes more sense when you acknowledge that IEEE-OES goes all the way from engineering to science and society.

If you have any comments on the review of the Technology Committees please contact me on **mal.heron@ieee.com**.

OES VPCD Report

Albert J. Williams 3rd (Sandy Williams), OES Vice President for Conference Development

Venues for future OCEANS conferences have been explored. OCEANS'22 in Chennai, India is gaining strength based upon a series of meetings held in Chennai between the two Societies' Chapters there. Change in positions of key players in that location have caused some realignments but the hotel and convention center are still viable and a new General Chair is on board with a strong LOC to back him up. It should be possible to confirm OCEANS'22 Chennai at the OCEANS Conference in Anchorage. OCEANS'24 is just getting started as a possible venue in Australia with Perth or Melbourne as possible locations. OCEANS'19 Marseille is moving along and no longer a VPCD concern; transitioned to VPCO. OCEANS'21 Porto is

VPCD, Sandy Williams, addressing the AdCom at OCEANS'17 Aberdeen.

also at nearly the transition point to VPCO. With a change in the dates of the conference in Porto this should be settled in Anchorage and transferred to VPCO. OCEANS'23 in Europe has not been chosen although there are several potential possibilities. In North America OCEANS'18 Charleston is no longer a VPCD concern. OCEANS'19 Seattle is ready for transition to VPCO with an ICX completed and MoU recently signed. OCEANS'20 Biloxi has been moving along well and OCEANS'21 San Diego is ready for presentation in Anchorage for acceptance and then transition to VPCO. Most recently a trip to select the venue in San Diego was completed and will be reported upon in Anchorage. There are openings in the North American schedule from 2022 onward and we are ready to hear expressions of interest from Hampton Roads, VA; Halifax, NS; St. John's, Newfoundland; or another location in eastern North America for 2022.

Sea the Difference

Diane DiMassa, Ph.D., Vice President of Conference Operations

The OCEANS Conference—our Flagship Conference. The OCEANS Conference—there have been 60. The OCEANS Conference—hosted by over a dozen different countries on four different continents. The OCEANS Conference—a long-standing venture with our co-sponsors, the Marine Technology Society (MTS). The OCEANS Conference—oversight and administration is changing.

What this means to you? Well, probably not much. What this means to me? An ocean of change. (Sorry for the pun. Well, no, not really.)

Recently the OES Administrative Committee approved a change in the duties and responsibilities of the Vice President of Conference Development (VPCD) and Vice President of Conference Operations (VPCO), and the Society Bylaws are being updated to reflect this. Simply put, I have a new job description. In the past, the responsibilities for OCEANS conferences were divided between two Vice Presidents, one centered on future planning and one centered on successful operation. Now, all activities related to OCEANS will be under the purview of the Vice President of Conference Operations. This means that the entire thread of a conference will have more continuity and transparency—from the first discussions of strategic planning through the reconnaissance and vetting, the site approval, the detailed planning, and all the way to successful operation and wrap-up. Uh-huh, I have a big job. Fortunately, there are two committees that are involved in the oversight of an OCEANS conference—the Reconnaissance (RECON) committee and the Joint OCEANS Administrative Board (JOAB). Both of these committees are comprised of members of both the OES and the MTS. The primary function of the RECON committee is to identify and evaluate prospective sites suitable for holding OCEANS Conferences. The primary function of the JOAB Committee is to provide oversight

Vice President of Conference Operations, Diane DiMassa, addressing the OES AdCom at OCEANS'17 Aberdeen.

of a conference's Local Organizing Committee (LOC) and to coordinate and guide LOC activities related to the OCEANS Conference and Exhibition. Both of these committees now report to the VPCO. This includes all OCEANS conferences, regardless of location throughout the world.

However, this does not mean that the VPCD has nothing left to do. The complete threads of all other conferences, workshops, and symposia that are sponsored in whole or in part by the OES will now fall under the purview of that office. The OES Administrative Committee firmly believes that this change in duties and responsibilities will make the management of these Society activities more efficient and effective. I happen to agree.

But this is not the only change. Recently, a new committee, joint with our partners MTS has been developed. The primary functions of the OCEANS Conference Steering Committee are to ensure that decisions related to OCEANS fit within the OES Strategic Plan and to ensure that there are close communication

and cooperation between OES and MTS. The VPCO is a member of this new committee.

But wait, there's more. One of the first actions of the Steering Committee was to ensure that the OCEANS conference continued to be well supported administratively by a Professional Conference Organizer (PCO). A Request for Proposals was published, applications were received and evaluated, and the OES is pleased to announce that a contract has been signed with MCI as our new contractor for OCEANS Conferences in North America. MCI has considerable experience with events similar in scope to the OCEANS Conference and offers a complete range of meeting services, technology solutions, development services, etc. that are needed to support professional technical conferences. Although MCI is a global organization, conferences outside North America are not included in this contract at this time. We are confident that this new partnership with MCI will keep OCEANS as the premier international ocean engineering conference.

So there you have it. An ocean of change. A wave of innovation. The crest of technology. The flow of information. The depth of investigation. The turbulence of research. The tide of development. OK, that's enough. I need a drink of water.

From the Journal Editor's Desk: Notes from Aberdeen: the Silver City

Ross Chapman, Journal Editor-in Chief

About a year ago I wrote an editorial on Technical Communications (TCs) (Editorial: 'TCs or not TCs' IEEE J. Oceanic Eng., 41, 499–500 2016) to tell our J-OE community about TCs–what they are and the benefits of having this type of contribution as an option for authors. Since then, from many discussions with authors, reviewers and Associate Editors, I've realized that the editorial was only the first step in a very long-term education process to bring everyone up to speed. So, it's not surprising that you'll find yet another editorial in the July 2017 issue that revisits TCs, with new perspectives and information. I'm not going to repeat the story here, so please take a moment to read the editorial. Suffice to say that I am convinced about the benefits of TCs: they provide an opportunity for authors to publish information for the use of the rest of the research community in oceanic engineering.

Instead, I'm going to talk briefly about Aberdeen. OCEANS'17 was a blast, set in the Silver City, with access to some of the finest of Highland distilleries and within easy drives of an uncountable large number of historic castles. And the Celidh! Where else would you have the chance to dress in Scottish tradition, dine, sample whiskey and dance all night? Hat's off to John Watson for organizing such a wonderful Scottish welcome for all of us. And a heap of thanks also to Kiltmakers in Aberdeen for providing instructions on how to wear a kilt. I'm happy (and greatly relieved) to say that I didn't lose it in all the dancing!

Apart from the good times at the conference, it was great fun to travel into the Speyside highlands north of the city with Marinna and Stan. The feature of the tour was a stop at Ballindalloch Castle, a historic site and home that is open to public visit. It's a place with royal connections: royals have fished salmon in the nearby River Spey, and family children have served as pages to the Queen. You can see from the photo that the weather co-operated wonderfully well while we wandered around the estate! I have to confess that the other feature was a visit to the Glenlivet Distillery. Glenlivet is well known, you can get the whiskey almost anywhere. Instead, the highlight of the visit there was a stop outside the distillery by a field of Highland cattle. The hairy beasts with the formidable horns were off in the distance when we arrived, but they are curious characters and came over to check us out.

Figure 1. With John Watson at the Celidh.

Back to Aberdeen at the end of the day, the sun was still shining on the Silver City. Connecting Aberdeen and silver is a clever marketing idea, it comes about this way. To the uninformed and maybe unobservant eye, Aberdeen is a city of gray stone, which is a fact since the stone that you'll see in most if not all the buildings

Figure 2. Ballindalloch Castle in the sunshine.

Figure 3. Highland cattle on their way over to greet us.

was quarried from a nearby site. If the sun isn't shining, that's the impression anyone would get. But when the sun comes out, the stone sparkles like silver! It's full of mica crystals. So, with some clever marketing, Aberdeen becomes the silver city.

Back to a bit of business, it's a pleasure to introduce our most recent appointment to the Editorial Board, Dr. Blair Thornton of the University of Southampton. Dr. Thornton brings expertise in Underwater Spectroscopy and Imaging, Underwater Robotics, and Localization and Mapping, adding to our capacity on the Editorial Board for managing reviews of papers related to Autonomous Underwater Vehicles. This is our fastest growing research area, and I greatly appreciate Dr. Thornton's willingness to join the Board.

Finally, I usually conclude with the list of papers that were published as Early Access papers on IEEE Xplore and will appear in regular issues soon. Here's a new twist this time. For your homework, check out the Early Access button on the Journal website on Xplore. You'll find the most up to date list of papers there!

That's it for now.

Ross Chapman
Editor in Chief

Chapter Coordinator's Report: What's in your Chapter's Wallet Today?

Jim Collins, OES Chapter Coordinator

For some Chapters the answer to the above question is positive. Since the OES started to give a financial incentive for holding technical meetings a few years ago, several Chapters have benefited.

The following paragraphs outline incentive plans by both the IEEE and the OES to promote activity in OES Chapters. Although the financial incentive is based on holding a least two technical meetings in each twelve-month period from November 1st to October 31st, the incentive funds received may be used to promote technical, administrative, social, professional and student activity. Please let me know if you have any questions on this initiative by the OES.

For the last few years there have been two sources of financial incentives available for IEEE OES Chapters that have organized at least two technical meetings annually. The first incentive is supplied by the IEEE HQ to a Chapter through its parent Section. It is typically in the range of US$200. The processing of this happens automatically if a Chapter has reported two or more technical meetings on L31 forms, and the list of Chapter officers is lodged with IEEE before February of the following year. This incentive may take two to three more months to be actually credited to the parent Section or Council that hosts the Chapter. If the Chapter has an independent bank account it may request the parent Section or Council to then forward the funds.

The second source of incentive payment is sent from IEEE HQ at the request of the OES Treasurer. The amount is determined annually in November by dividing the available year end surplus (budgeted for the Chapters) among Chapters eligible to receive it. This year eligibility is based on a Chapter satisfying the following requirements:

1) At least two technical meetings must be held between 1 November 2016 and 31 October 2017.

2) L31 forms must have been filed by 31 October 2017 for those meetings
3) The Beacon Editor(s) must have accepted for publishing two completed technical meeting reports for those meetings by 31 October 2017. Copies of the emails of acceptance should be attached with the application.
4) An IEEE OES Chapter Incentive Application and Banking Information form must be received by 31 October 2017. Blanks have been sent to Chapter Chairs.

Information on eligible incentive funding applications will be circulated to the OES ExCom before their November meeting. At this OES ExCom meeting the budget to year end will determine the total amount available for incentive payments from 2017 funds, if any. ExCom may limit the amounts at their discretion. In the case of Joint Chapters, the incentive is reduced in proportion to the number of OES members in the Chapter. Chapter current year technical meetings that do not receive Beacon publishing acceptance by October 31, 2017 will not be counted toward the 2017 incentive calculation but a maximum of one may be used for the 2018 incentive calculation if accepted.

Recent OES Beacons have published meeting reports for Victoria, Singapore, India, Malaysia, and New South Wales. At this time, there are thirty OES chapters in the world which would each be eligible for the incentive funds if they satisfied the above four conditions. If you are interested in helping your Chapter organize meetings and to receive incentive funds, please contact your Chapter Chair. Their contact information can be found on the inside back cover of this magazine.

There are Sections without OES Chapters that have large numbers of OES members. These include Boston (63), Baltimore (44), New Orleans (18), Santa Clara Valley (41), and Beijing (23). OES members in those Sections who are interested in forming a new OES Chapter can look up the names of the OES members in their Section by signing on to my IEEE and using the Advanced Search tool in the IEEE member Net window. Twelve petition signatures are required. Let me know if you have a problem.

Finally, I would like to congratulate Anibal Matos and his colleagues on the formation of a new Portugal Chapter. If you are travelling there and would like to discuss giving a seminar, send him an email.

Young Professional Activities
Face to Face: A Young Professional's First AdCom Meeting

Brandy Armstrong, Elected OES AdCom member, OES WIE Liaison

I'll admit it. Attending my first OCEANS as an elected Administrative Committee (AdCom) member (and new mother) was a little intimidating. The 24 hour international travel time with an infant alone was cause for anxiety. Add to that meeting so many new faces and trying to remember all those names, which many of you may have noticed I am quite bad at, and you can imagine I was in quite a state. Thank goodness for name tags. Now that I am back in the US and reflecting on everything, I can exuberantly say that I not only had a fun but very productive time in Aberdeen! In addition to the AdCom meeting, I also participated in fruitful meetings with fellow Promotion and Outreach (PO) committee members and the Young Professionals (YP) Oceanic Engineering Society (OES) group between talks. I had the opportunity to put a whole lot of faces to email correspondence names and make a lot of new contacts. I even managed to help a fellow OES member troubleshoot a technical issue. But let me take a step back and introduce myself.

Taking in some family time at the OCEANS'17 Aberdeen grand banquet with my husband Steve Mortillaro and daughter Aileen.

My name is Brandy Armstrong. I am a hydrologist at the U.S. Geological Survey's Hydrologic Instrumentation Facility (HIF) located at Stennis Space Center, where I manage the hydraulics laboratory and quality assurance programs for velocity meters. I am an elected AdCom member for 2017–2019. I am a member of the Promotion & Outreach and Membership Development committees. I am also the OES liaison to Women in Engineering and a member of IEEE Young Professionals. Even if you're not actively participating in OES committees my name may still sound familiar. If you are a member of the IEEE OES LinkedIn group or Facebook group (and page), you may have noticed I have been posting some (hopefully) interesting content on a pretty regular basis. I am working with the Promotion and Outreach and Membership Development committees to implement a social media strategy and improve web-based interfaces that will help increase participation in OES activities.

You might be thinking, wow, as a YP and a relatively new member of OES, it's surprising that she is making the time to actively participate in the organization. I know that at least one YP I spoke with was thinking that. He was surprised and excited to meet an AdCom member at the YP lunch meeting who was also a YP. That conversation brought into focus exactly why I need to continue to be an active participant in OES.

As I am learning how the organization works and coming to understand where it has been and where it is headed, I hope that I am also bringing a fresh perspective that will help OES attract more women and young professionals to actively participate in OES. After such a great first AdCom meeting in Aberdeen, I am really looking forward to our next AdCom meeting in Anchorage!

For those of you who would like to get involved, please contact me at brandy.armstrong.us@ieee.org. Also be sure to stay tuned for our YP-BOOST program to begin providing funding for selected OES YP members to travel and participate in the OCEANS conferences starting next year.

OES Young Professionals Meeting at OCEANS'17 Aberdeen

Frédéric Maussang, OES Young Professional CHAIR

OCEANS'17 Aberdeen was an occasion to have a meeting of the IEEE/OES Young Professionals members.

This meeting took place in Room 1 of Aberdeen Exhibition & Conference Centre (AECC) on Thursday 22nd June 2017.

It brought together a dozen of YP members, including Brandy Armstrong, OES WIE (Women in Engineering) Chair, and me, as YP Chair.

The subjects covered in this meeting were:

- Ask the participants to introduce themselves (name, position…);
- A short presentation on what is a YP, of the IEEE YP community, of the OES YP branch (history, figures…);
- News and description of the future YP-BOOST program;
- Discussion on the YP position and needs in OES.

The discussion was particularly on the future YP-BOOST program, what it brings to OES and its committees, and to the YP members.

You will be informed very soon about the agenda of this program, and the beginning of the candidature process, presently scheduled for a September start.

We will continue to keep in touch regarding this program and future YP events. See you soon.

Fred.

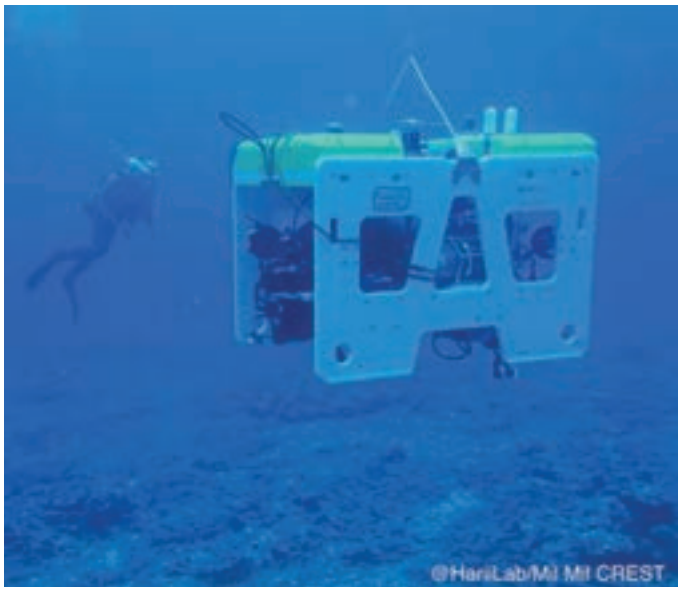
Email: frederic.maussang@imt-atlantique.fr

Your YP Chair in front of Glenfinnan Viaduct, Harry Potter's railway viaduct, Scotland.

UK and Japan Collaboration in Marine Robotics and Coral Mapping

Blair Thornton and Toshihiro Maki, Beacon Associate Editors

The diverse and abundant marine life that **coral reefs** support creates spectacular scenes that are enjoyed by hundreds of thousands of divers from all over the world. While to most, the word coral will conjure up images of people snorkeling in warm, clear blue waters, however, coral reefs are also known to exist more than a kilometre beneath the ocean's surface, in complete darkness where the temperature of the water is just a few degrees above freezing. The role that healthy coral plays in supporting marine life, not only in the shallows of the tropics but also in the deep ocean, is seen as one of the key essential variables for scientists to form a better understanding of the marine ecosystem.



AUV TUNA-SAND2 with a diver off Sesoko Island (2016). Photo courtesy of Harii Laboratory of the University of the Ryukyus.

The **Daiwa Anglo-Japanese Foundation** Award has been awarded to Blair Thornton of the Southampton Marine and Maritime Institute (SMMI) of the **University of Southampton** and Toshihiro Maki of the Institute of Industrial Science (IIS) at the **University of Tokyo** (both Beacon Associate editors) to allow marine robotics researchers in both the UK and Japan to coordinate their efforts in addressing the challenges faced when applying robotic systems to study these unique underwater environments. This effort will complement the efforts of the University of Southampton's **Maritime Robotics Lab** (MRL), which has recently been awarded a grant by the UK's Natural Environment Research Council (**NERC**) to develop a high-resolution 3D seafloor visual mapping sensor, under the **OCEANIDS** program, by allowing researchers in the UK to participate in a collaborative survey expedition off **Sesoko Island** in **Okinawa**.

The autonomous underwater vehicle (AUV) **TUNA-SAND 2**, developed under funding of the Japan Science and Technology **JST-CREST** program, and **HATTORI** developed by the IIS will be used to visually map the distribution of live coral together with scientists at the Harii Laboratory of the **University of the Ryukyus**. This **JST-CREST** Field Campaign will also welcome experts from the **University of Sydney's** Australian Centre for Field Robotics (ACFR) who will share their expertise. Coordinated international efforts like these, which are enabled by schemes such as the Daiwa Foundation, are expected to pave the way for sustainable, international collaborations that will drive progress towards establishing global standards to inform responsible stewardship of our oceans. This is becoming increasingly recognized by governments and funding agencies, with programs such as the **NERC-JST** joint UK and Japan **Marine sensor proof of concept** call being recently announced.

The collaborating coral reefs survey will be conducted from 14–18 August, this year. The highlights (fingers crossed) will be reported in the next Beacon issue.

Chapter News

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

Victoria Section and OES Chapter Joint Technical Meeting

Reported by Jim Collins

On Friday April 21st, 2017, Heike Schmitz of the Jupiter Research Foundation (JRF) of Los Altos, California, gave an invited talk titled, A novel method of obtaining near real-time observations of phytoplankton from a mobile autonomous platform.

Heike's project centers on the important science of phytoplankton, the base of the marine food network. Emerging marine observation technologies provide new opportunities to learn about phytoplankton communities with greater spatio-temporal resolution. Autonomous vehicles enable real-time ocean data collection and communications over long durations, in varying sea states and at lower cost than crewed ships. Liquid Robotics' Wave Glider is one of these autonomous marine vehicle systems and JRF is developing a novel device to obtain near real-time phytoplankton observations from this mobile unmanned platform. The Jupiter Autonomous Microscope (JAM) is an autonomous microscope imaging system that acquires crops and geo-tags phytoplankton images and sends them to a shore-based server via mobile phone or satellite networks. On-shore processing includes automated object measurements and classification, as well as statistical calculations. Images and corresponding data are made accessible on a dedicated website that allows filtering, annotation and sharing. Successfully deployed on Wave Gliders for several weeks at a time, JAM provides a unique view of phytoplankton community structure. Early prototypes of the JAM camera and sampling system price out at about $25,000 and the hope is to reduce this to about $10,000.

Jupiter Research Foundation (JRF) is a 501(c)(3) non-profit scientific research organization, established in 2003. It is dedicated to developing and applying new technologies for monitoring and understanding the natural world, and sharing them with the public and the academic community. This mission, and the founder's passion for the ocean early on, led to the invention and commercialization of the famous Wave Glider through the spin-out of the commercial venture Liquid Robotics, Inc., in 2007. Today JRF's 14 members are involved in a variety of projects around application of the Wave Glider as well as going beyond that into realms from Biology to Radio Communication and Educational Outreach, involving creatures as big as whales and as small as single-celled organisms.

Heike Schmitz works at the Jupiter Research Foundation (JRF) in Los Altos, California, where she manages the JRF Autonomous Microscope (JAM) project as well as develops its diverse underlying software system. For these roles, she combines a background in software engineering and management with a passion for marine biology and an interest in marine microalgae. She studied Computer Science at the Federal Institute of Technology in Zurich, Switzerland, and after a successful career as a software engineer and engineering manager at Google, she returned to college for a B.S. in Marine Biology from UC Santa Cruz.

The talk, sponsored by the IEEE Victoria Section and the IEEE OES Victoria Chapter, was held at the Technology Enterprise Facility of the University of Victoria with six IEEE members and fourteen nonmembers in attendance.

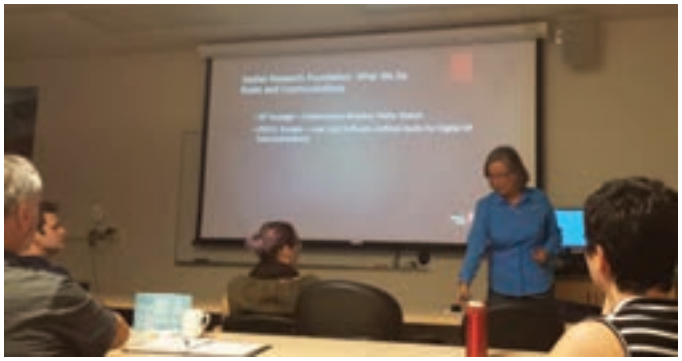
Canadian Atlantic OES Chapter Report

Dr. Ferial El-Hawary, OES Chapter Chair with Cooperation of Canadian Atlantic Section and Chapter's Volunteers

Reported by Christopher Whitt

It is a pleasure to report on this year's OES Chapter activities. To date the Canadia n Atlantic OES Chapter has held four successful events featuring prominent speakers including a Distinguished Lecturer.

The first event this year was held on April 18th, jointly sponsored with the Dalhousie University Electrical & Computer Engineering Graduate Student Conference along with the Section's Women in Engineering (WIE) Affinity Group. The highlight of this event was the keynote speaker, Dr. Marlon R. Lewis, Director of the new Ocean Frontier Institute at Dalhousie



Heike Schmitz Talk.

Dalhousie Students Attendees.

Dr. Marlon Lewis in the middle receiving gift of appreciation with Dr. Jason Gu on the Left & Dr. Ferial El-Hawary.

Workshop Attendees.

University, who spoke on the topic "Ocean Technology and New Opportunity for Nova Scotia" with emphasis on optical sensors. Dr. Lewis is Professor Emeritus, former Chair of the Department of Oceanography, and founder of Satlantic (now Sea-Bird Scientific Halifax), which develops optical sensors for oceanographic research.

Dr. Lewis has served on numerous advisory councils and boards for organizations and governments in Canada, USA, Europe, Japan and Asia, including the U.S. Woods Hole Oceanographic Institution, the Council of Canadian Academies, and on the Advisory Committee to the Canadian Minister of International Trade. The talk was well attended by EE Graduate Students, faculty members, and the Dean of Engineering, as well as others from the Oceanography Department at Dalhousie University.

The second event was a workshop on May 23rd entitled "Electric Boats," held at the Royal Nova Scotia Yacht Squadron and jointly sponsored with the local Power Engineering and Industrial Applications (PES/IAS) joint chapter. The workshop was facilitated by Dr. Sue Molloy. Dr. Molloy spoke about the long history of electric propulsion use in Marine Vessels, the surge of interest in diesel electric propulsion and electric thrusters over the past 20 years, including how recent progress can be applied to small vessels. She highlighted some exciting applications for small vessels from the AKA Tugs to ferries in Norway and as more renewable energy becomes available, how electric options will be looked at more seriously in the marine sector. Workshop attendees then broke into groups to discuss

how electric boats can be integrated into grid energy systems as energy storage, and what obstacles need to be overcome to make electric propulsion a real option in fishing.

Dr. Molloy is a consulting engineer, researcher and adjunct professor of Ocean Engineering, specializing in Marine Renewable Energy, Eco-Ships and sustainable engineering. Sue's doctoral work focused on ship propulsion and diesel electric propulsion. She is the international chair for the International Electrotechnical Committee River Turbines Power Performance Project Team, and her consulting clients include ocean related SMEs, tidal power project developers, non-profits, academia and government.

Finally, on July 4th, the Chapter held an event including two Distinguished Lecturers by Dr. Marcia Isakson of the Applied Research Laboratories (ARL) at the University of Texas, Austin. In the afternoon, Dr. Isakson spoke on "Underwater Acoustic Modeling with Finite Elements," and in the evening, on "Environmental Sensing with AUV-based Sonar." Both talks were well attended by a wide cross-section of members and non-members from industry, government, and academia. The two talks were made possible by the generous financial support of the Oceanic Engineering Society's Distinguished Lecturer Program.

In the first talk, Dr. Isakson reviewed recent progress in applying finite element methods to acoustic modeling problems. Underwater acoustic propagation and scattering is normally modeled by various approximations to the Helmholtz equation which neglects complexities in the environment, multiple scattering events and/or backward propagating waves. However, finite element modeling provides a method of solving the Helmholtz equation. Finite element models are completely customizable to include sound speed profiles, bathymetry, a range of sediment properties and ice cover. Dr. Isakson presented examples of the finite element method applied to acoustic propagation and scattering in a variety of environments including those with rough seabed, air/water gravity waves and ice keels.

In the second talk, Dr. Isakson discussed high-frequency AUV-based sonars as a unique method of mapping acoustic refraction and scattering by water column features such as tidal fronts. These structures have a profound effect on sonar

Dr. Marcia Isakson addressing her talk.

Figure 1. Delegates at OSES 2017 Symposium.

performance, and have been explored with satellite, imaged with marine radar, directly measured with CTD and inferred through propagation measurements, but AUV methods offer the possibility to map them dynamically over a large area. A proof of concept was carried out in the Columbia River in September of 2014 and 2015. In these field tests, a forward-looking sonar was used to map large hydrological events. These events were simultaneously sensed with marine radar and a large swath of the tidal front was imaged with both systems.

Because the marine radar is only sensitive to surface features, the use of the sonar provides the underwater picture of the event for both fluid dynamics model verification and prediction verification for remote sensing techniques. This sensor is now being deployed on a REMUS 600 AUV for seven field trials in the next five years in rivers and estuaries to further explore the method.

Dr. Marcia Isakson has been involved in research in underwater acoustics at the Applied Research Laboratories at The University of Texas at Austin since 2001, and currently is the principal investigator on two Office of Naval Research Projects. Her current research interests are the acoustics of ocean sediments, finite element modeling, acoustic scattering and propagation and high-frequency AUV-based sonar. Dr. Isakson is currently serving as the president of the Acoustical Society of America, and a member of the governing board of the American Institute of Physics. Dr. Isakson has been designated as a Distinguished Lecturer of the IEEE Oceanic Engineering Society since 2010.

Our Canadian Atlantic OES Chapter thanks the OES Society, and local Section /Chapter volunteers for adding to the success of these events.

Providence Chapter—Offshore Energy Storage Symposium, OSES 2017, July 12–14, 2017, Woods Hole, MA

Albert J. Williams 3rd., Providence Chapter Chair

This symposium, fourth in the series and for the first time held in the US, was hosted at the Woods Hole Oceanographic Institution Wednesday through Friday, July 12–14, 2017. Organizers were Rupp Carriveau from Windsor University, Ontario, Seamus Garvey from University of Nottingham, UK, and Tanio Sant from University of Malta. Previous OSES Symposia in 2014, 2015, and 2016 were held in Windsor Ontario, Edinburgh UK, and Malta. There were 39 papers presented to an audience of about 80 delegates from a great many countries. Fig. 1 shows some of us getting up for a coffee break.

By chance the OSES 2017 Icebreaker on Tuesday, July 11, was preceded by a Woods Hole Oceanographic Institution meeting for the Bureau of Ocean Energy Management (BOEM). And we were fortunate to have a plenary talk on Wednesday by the Wind Program Director of MassCEC, Nils Blogen (Fig. 2) who pointed out to us that Massachusetts has the highest potential for offshore wind power of the entire US east and west coast. Yet so far the only offshore wind farm is in Rhode Island, off Block Island with five turbines just now being turned on.

The combination of renewable energy production with energy storage, made more demanding by being offshore, addresses a need not fully appreciated before this symposium by me. I had thought that the intermittency of PV solar power, wind harvested by large turbines, and possibly wave and tidal power could be accommodated by the very much greater source of power in the land based electric grid. But this is only possible if the renewable source is minor. Energy storage is the little recognized elephant in the room and must not be overlooked when renewable power becomes a significant part of the total electric power mix. On land, particularly where there are mountains, hydroelectric power can be stored by pumping water into an elevated reservoir when energy production exceeds demand. Even without mountains, air can be pumped into an underground cavern or manmade deep underground pond. This can supply power to the hydro turbines when the demand increases at a savings in the primary hydro source or in an air turbine from the air stored in the underground cavern or pond. But there are no mountains offshore (or land to dig an underground pond from) so when wind turbines or other offshore renewable energy sources exceed demand ashore, either

Figure 2. Nils Blogen, Wind Program Director MassCEC presenting information about the Massachusetts wind potential offshore.

Figure 3. Organizers of OSES 2017: Rupp Carriveau on the left, Judy Rizoli in the center, and Seamus Garvey on the right.

the excess is sent ashore for storage through oversized transmission cables or it must be stored offshore. And this is what many of the presentations addressed.

One approach is to pump air into a submerged storage volume from which it can be allowed to generate electricity by spinning a turbine when the primary source is insufficient to meet the demand. The amount of storage is ideally longer than the periods of calm in the case of winds or waves so that the load can be matched to the source plus storage continuously. Many variations of this were presented such as adiabatic compressed air storage and isothermal compressed air storage. The heat of compression itself in several cases was the form of storage with a thermal heat engine generating the electricity upon energy recovery when needed. In each case the benefits were reduced demand for excess transmission capacity while retaining the capacity for high energy sourcing intermittently.

Combinations of uses also provided benefits such as freshwater production in addition to electricity for islands, cooling as well as electricity in warm regions with sharp subsurface slopes, and chemical storage in the form of ammonia production as a fuel for burning when electricity was needed but there was little wind. The last could also serve for distant offshore floating turbine systems where an electric cable ashore was not practical but ammonia would be a viable liquid product.

Although it was acknowledged that Li ion batteries are the most developed, off the shelf, kind of energy storage, the flavor of this symposium was more tilted towards exploratory for new ideas, not yet implemented in most cases. Details of how to store heat in adiabatic compressed air systems with packed beds of rock or to remove heat in isothermal compressed air systems with fine water sprays were thought provoking. There were talks that addressed seafloor surveying for unexploded ordinance where a wind farm might be installed and for surveying turbines by autonomous drone for leading edge erosion, blade cracking, or lightning damage to blade tips. Test facilities were described as well as structures including fabric bags for capturing compressed air.

Social activities included a clam boil at a Woods Hole Village restaurant for the Gala and breakfasts and lunches in the auditorium on the top of the Clark Laboratory. Fog limited views of the islands but it was attractive nonetheless and the delegates expressed pleasure at the venue.

Singapore Chapter

Reported by Venugopalan Pallayil

The Chapter has been active in organising technical talks and also a social gathering of its members. On 26th April, Dr. Grant B Deane, Research Oceanographer from Marine Physical Laboratory, Scripps Institute of Oceanography (SIO), gave a talk on "The role of bubbles in high frequency underwater noise: from tropic to arctic." In this talk he presented results from his work on near surface bubbles and their effect on sound scattering through acoustic measurements and videography. Models developed from these studies have been incorporated into the propagation model to predict the performance of underwater acoustic modems. He also illustrated how the measurement of ambient noise generated by ice calving is used for quantifying the rate of loss of glaciers in the Arctic. Dr Deane is also currently a scientific collaborator with the Acoustic Research Laboratory, National University of Singapore. (NUS)

Ms. Veronica Koh, Senior Member of Technical Staff, DSO National Laboratories, presented her work on "Design Improvements of an Underwater Low Frequency Projector Based on Clarinet Acoustics" on 11th July 2017. This was her Master's thesis work at Pennsylvania State University and the focus was on modelling the acoustics of clarinet for a possible application as an underwater low frequency transducer.

On 17th July 2017, Dr. Ying Tsong Lin (YT), Research Associate from Woods Hole Oceanographic institution, presented an exciting talk on "3D Acoustic Modelling in a Dynamic Environment." In this talk YT showed how the internal waves can affect the sound propagation paths and discussed the models developed by him to describe the phenomenon. He also shared the experimental results as part of verification of the models.

In addition to the above three technical talks, the chapter also organised a social gathering for its members followed by a dinner. About 20 members participated in the bowling event organised at the West Coast Bowling Centre. There was thrill and enthusiasm

Dr. Grant B Deane delivering his talk at the S2S Conference Room, NUS.

Ms. Veronica Koh interacting with the audience during her talk.

Chapter members getting ready to try their hand at Bowling.

Right lower: It's all written on their faces. All the eyes on the scoreboard. Right upper: The best team receive cash voucher from the Chairman and on the left: The social gathering ends with sumptuous dinner.

all through the event. Cash vouchers were presented to the best team and also to the first three individuals with highest scores. The highly interactive session also included discussions about the future event organisations by the chapter and also membership development. The chapter has also been spending time in the planning of the next Singapore AUV Challenge. See the ad on page ??

India Chapter—Meetings and Activities

R. Venkatesan, Chair—OES India Chapter

General Body Meeting

The General Body (GB) meeting of IEEE-OES India Chapter chaired by Dr. R.Venkatesan was held on 16th Jan 2017 at National Institute of Ocean Technology (NIOT), Chennai. The officers briefed those in attendance on the activities of 2016. Since the term of the present officers ends at the end of 2016, the GB proposed to continue with the same executive committee members for the year 2017.

General Body meeting.

Dr. R. Venkatesan	Chairman
Dr. G. A. Ramadass	Vice Chairman
Mr. N. Vedachalam	Secretary
Mr. M. Arul Muthiah	Treasurer
Mr. S. Rajesh	Joint Secretary
Dr. Unnikishnan	Joint Secretary

Event—1

The India Chapter of IEEE-OES, jointly with NIOT, M/s Teledyne, and the MTS India section organized a 3-day Ocean Technology workshop at NIOT. The workshop was held 16–18 November 2016. Participants from 14 different organizations including Government institutions, universities and private

Group Photo of Ocean Technology workshop.

firms participated. Experts from industries such as Teledyne RD Instruments and CODAR Ocean Sensors delivered lectures and offered training to participants. A certificate was issued to all participants.

Event—2

Technical Talk on Deep-Sea Turbulence Measurements by Dr. Rolf Lueck. Dr. Lueck was a Research Professor formerly with the Naval Postgraduate School, the University of Victoria, and was a Senior Scientist at the Johns Hopkins University. His presentation was organized by IEEE OES India chapter, and held on 3rd November 2016 at the NIOT Campus.

Talk by Dr.Rolf Lueck.

Event—3

IEEE-OES India Chapter, jointly with NIOT, organized a talk on 'Impacts of deoxygenation and low oxygen zones of the Oceans'. The talk was held at NIOT on December 20, 2016. The featured speaker was Dr. Amal Jayakumar, Senior Research Scientist at the Department of Geo-sciences, Princeton University, USA. The talk was particularly informative for those in the Ocean Research community who are interested in the issue of deoxygenation and its environmental impacts.

Talk by Dr. Amal Jayakumar.

Event—4

IEEE-OES India Chapter, jointly with NIOT, organized a technical talk titled "Vision-guided curious underwater exploration robots" delivered by Dr. Yogi Girdhar. Dr. Girdhar is a scientist in the Deep Submergence Laboratory at the Woods Hole Oceanographic Institution, USA. The talk was held at NIOT on 20th Feb 2017. The presentation provided practical information on imparting artificial intelligence features to autonomous underwater vehicles.

Talk by Dr.Yogi Girdhar on vision-guided robots.

Event—5

Shri AN. Subramanian, a scientist, from the Deep Sea Technologies group, representing NIOT, attended the 10th International Symposium on Underwater Technology 2017 (UT 2017) organized by IEEE Oceanic Engineering Society. The symposium was, held February 21–24 2017 in Busan, Korea. The purpose of the symposium was to bring academicians, researchers and engineers around the world to share current state-of-the-art underwater technology. The symposium was attended by an international cadre of those concerned with the application of underwater technologies to issues impacting the global community.

AN. Subramanian, presenting papers on deep sea technology sector at 10th International Symposium on Underwater Technology (UT17).

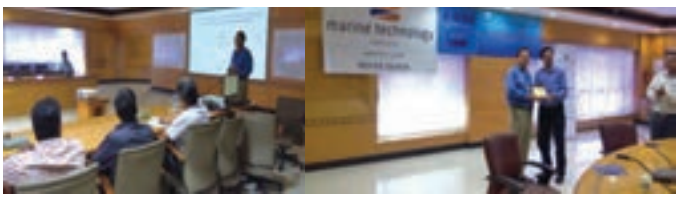
Two papers from the deep-sea technology sector at NIOT that received particular adulation were:

"Modeling and Simulation of Three Phase Variable Inductance BLDC Motor Driven Thruster for Underwater Applications", and "Mechanical Engineering Challenges in the Development of Deep Water ROV (ROSUB 6000)".

Robert Wernli, Vice President for Professional Activities of IEEE-OES, in his address at the 10th International Symposium on Underwater Technology (UT17), praised the NIOT, and Dr. M. A. Atmanand and his team for the success of UT15 at NIOT, Chennai, India.

Event—6

Technical Talk on Autonomous Underwater Vehicles and Sensors Powered by Ocean Thermal Energy by Dr. Yi Chao, Seatrec, Inc, Pasadena, California, USA. The talk was organized by IEEE OES India chapter, NIOT, and MTS India section.



Talk on ocean thermal powered sensors.

Event—7

IEEE OES India Chapter jointly with NIOT, and MTS India section organized a Technical talk on "Acoustic Instruments and its Applications", by Dr Sairajan Sarangapani, Research and Engineering Director at Rowe Technologies Inc, U.S., on April 25 2017.

Dr. Sairajan Sarangapani, Research and Engineering Director, Rowe Technologies, Inc, delivering lecture at NIOT.

Event—8

IEEE OES India Chapter, jointly with NIOT) and MTS India section organized a Technical talk on "Automation of Underwater Soundscape Analyses", by Dr. Shyam Madhusudhana, Research Associate at CSIR—National Institute of Oceanography at Goa, on 23 June 2017. Dr. R. Venkatesan, Chairman IEEE OES India Chapter & MTS India Section, presented a memento of appreciation to Dr. Madhusudhana on behalf of IEEE OES India Chapter.

Lecture by Dr. Shyam Madhusudhana.

Global representations

Dr. Venkatesan, Chairman IEEE OES India Chapter is elected to represent Asia Pacific in the Steering Committee of the Global Ocean Observations System (GOOS) of the UNESCO Intergovernmental Oceanographic Commission (IOC). Dr. M A Atmanand, Chair, IEEE Madras Section is elected as the Chair of the IOC Regional Committee for the Central Indian Ocean (IOCINDIO) of the UNESCO IOC.

Japan Chapter—Science Talk for Marine Day

Reported by Harumi Sugimatsu, Co-vice Chair

An exciting "Science Talk to explore the mystery of the deep sea" was held at Institute of Industrial Science (IIS), the University of Tokyo on 26th July, 2017, in commemoration of the Japanese national holiday "Marine Day." Ken Takai, a scientist from JAMSTEC (Japan Agency for Marine-Earth Science Technology) and Tamaki Ura, an AUV engineer from Kyushu Institute of

Ken Takai giving his talk.

Takaki Ura giving his talk.

HOV vs. Unmanned Submersible.

Attendees.

Technology, debated upon the subjects of the discovery of new creatures in the deep sea (the truth/dream of the scientist) and the emerging technology to open this new door of science (the task/dream of the engineer). The talk was broadcasted live by "Niconico live" (http://live.nicovideo.jp/), and more than 10,000 people enjoyed it. The highlight of the talk was the debate on "Human occupied vehicle (HOV) vs. Unmanned Submersible."

Question: Do we need a new project to develop an HOV diving to 10,000 meters deep?

Tamaki: If we have enough funding, YES, but if not, No. Technology for developing the HOV has already matured and there are no new technological aspects. HOVs could be operated by the rich. On the other hand, its operational and maintenance costs are quite large. The deep sea is a world for the safer and cheaper Unmanned Submersible Systems.

Ken: How about the experience of seeing the strange creatures in an unusual environment, such as in a deep sea? Especially for the younger generation, it must be a very important experience. We should use the limited funds for enhancing the abilities of younger generations. Do we?

Tamaki: Experience of diving into the deep sea stimulates and changes the human nature. A new innovation starts then. When we see the actual things, such as a unique living creature in the deep sea, we can feel their own power directly. Inspired by such power, we can transform ourselves. Especially for the younger generation, going to the deep sea is an important experience.

Ken: Then, shall we go into the deep sea by a new HOV SHINKAI 10000! Otherwise, you could not transform into a new guy.

Tamaki: No thank you. I have already transformed into a "new me" many times without going to the deep sea. That is me.

Dear Beacon readers, your thoughts?

Give us responses: **harumis@iis.u-tokyo.ac.jp**

Malaysia Chapter—Meeting Report and Activities

Prepared by Zulkifli Zainal Abidin, Rosmiwati Mohd Mokhtar and Mohd Rizal Arshad

1. Chapter Meeting

As of August 2017, the IEEE OES Malaysia Chapter has conducted five chapter meetings for the year.

Date	Meeting
25 Feb 2017	12th IEEE OES MY Meeting (Shah Alam, Selangor)
10 Mar 2017	13th IEEE OES MY Meeting (MJIIT, Kuala Lumpur)
19 May 2017	14th IEEE OES MY Meeting (MJIIT, Kuala Lumpur)
14 June 2017	15th IEEE OES MY Meeting (USM Engineering, Pulau Pinang)
8 Aug 2017	16th IEEE OES MY Meeting (IIUM, Gombak Selangor)

2. Technical Seminar on Development of Autonomous Surface Vessel (ASV)

On 22nd May 2017, The IEEE OES Malaysia Chapter organized a technical seminar on Development of an Autonomous Surface Vessel (ASV). The event took place at the Underwater Robotics Research Laboratory, School of Electrical and Electronic Engineering, Universiti Sains Malaysia (USM), Engineering Campus, Nibong Tebal, Pulau Pinang, Malaysia. A one day seminar and workshop was delivered by Dr. Zulkifli Zainal Abidin from International Islamic University Malaysia (IIUM). Dr. Zulkifli is also one of the current executive committee of the IEEE OES Malaysia Chapter.

The purpose of the seminar was to share the research finding, challenges and technologies used in the development of the ASV. The seminar provided an overview of the general system architecture of the ASV, platform development as well as digital signal processing technology used in the system. In the design, the CruzPro™ active transducers were used to provide reliable depth tracking to over 1000 feet. It operated at 120 kHz to prevent interference with other nearby depth sounders and fishfinders. A smart transom mount transducer is also used to provide depth, speed and temperature data to the network. The ASV system incorporated a mobile surface platform, mobile ground station (on site) and a control room.

The seminar was attended by participants from various agencies including representatives from the industry and postgraduate students. The participants were divided into several groups to allow hands-on learning and in-depth explanation from the research team in each section. During the afternoon

Dr. Zulkifli with participants at the seminar.

Hands-on activity during the seminar.

ASV demo at USM's lake.

session, the demonstration was conducted at the lake nearby. The ASVs were deployed to the lake, collected data and the information was transferred to the mobile ground station.

3. Visit to Robotic Design Laboratory

A visit to Robotic Design Laboratory was held on 8th August 2017 in conjunction with the Chapter Meeting which was held on the same day. The laboratory is situated at the International Islamic University Malaysia (IIUM), Gombak Selangor.

Delegates were first introduced to activities that were conducted in the laboratory. Dr. Zulkifli, as a representative from

In front of the Robotic Lab.

In front of Research Team Logo.

Dr. Zul explaining on 3D printer.

IIUM, mentioned that the laboratory was not only conducting research but was also doing some income generation to sustain the group. With the 3D printer technology that is available in the lab, they usually received manufacturing orders from other researchers of different departments.

ASV platform area.

Then the delegates were brought around to see the laboratory, which covers areas for post graduate students work, automatic surface vessel (ASV) platforms, a mechanical workshop, 'take a break' area and others. The lab is also equipped with a meeting room that can cater for around 10–15 people. There is also a control area where the facilities such as a big screen TV panel with a server, computer and laptop attached for the purpose of teleconferencing activity, control and monitoring of ASVs during launching and others. It is interesting to see the activities that run in the lab, which foresee the enhancement and development of the Oceanic Engineering field being cultivated progressively.

OES Connecting Around the World

Kevin J. Delaney, OES San Diego Chapter Chair

The San Diego Chapter assisted retired member Larry M. Occhiello in donating his collection of IEEE/OES *Journal of Oceanic Engineering* to India's National Institute of Ocean Technology. The Institute, based in Chennai, was formed in 1993 and its library did not contain older editions of the *Journal*; Larry's donation allows them to complete their collection. This effort is an example of how our Society connects professionals around the world.

IEEE/OES member Larry M. Occhiello displaying his donated copies of the Journal of Oceanic Engineering.

Young scientists and engineers at India's National Institute of Ocean Technology displaying the back editions of the Journal.

The Singapore Autonomous Underwater Vehicle Challenge (SAUVC) 2018 Dates Have Been Announced

The Singapore AUV Challenge (see page ??) will be held from 9–12 Mar 2018. This is a swimming pool based autonomous underwater robotic competition open for international tertiary students. The objective of the competition is to engage and educate students on the design challenges associated with autonomous underwater vehicles and also develop an appreciation for related technologies. The competition is organised by the IEEE OES Singapore Chapter in collaboration with the Singapore Polytechnic. The event is well supported by IEEE OES, National University of Singapore, DSO National Laboratories and Centre for Sensing and Monitoring, NUS Singapore. For more details visit www.sauvc.org

Call for Papers AUV 2018

2018 IEEE OES Autonomous Underwater Vehicle

Rectorate Building, Porto University, Porto, Portugal

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

Topics

AUV2018 invites the authors to submit contributions in the following topics.

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

Important Dates

Abstract Submission Page Open	**April 9, 2018**
Deadline for Abstract Submission	**June 22, 2018**
Notification for Authors	**July 27, 2018**
Deadline for Full-paper Submission	**September 7, 2018**

Student Poster Competition "AUV conceptual design challenge"

Students are invited to submit proposals to address an AUV conceptual design challenge
The winners will receive incentive fund and travel support!

Organizers

IEEE Oceanic Engineering Society | IEEE / OES Portugal Chapter
IEEE Oceanic Engineering Society
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For Inquiries, please contact AUV2018 Secretariat: **auv2018@lsts.pt**

auv2018.lsts.pt

OES Conference Outreach
CWTM Workshops

Albert J. Williams 3rd (Sandy Williams), OES Vice President for Conference Development

OES has a Current Measurement Technology Committee and CMTC has held Workshops about every four years since the first in Delaware in 1978. The original motivation for a workshop was to advise the user community of physical oceanographers about the quality of existing current meters. At the second CMTC Workshop at Hilton Head, South Carolina, in 1982, Bill Boicourt pointed out that there were three communities present: wizards and high priests, cognoscenti, and happy go lucky users. These communities have been represented at all our workshops since then. The developers of new sensors are in the first group, those who test and calibrate them in the second group, and those who recover measurements from them to understand oceanic and other fluid processes in the third group. At the time of the first workshop the moored current meter of broadest acceptance in the US was the Vector Averaging Current Meter (VACM) while the world's most numerous current meter was the Aanderaa CM. Each of these, while depended upon to obtain observations of mean flow for oceanic "plumbing diagrams", was suspect in its exact precision and freedom from bias in certain conditions. The acoustic Doppler current profiler was introduced at the third CMTC Workshop in Arlie, Virginia in 1986. These Doppler profiling instruments eventually took the lead away from the RCM and VACM although both are still in widespread use today, see Fig. 1 from a paper at 10th CWTM in 2011.

Figure 1. Moored current meters require floatation, wire rope, and anchors. Floatation and one spool of wire rope are shown in this photograph of preparations for loading the R/V Knorr in a snowstorm in Woods Hole before a current meter deployment cruise.

In subsequent workshops, HF Radar as a means for measuring surface currents remotely was introduced and has become a significant part. HF and X-band radars are both used for current measurements but also for wave measurements.

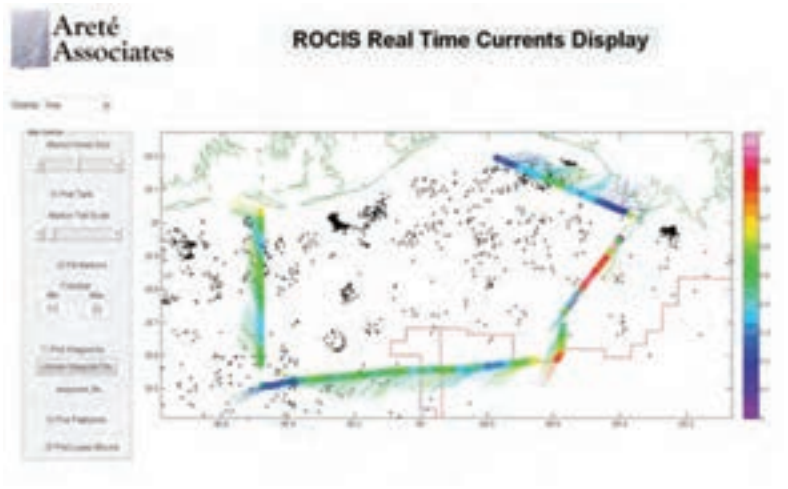

Figure 2. Real-Time Data Display.The data were acquired from aircraft covering a large area of the northern Gulf of Mexico. Figure courtesy of Steve Anderson.

Many acoustic Doppler current sensors have proliferated and become successful to the point that one supplier claimed they were a commodity. While that may be, there is no lack of interest in what they show us and how they can be used. More recently the role of current measurement in studies of ocean mixing has led us to change the name of our workshops, and the Technology Committee from Current Measurement Technology to Current, Waves, and Turbulence Measurement (CWTM).

Recent CWTM Workshops have included new velocity sensors but more about characterizations of performance of existing sensors. One theme has been intercomparisons between sensors since behavior in the real world frequently is inadequately represented in controlled flow testing. Difficulties in comparing measurements from fundamentally different sensors are addressed as for example an upward looking Doppler current profile compared to a HF Radar surface current map. Some of the most recent new technologies have been aircraft observations of surface features drift speed, see Fig. 2 from at paper at the 11th CWTM in 2015. I anticipate that these type measurements will be reported from drones at the next CWTM Workshop in San Diego in March 2019.

There were about 44 members of the CWTM Committee in 2014 and they and the specialty I used to assign them to review abstracst are listed in the table below.

Anderson, Steve	CM User
Williams, Sandy	WHIPR
Rizoli, Judy	Arrangements
Heron, Mal	HF Radar
Kamminga, Sicco	River ADV
Martini, Marinna	CM User
Spain, Peter	ADCP
Moore, Andy	ADCP
Creed, Liz	Vehicles
Terray, Gene	Everything
Griffiths, Gwyn	WHIPR
DiMassa, Diane	CM User
Howe, Bruce	Tomography
Paduan, Jeff	HF Radar
Pinkel, Rob	WHIPR
Sherman, Jeff	Vehicles
Bosley, Kate	PORTS
Cole, Rick	Waves
Cumbee, Craig	Navy Worldwide
Glenn, Scott	HF Radar
Hachiya, Hiroyuki	River ADV
Haus, Brian	HF Radar
Kelly, Frank	Coastal
Kosro, Mike	HF Radar
Meldrum, David	Coastal
Morrison, Todd	WHIPR
Mullison, Jerry	ADCP
Mutsuda, Dr. Hidemi	Tomography
Oberg, Kevin	ADCP, shallow
Plant, Dr. William	Radar
Pratt, Thad	Inland Waters
Roerbaek, Kim	ADCP
Schmidt, Bill	Waves
Seim, Harvey	CM User
Thurnherr, Andris	LADCP
Veseckey, John	HF Radar
Wilson, Doug	PORTS
Winkler, Michael	Inland Waters
Wyatt, Lucy	HF Radar
Zheng, Hong	Tomography

From the President *(continued from page 3)*

international Standards organizations to foster ocean engineering standards.

Now the what: the governance structure of the Society remains unchanged, with the same number of officers (10), but the lines of responsibility of the officers concerned are modified as described below and in the text of the revised bylaws.

- All OCEANS conference matters constitute a single line of responsibility under one Vice President, currently Conference Operations (to be renamed OCEANS). OCEANS conferences are co-sponsored with the Marine Technology Society (MTS).
- OES-sponsored or co-sponsored symposia, workshops, and Advanced Studies Institute events constitute a single line of responsibility under one Vice President, currently Conference Development (to be renamed Workshop & Symposia).
- Responsibility for Chapters is transferred from Professional Activities to Technical Activities to emphasize the largely technical nature of Chapter activities. Chapters are local technical forums.
- The Treasurer's term of office increases from 2 to 3 years (same as Editor in Chief of the Journal) to improve continuity in management of OES finances.
- Strategic partnership committees become standing committees (OCEANS Steering Committee, Offshore Technology Conference Committee, Global Earth Observations Committee, and Standards Committee)

Because ExCom offices are named in the OES Constitution, all OES members will be asked to vote in the near future to approve the new designations of Vice President OCEANS and Vice President Workshops & Symposia.

Formation of the new strategic partnership standing committees, with no defined end dates, recognizes the importance of the work done by OES members who represent the Society on these committees where they help define policies and address governance issues specific to those bodies.

In case you wondered, OES is governed by an Administrative Committee elected by the members of the Society, and an Executive Committee elected by AdCom. AdCom meets twice a year, generally on the first day of an OCEANS conference. ExCom meets three times per year, often in combination with the IEEE-wide Technical Activities Board meetings that are held each year in February, June, and November.

These committees need your input. Active involvement in running the Society starts by contacting any of the committee members and sharing your ideas, expectations, concerns ...

Looking forward to hearing from you.

Christian de Moustier

OFFSHORE TECHNOLOGY CONFERENCE ASIA

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Marseille
France
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Porto
Portugal
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Kobe
Japan
28-31 May 2018

Singapore
6-9 April 2020

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WWW.IEEEOES.ORG

60th OCEANS Conference Held in Aberdeen in June 2017

John Watson, Co-Chair of OCEANS'17 Aberdeen

The 60th occurrence of the MTS/IEEE OCEANS conference and exhibition was held in Aberdeen, Scotland in June 2017. The conference returned to Aberdeen after its great success ten years earlier.

The conference followed its now traditional format with an opening set of Plenary Welcomes and Presentations summarizing specific aspects of ocean technology and policy. The General Chair of OCEANS'17 Aberdeen opened the proceedings before the MTS and OES Presidents, Donna Kocak and Christian de Moustier gave their welcomes. This was followed by the Principals of the two Aberdeen universities, Prof Sir Ian Diamond (Aberdeen University) and Prof Ferdinand von Prondzynski (Robert Gordon University); and the Gold Sponsors, Neil Gordon (Subsea UK) and Dr. Gordon Drummond (NSRI). The three plenary talks by Professor Dame Anne Glover, the University of Aberdeen; Dr. Gareth Davies, Aquatera; and Dr. Stef Kapusniak, SMD provided a set of thought-provoking presentations on innovation, offshore renewable energy and deep-sea mining. They set the tone for the whole conference and drove home the same message of the need for innovative thinking coupled with the desire to communicate with each other across as many platforms as possible.

A closing Plenary on Thursday (22nd) morning featured an overview of the previous 59 OCEANS' by immediate past President of OES Dr. Rene Garello, followed by a presentation of the Student Poster Competition (SPC) prize winners and participants; IEEE Fellowship awards to Profs Andrea Caiti and Maurizio Miglaccio. The session closed with a presentation on subsea sensing by Dr. Eric Delory of PLOCAN, Spain.

Professor John Watson (University of Aberdeen) and Conference General Chair speaking at the Plenary Session.

Dame Prof Anne Glover giving her Plenary address.

The Plenary Panel (Chris de Moustier, Donna Kocak, John Watson, Dame Anne Glover, Sir Ian Diamond, Ferdinand von Prondzynski, Stef Kapusniak, Gordon Drummond, Neil Gordon).

Rene Garello getting ready for the Ceilidh.

The MTS/IEEE OCEANS'17 Aberdeen Student Poster Competition (SPC) award winners, from left to right: Faye Campbell (LOC SPC Chair), Bilal Wehbe (Second Place), Klemen Istenic (First Place), Habib Mirhedayati Rouds (Third Place) and Philippe Courmontagne (SPC Chair).

The Sensors Innovation Session Panel.

Student Poster Students.

A total of 781 registrants attended OCEANS'17 across all categories of registration, with about 560 full conference delegates, and exhibitors, exhibit–only visitors, VIPs, and patrons making up the remainder. Over 480 papers were presented on subjects ranging from subsea engineering and operations, optical sensing, imaging and instrumentation, fisheries and aquaculture, to exciting cutting-edge technologies like marine renewable energy, and unmanned underwater vehicles in defense applications, including 20 posters presented in the Student Poster Competition.

Registration at AECC.

Brian Horsburgh, Neil Gordon (SUBSEA UK) and John Reynolds (ACC) at the Welcome Reception.

Exhibitor Reception.

Welcome Reception at AECC.

The Beach Ballroom.

Ceilidh Dancing in action.

More than 25 countries were represented from around the globe from Scotland, via Brazil, New Zealand, China and Japan through India, Europe and back to Aberdeen. An unexpected and welcome outcome was the presentation of 115 papers from China (nearly a quarter of total presentations!). The remainder came from the Far East, the Pacific Rim, Russia, Ukraine and the new member states of the European Community. OCEANS Aberdeen featured more than 43 exhibitors, including local companies and exhibitors from as far away as Japan and Canada.

Exhibitor Reception The Conference Chair, Professor John Watson, said that the conference and exhibition was a great mix of local Scottish marine technology with examples of marine science and technology experts from around the globe.

When OCEANS visits countries outside North America it is important that the conference technical programme reflects the local and geographical interests' specific to that region. With that in mind, the overall theme for OCEANS'17 Aberdeen was chosen to be "*A vision for sustaining our marine future.*" Although our knowledge and understanding of the world's oceans has grown immeasurably over the years and our ability to explore, exploit and investigate this unique environment has developed beyond our wildest dreams, there are still many significant challenges and problems facing the global oceans community. To reflect and underpin that theme, a set of local Aberdeen topics were chosen to be the centerpiece of the conference and a series of plenary and keynote talks presented to highlight them.

The Banquet at the Beach Ballroom.

Pipers at the door of the Beach Ballroom.

What a nice set of legs (names withheld to protect the innocent!).

As always the Student Poster Competition was keenly fought in Aberdeen. Around 150 poster abstracts were submitted with 20 finally being chosen for presentation in Aberdeen. The winners of this year's competition were Klemen Istenic from the University of Girona (First Place), Bilal Wehbe from the DFKI Robotics Innovation Center (Second Place) and Habib Mirhedayati Rouds from Dalhousie University (Third Place). The winners of the SPC receive $3,000, $2,000 and $1,000 prizes, respectively, and all 20 competitors' travel expenses are paid for with funding from U.S. Office of Naval Research Global (ONRG), MTS and OES.

As in all OCEANS meetings, the social programme is an essential aspect in enabling delegates to relax and interact in an

The KILT line-up at the ceilidh.

Happy diners at the Banquet.

Cutting the 60th Anniversary cake (Chris de Moustier, Donna Kocak and John Watson).

Aberdeen Highland Games Tug o'War.

informal atmosphere. The OCEANS'17 Aberdeen team laid on a series of events that were judged to have been a resounding success. From the Opening Welcome Reception in the Rotunda at the Aberdeen Exhibition and Conference Centre through to the traditional Scottish ceilidh and the conference banquet in Aberdeen's Beach Ballroom. The Beach Ballroom is an Aberdeen icon and many thousands of Aberdonian's have met their future partners there. The Cabrach Ceilidh Band led the delegates through a series of intricate dance steps and it was great to see so many participating. It was a delight to see a significant portion of delegates wearing kilts (Englishmen, Americans, Japanese, French, Portuguese and Scotsmen alike). It is not

Aberdeen Highland Games Shot Put.

Some of the Aberdeen LOC (Trish Banks, Prabhu, Thanga, John Watson, Nikki Pearce, Brian Horsburgh).

Pipers on the lawn at Kincardine O'Neil.

Kincardine O'Neil Castle—location of the Leadership dinner. The AdCom and Social committees of OES and MTS held their "Leadership Dinner" in Kincardine O'Neil Castle in rural Aberdeenshire on the Sunday evening before the start of the conference.

The Great Hall at Kincardine O'Neil.

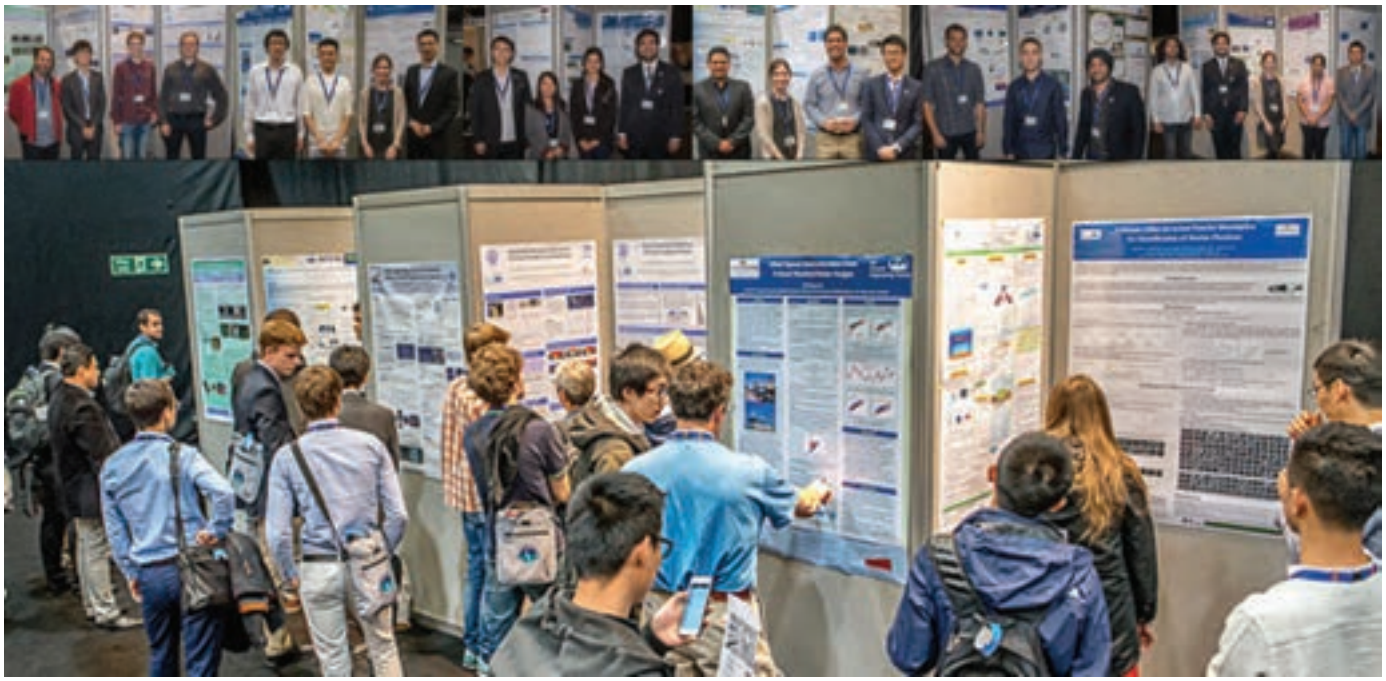
recorded how many wore their kilts in the traditional manner of a Scotsman! In celebration of this being the 60th occurrence of OCEANS an "exclusive" complimentary miniature whisky (10-year-old Isle of Arran) was given to all banquet attendees and a celebration cake was cut. All attendees also received a copy of a celebratory pamphlet—The OCEANS Conference . . . Sixty and Counting—which was produced by the sponsoring societies, IEEE/OES and MTS.

Some delegates even managed a visit to the Aberdeen Highland Games which on this occasion was not washed out!

All in all, this was a very successful conference and the local Aberdeen committee would like to thank all those who came and participated on many levels.

Student Poster Competition, OCEANS'17 MTS/IEEE ABERDEEN

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



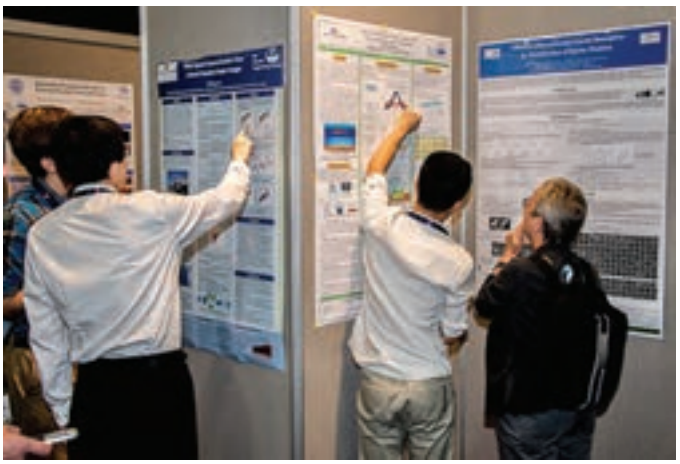
This 40th Student Poster Program of the OCEANS Conferences was held at OCEANS'17 MTS/IEEE Aberdeen, at the Aberdeen Exhibition and Conference Centre, from June 20 to June 22. The program was organized by Faye Campbell (HGF Limited) as local coordinator and Philippe Courmontagne, SPC Chair, from IEEE OES.

This student Poster Program has been initiated by Norman Miller in 1989 and became an integral part of the OCEANS conferences in 1991. For this edition, more than 100 abstracts were received and 20 were selected for this contest, not without difficulty given the high quality of the received abstracts. Students came from universities and industries around the globe (Canada, China, France, Germany, India, Japan, Korea, Norway, Scotland, Spain and the United States). All participants were awarded with complimentary conference registration, reimbursement for their travel fees, and were provided with free accommodation at the University of Aberdeen's Halls of Residence at Hillhead. The program was supported by funding from the US Navy Office of Naval Research Global and from the two Aberdeen's universities (University of Aberdeen and Robert Gordon University), which enabled the students to attend the conference.

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 the local chair. The roster of students and their schools are (in order of appearance of the Program Book):

- Jialei Zhang, *Huazhong University of Science and Technology*
- Yadpiroon Onmek, *LIRMM Laboratory, University of Montpellier*



Well explained!

- Jincy Johny, *Robert Gordon University*
- Javier Busquets-Mataix, *Norwegian University of Science and Technology*
- Cesar Galarza, *Universitad Politecnica de Catalunya*
- Habib Mirhedayati Roudsari, *Dalhousie University*
- Jonghyun Ahn, *Kyushu Institute of Technology*
- Minsung Sung, *Pohang University of Science and Technology*
- Zhi Li, *Memorial University of Newfoundland*
- Zonghua Liu, *University of Aberdeen*
- Gregory Murad Reis, *Florida International University*
- Farheen Fauziya, *IIT Delhi*
- Eduard Vidal, *University of Girona*

Who will be the winner …

- Puneet Chhabra, *Heriot Watt University*
- Bilal Wehbe, *DFKI—Robotics Innovation Center*
- Björn Barz, *Friedrich Schiller University of Jena*
- Xinlong Liu, *Memorial University of Newfoundland*
- Jianghui Li, *University of York*
- Klemen Istenic, *University of Girona*
- Felix Schneider, *Friedrich Schiller University of Jena*

The judging was completed on Thursday morning and the winners were announced in front of the delegates during a congratulatory speech given as part of the Closing Plenaries by Phillipe Courmontagne (Student Poster Chair, IEEE OES).

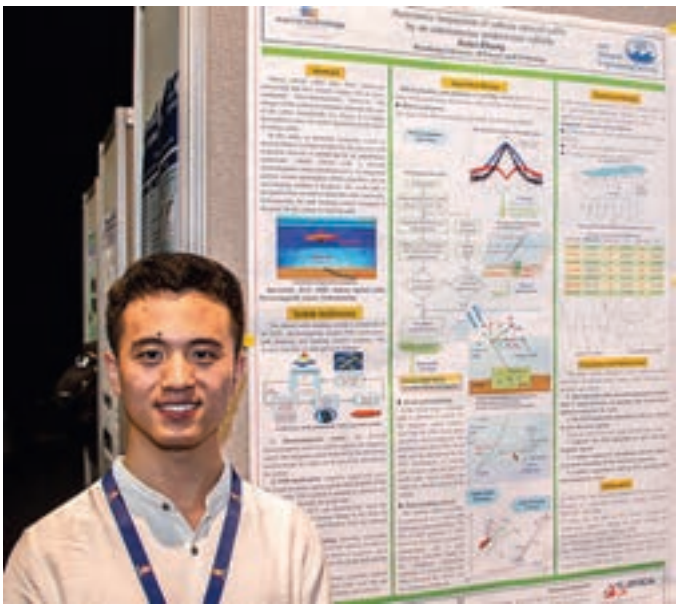
Philippe Courmontagne presented, with Faye Campbell, each student with a Certificate of Participation in the OCEANS'17 MTS/IEEE Aberdeen. Then, Philippe Courmontagne presented the third place winner to Habib Mirhedayati Roudsari, from Canada. Then, he presented the second price to Bilal Wehbe, from Germany. The first price, the "Norman Miller's Price", has been presented to Klemen Istenic, from the University of Girona (Spain), for his poster entitled "Mission-time 3D Reconstruction with Quality Estimation". As with previous years, monetary prizes were awarded for the posters collectively ranked 1st, 2nd and 3rd place by the judges ($3000, $2000 and $1000 respectively).

The awards ceremony.

The audience gave the students a big 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.

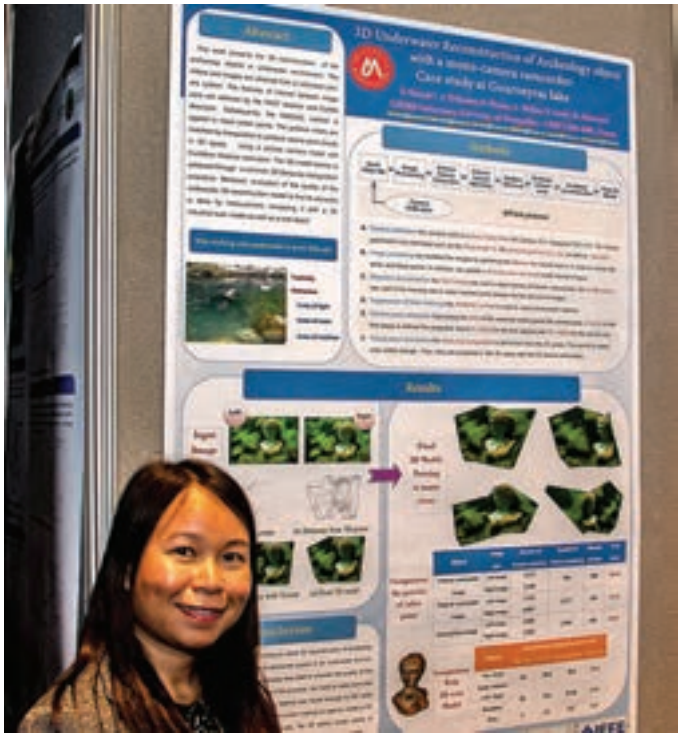
Jialei Zhang, Huazhong University of Science and Technology
Automatic inspection of subsea optical cable by an autonomous underwater vehicle



The changes of the seafloor environment caused by natural disasters and human activities greatly shorten the life span of the subsea optical cable. It is urgent to carry out routine inspection and maintenance for subsea cables. In this paper, an automatic inspection system to address these problems is proposed where the localization and inspection mission is conducted by an autonomous underwater vehicle (AUV) carrying with a tri-axial electromagnetic sensor. Firstly, the framework of the inspection system is presented, and the function of each subsystem is introduced briefly. Secondly, the inspection algorithms are designed which include localization algorithm, online path planning and path following control algorithms. A dedicated particle swarm optimization (PSO) algorithm is adopted to localize the subsea optical cable. In addition, the swath path is planned online so that the AUV can detect the cable in the repeatedly crossing manner. With the planned of swath path, the cable detection is elaborately constructed as a classic path following control problem, such that the AUV can track the planned path and inspect the optical cable automatically. Finally, the numerical simulation results are provided to

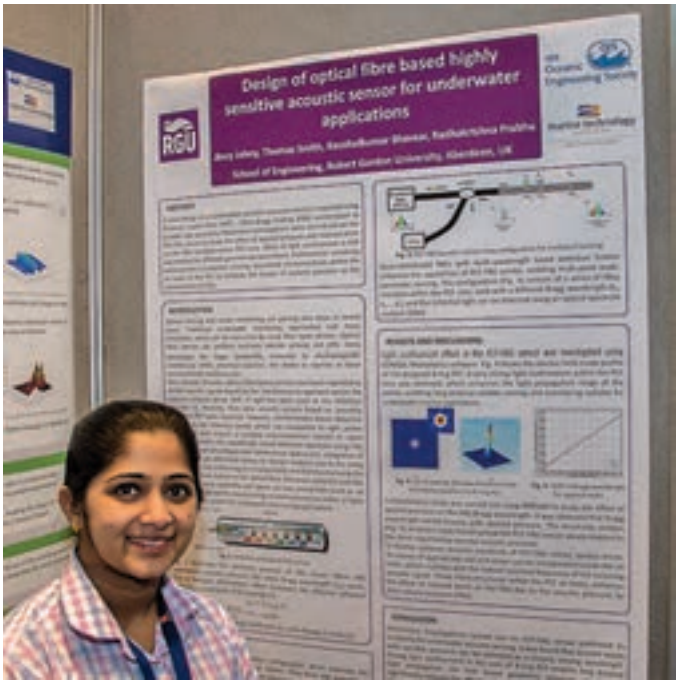
validate the effectiveness and feasibility of the automatic inspection system.

Yadpiroon Onmek, LIRMM Laboratory, University of Montpellier
3D Underwater Reconstruction of Archeology object with a mono camera camcorder: the case study at Gourneyras lake



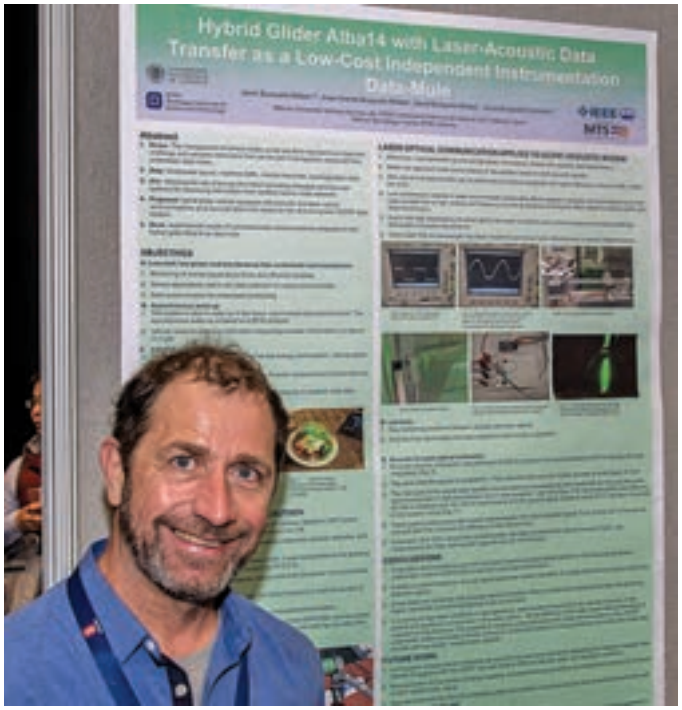
This work presents the 3D reconstruction of the archeology objects in underwater environment. The videos and images are obtained from a calibrated camera system. The features of interest between image pairs are selected by the FAST detector and FLANN descriptor. Subsequently, the RANSAC method is applied to reject outlier points. The putative inliers are matched by triangulation to produce sparse point clouds in 3D space, using a pinhole camera model and Euclidean distance estimation. The 3D model textrue is achieved through a commond 3D Delaunay triangulation procedure. Moreover, evaluation of the quality of the underwater 3D reconstruction model to find its accuracy is done by measurement, comparing it with a 3D industrial scan model as well as a real object.

Jincy Johny, Robert Gordon University
Design of optical fibre based highly sensitive acoustic sensor for underwater applications
Fibre optic sensing is a key technology for a variety of underwater sensing and monitoring applications. Fibre optic acoustic sensors are mainly based on interferometric detection approach where the acoustic pressure-induced phase shift of light has been used as sensing principle. Recently, fibre optic acoustic sensors based on speciality fibres like Photonic Crystal Fibre (PCF) were reported. However, interferometry based detection approaches amongst all these fibre optics sensors are intensity



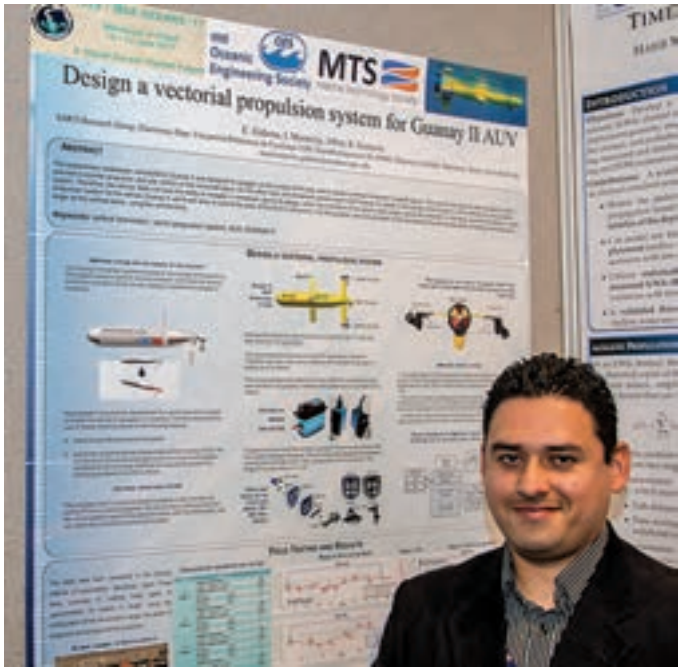
based and therefore susceptible to light power fluctuations and require a complex instrumentation related to signal detection. Besides, wavelength based detection approach using FBG (Fibre Bragg Grating) offers significant advantages over the conventional approach. FBG sensors were reported to have higher performance for underwater acoustic sensing applications. This paper reports a novel design of an underwater acoustic pressure sensor using a combination of PCF and FBG to provide high sensitivity. Theoretical investigations were carried out on the PCF-FBG sensor to study the effect of applied pressure and induced strain on the FBG inscribed in the core of PCF. Effect of light confinement in PCF was studied for different geometrical parameters and 4-ring PCF structure was reported. Further, sensitivity enhancement was proposed utilizing air hole structure of the PCF to enhance the impact of acoustic pressure on the induced strain in FBG.

Javier Busquets-Mataix, Norwegian University of Science and Technology
Hybrid Glider Alba14 with Laser-Acoustic Data Transfer as a Low-Cost Independent Instrumentation Data-Mule
The management of sensor nodes on the sea floor represents an important challenge due to the high difficulties associated to the deployment and recovering of untethered instruments on the seafloor. These difficulties are not only related to the management of the instruments themselves but also related to the valuable information that can be lost. Ambient sound and interferences, maritime traffic, marine mammals behavior, oceanographic data are all among this critical information suitable to be registered. The fact of part of these information being missed, represent a void gap in the spatio-temporal identification phenomena analysis. For reducing the risk of losing information and with the aim of providing a feasible and low cost systems for recovering information from seafloor, a hybrid glider vehicle equipped with acoustic and laser optical



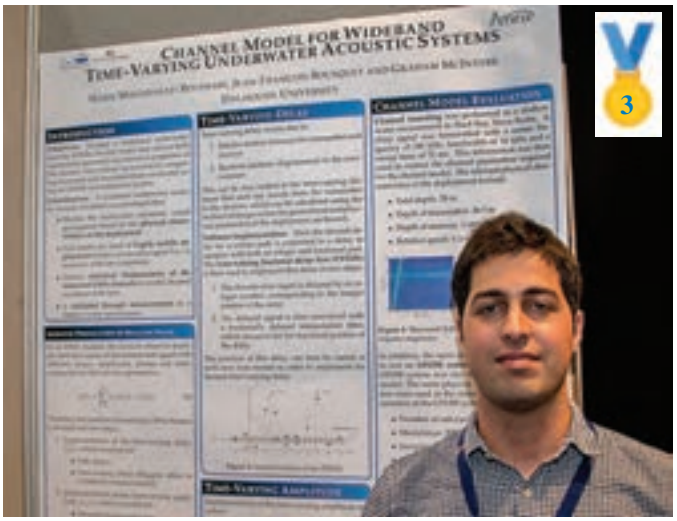
communications is proposed. Preliminary studies as well as experimental results of optical/acoustic communications integrated in the hybrid glider Alba14 as data mule are presented.

Cesar Galarza, Universitad Politecnica de Catalunya
*Design a vectorial propulsion system for Guanay II AUV **



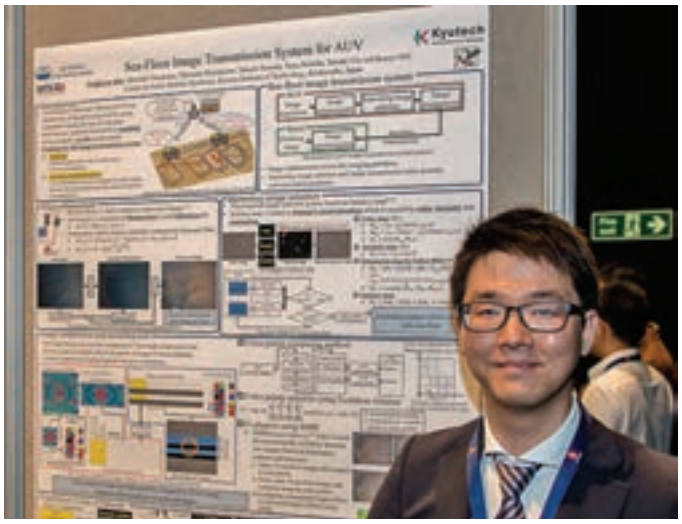
The autonomous underwater vehicle (AUV) Guanay II was designed to navigate on the surface of the sea, and to realize a vertical immersion in specific points. This vehicle has three thrusters located on stern, oriented to provide propulsion and yaw control on the horizontal plane. On the other hand, the immersion system used in the Guanay II is based in the change of the buoyancy of the vehicle, by using a piston system. Therefore, the vehicle does not have the ability to navigate in immersion, due to its design, which the inclination of the vehicle (pitch angle) cannot be controlled. In this work, we show the design a vector propulsion system for the vehicle Guanay II, which will allow to control the pitch of the AUV in immersion. For this purpose, we have provided to the two laterals thruster the possibility of varying their propulsion angle on the vertical plane, using two servomotors. Next, we will show the design and the results obtained.

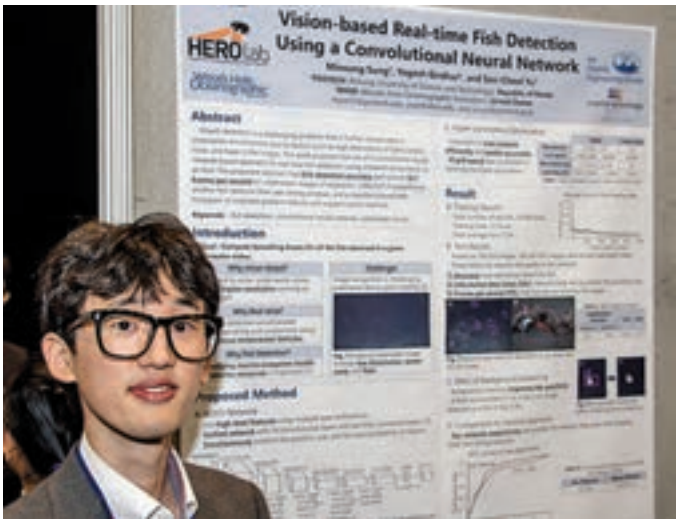
Habib Mirhedayati Roudsari, Dalhousie University
Channel Model for Wideband Time-Varying Underwater Acoustic Systems



In this paper a wideband underwater acoustic (UWA) channel simulator is developed based on the geometry of the system deployment and by considering the statistics of the random amplitude variation of the channel. This channel simulator is capable of modeling any relative motion between the transmitter and receiver. The delays of multipath arrivals are calculated based on the geometrical and physical parameters of the deployment. The time-varying fractional delay line (TVFDL) is utilized as a flexible and low-complexity software tool to model time-scaling observed on individual paths. The fading characteristics of the channel which is extracted from the measurements is utilized to model the time-varying amplitudes of paths. Also, an orthogonal frequency division multiplexing (OFDM) system is tested throughout a sea trial. The geometrical and statistical parameters of the sea trial are utilized to test the OFDM system using the proposed channel simulator. The bit error rate (BER) of the system is calculated in both measurements and simulations and it will be shown that the assessment of the communication performance realized using simulations is very close to that of the measured performance.

Jonghyun Ahn, Kyushu Institute of Technology
Sea-Floor Image Transmission System for AUV
Autonomous Underwater Vehicle (AUV) has become one of the promising tool for ocean exploration during the last few



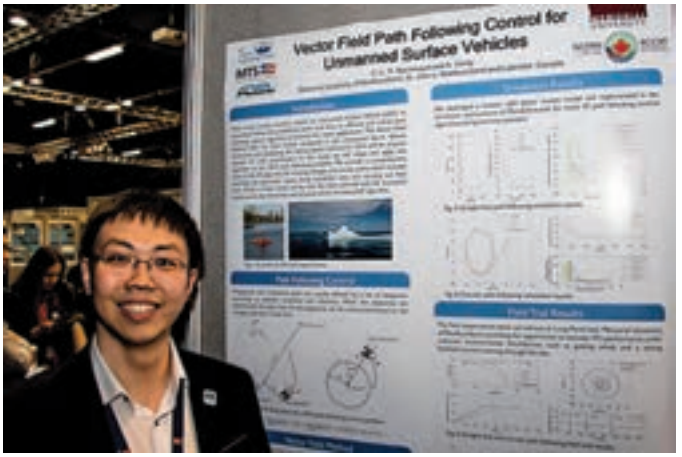


decades, and, in particular, is the solution for the spatial-temporal investigations in wide areas for a long period. One of the next mission expected from AUV is deep sea specimen sampling, which is currently performed by Remotely Operated Vehicle (ROV) or Human Occupied Vehicle (HOV) where the sampling targets are selected by scientists on-line. In order to establish the similar on-line investigation with AUV system, the sea-floor images have to be transmitted to the scientists on the support vessel by acoustic communication. However, the speed of the acoustic communication is low compared with that of radio communication, and the data can be lost because of the directionality of acoustic modem, the positional relationship between the AUV and the support vessel, attenuation and so on. The robust image transmission system is necessary with acoustic communication for in-situ decision making for sampling by AUV with many tasks. In this paper, we propose a sea-floor image transmission system with image compression, and evaluated by sea trials in Suruga-bay. The image compression method is based on a set of color palettes, where the colors of a color palette are assigned as a set of main colors obtained from the minimum variance quantization, to represents a typical sea-floor image. The colors of the obtained images are replaced by the most similar colors in the color palette. The images compressed by a 16-colors color palette are evaluated by Structural SIMilarity (SSIM) method, and these compressed images have shown the SSIM index of 88.5%. The duration of one image transmission is about 40 seconds in the sea trials and the transmission success rate is 75%.

Minsung Sung, Pohang University of Science and Technology
Vision based Real-time Fish Detection Using Convolutional Neural Network

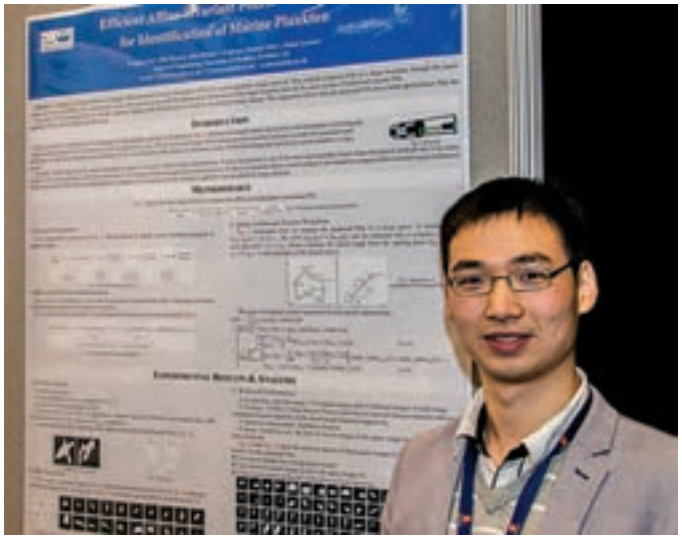
Underwater vision has specific characteristics such as high attenuation of lights, severe noise and haze in the images. For real-time fish detection using underwater vision, this paper proposes convolutional neural network based techniques based on You Only Look Once algorithm. Actual fish video images were used to evaluate the reliability and accuracy of the proposed method. As a result, the network recorded 93% classification accuracy, 0.634 intersection over union between predicted bounding box and ground truth, and 16.7 frames per second of fish detection. It also outperforms another fish detector using sliding window algorithm and classifier trained with histogram of oriented gradient features and support vector machine.

Zhi Li, Memorial University of Newfoundland
Vector Field Path Following Control for Unmanned Surface Vehicles



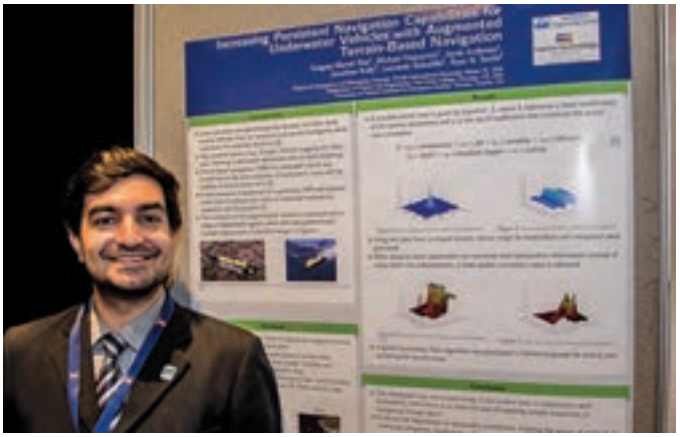
Many ocean survey missions require an Unmanned Surface Vehicle (USV) to accurately follow predefined paths, and thus, an efficient and robust path following control algorithm is essential for many applications. The Vector Field Method (VF) has been widely employed in the Unmanned Aerial Vehicle (UAV) community, and evaluating this well-accepted method for USVs will be of great interest for USV practitioners. In this paper, we will adapt and apply this algorithm on the USV path following problem. We provide a comprehensive study of the VF algorithm for tracking straight and circular paths, which includes searching the parameter space, doing simulation tests and carrying out field trials. Finally, a mock ocean survey task has been planned and the successful results prove the robustness and accuracy of the introduced VF algorithm.

Zonghua Liu, University of Aberdeen
Efficient Affine-invariant Fourier Descriptors for Identification of Marine Plankton



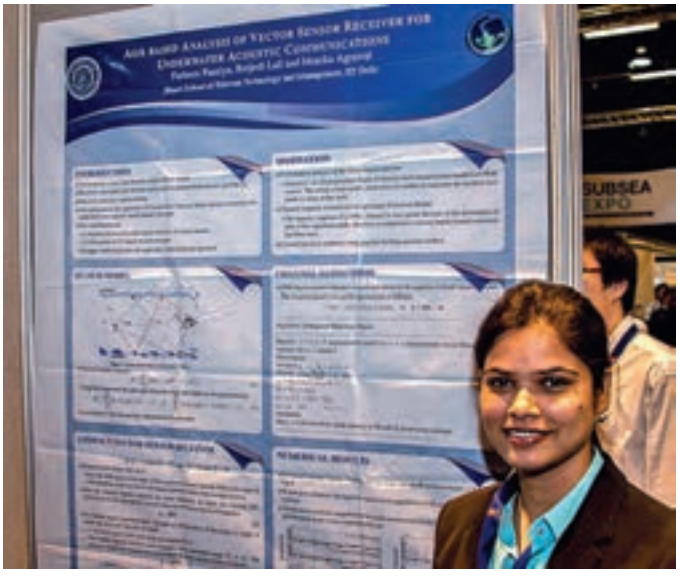
A study of population and distribution of plankton in the sea can be a good indicator of the health of the marine environment. Many digital images of marine plankton have been recorded. Image extraction and plankton identification can aid research of oceanic plankton. In this paper, we present a method to compute affine-invariant Fourier Descriptors (FDs) for marine plankton image retrieval. This method computes FDs of a shape boundary through the quasi-continuous Fourier transform. The experimental results show that the proposed FDs capture more information of the shape boundary than the the same number of traditional discrete FDs. Before calculation of FDs, each plankton image is pre-processed and the plankton shape is compacted into the boundary polygon. We have developed a set of approaches to quickly extract the exact and compact boundary polygon of an object, including methods of edge detection, boundary tracing, coordinate compensation of the boundary points and break-point detection. An affine-invariant curve normalization method then is adopted to reduce the geometrical deformations or distortions from the polygonal boundary curves possibly caused by changes of the camera angle. The experimental implementation shows that this curve normalization method is robust and can successfully eliminate transformations of translation, scaling, non-uniform scaling and shearing from two affine-transformrelated curves. Lastly, the ability of the proposed FDs to identify plankton images with deformations is tested on an artificial image dataset. The experiment shows that the proposed FDs have better performance than the traditional FDs in terms of retrieval efficiency.

Gregory Murad Reis, Florida International University
Increasing Persistent Navigation Capabilities for Underwater Vehicles with Augmented Terrain-Based Navigation
Accurate and energy-efficient navigation and localization methods for autonomous underwater vehicles continues to be an



active area of research. As interesting as they are important, ocean processes are spatiotemporally dynamic and their study requires vehicles that can maneuver and sample intelligently while underwater for extended durations. In this paper, we present a new technique for augmenting terrain-based navigation with physical water data to enhance the utility of traditional methods for navigation and localization. We examine the construct of this augmentation method over a range of deployment regions, e.g., ocean and freshwater lake. Data from field trials are presented and analyzed for multiple deployments of an autonomous underwater vehicle.

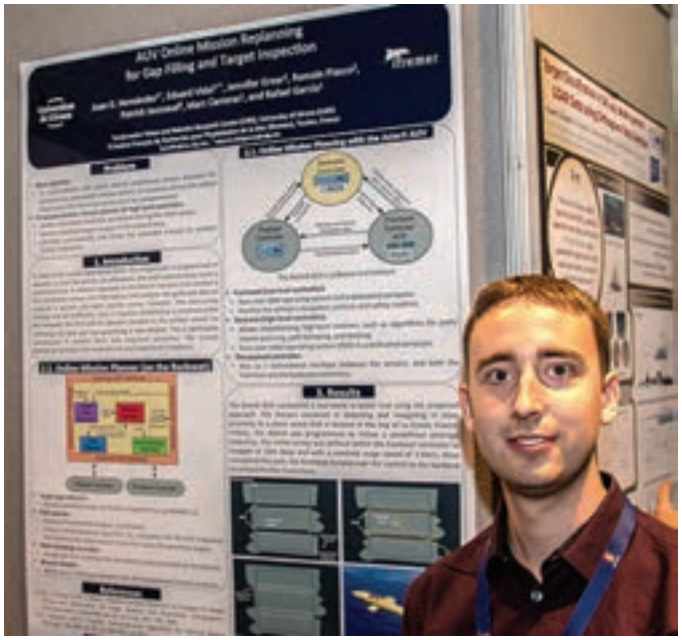
Farheen Fauziya, IIT Delhi
AoA based Analysis of Vector Sensor Receiver for Underwater Acoustic Communications



In this paper, we analyze a compact vector sensor receiver using angle of arrival (AoA) framework which was recently proposed by Fauziya et. al. We demonstrate that this receiver performs better than a scalar receiver at no extra computational cost. The receiver exploits the inherent capability of a vector sensor to provide spatial diversity without the use of a sensor array. The paper also discuss a compressive sensing based channel estimator

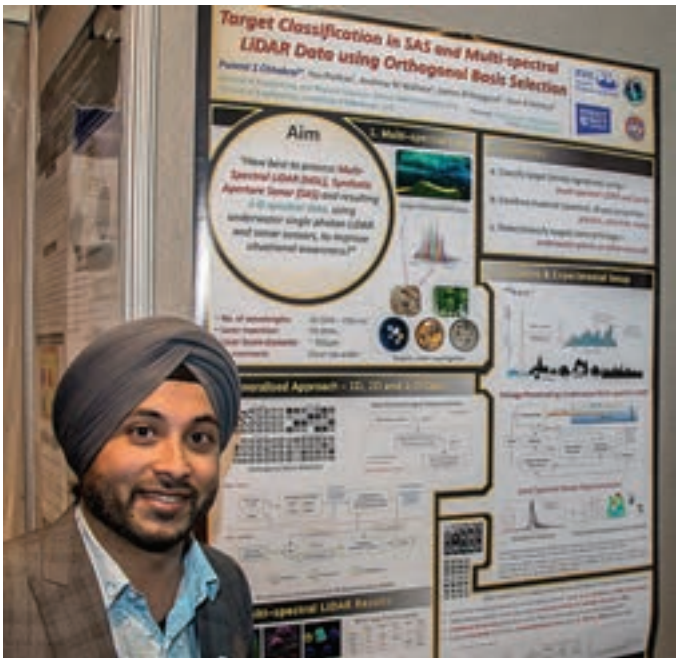
that performs better than a least squares estimator. Channel estimation is performed using a training sequence and the simulation clearly bring out the superior performance of the compressive sensing based channel estimator and that of the vector sensor based compact receiver.

Eduard Vidal, University of Girona
AUV Online Mission Replanning for Gap Filling and Target Inspection



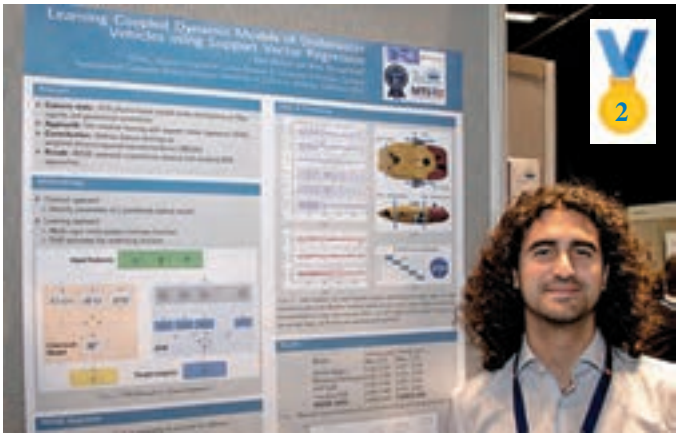
In most of the current operational autonomous underwater vehicles (AUVs), a survey mission is generally composed of two main stages. The first one conducts an exhaustive coverage over an area of interest, while gathering data of the sea bottom. Then, and after processing the collected data, a second mission is programmed to obtain more detailed information of potential targets, and to cover the gaps that resulted from the first exploration. However, this two-survey strategy can be inefficient, since it requires establishing a communication link between the AUV and its operator for retrieving the data and reprogramming the second mission. To cope with this situation, we present a mission planner that endows an AUV with the capability of extending its missions online. With our approach, the vehicle is also required to conduct an initial and predefined survey of an area of interest, but it processes the gathered data onboard to plan 3D feasible paths to complement the initial exploration. To validate our approach, we present real-world results with the AsterX AUV.

Puneet Chhabra, Heriot Watt University
Target Classification in SAS Imagery using Orthogonal Basis Selection
This work proposes an approach that finds efficient representations for training and classification of different mine like objects (MLOs) in underwater imagery, e.g. side scan sonar and synthetic aperture sonar (SAS). The focus is on the design and



selection of a compact, optimal and a non linear subspace, a dictionary, based on the gradient and curvature models in 2D images. Here, the traditional sparse approximation formulation is decoupled and modified by an additional discriminating objective function and a corresponding selection strategy is proposed. During training, using a set of labelled sonar images, a single optimized discriminatory dictionary is learnt which can then be used to represent MLOs. During classification, this dictionary together with optimized coefficient vectors is used to label scene entities. Evaluation of our approach has resulted in classification accuracies of 95% and 94% on realistic synthetic side-scan images and real CMRE SAS imagery, respectively.

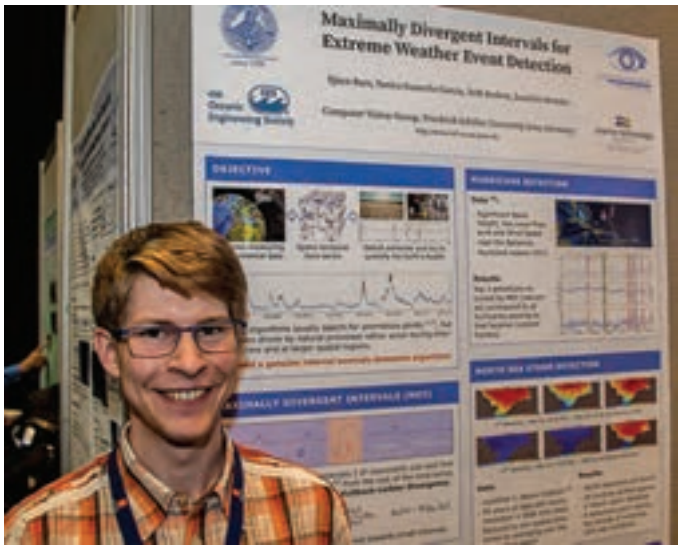
Bilal Wehbe, DFKI—Robotics Innovation Center
Learning Coupled Dynamic Models of Underwater Vehicles using Support Vector Regression



This work addresses a data driven approach which employs a machine learning technique known as Support Vector Regression (SVR), to identify the coupled dynamical model of an

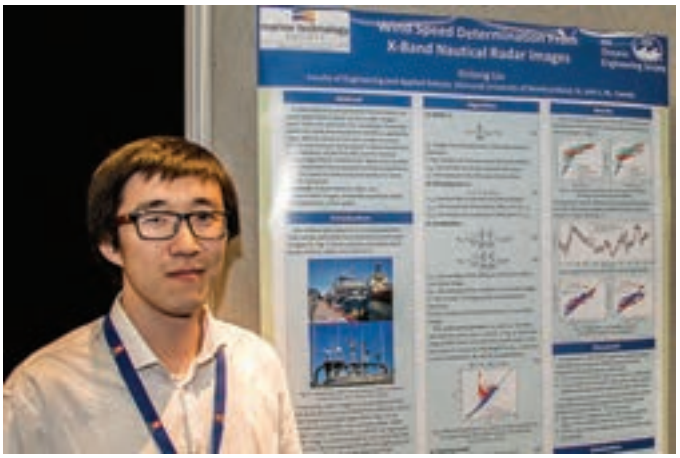
autonomous underwater vehicle. To train the regressor, we use a dataset collected from the robot's on-board navigation sensors and actuators. To achieve a better fit to the experimental data, a variant of a radial-basis-function kernel is used in combination with the SVR which accounts for the different complexities of each of the contributing input features of the model. We compare our method to other explicit hydrodynamic damping models that were identified using the total least squares method and with less complex SVR methods. To analyze the transferability, we clearly separate training and testing data obtained in real-world experiments. Our presented method shows much better results especially compared to classical approaches.

Björn Barz, Friedrich Schiller University of Jena
Maximally Divergent Intervals for Extreme Weather Event Detection



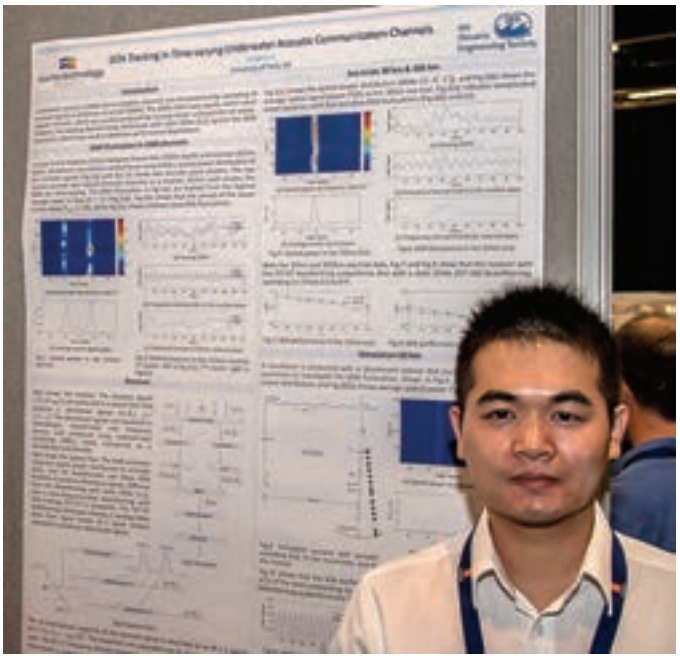
We approach the task of detecting anomalous or extreme events in multivariate spatio-temporal climate data using an unsupervised machine learning algorithm for detection of anomalous intervals in time-series. In contrast to many existing algorithms for outlier and anomaly detection, our method does not search for point-wise anomalies, but for contiguous anomalous intervals. We demonstrate the suitability of our approach through numerous experiments on climate data, including detection of hurricanes, North Sea storms, and low-pressure fields.

Xinlong Liu, Memorial University of Newfoundland
Wind Speed Determination From X-Band Nautical Radar Images
A new method is presented for estimation of wind speed from X-band nautical radar sea surface images. Ensemble empirical mode decomposition (EEMD) is first applied to the radar data. A normalization scheme is then used to obtain the amplitude modulation (AM) part of the first intrinsic mode function (IMF). Wind speed is determined from a combination of the first IMF and the residual using a logarithmic relationship. The method can be applied to both rain-free and rain-contaminated radar images. Radar and anemometer data collected in a sea



trial off the east coast of Canada are employed for the test. Compared to the spectral-analysis-based method, the proposed method improves the wind speed result with an increase of about 0.06 in the correlation coefficient and a decrease of about 0.28 m/s in the root-mean-square (RMS) difference with respect to the reference.

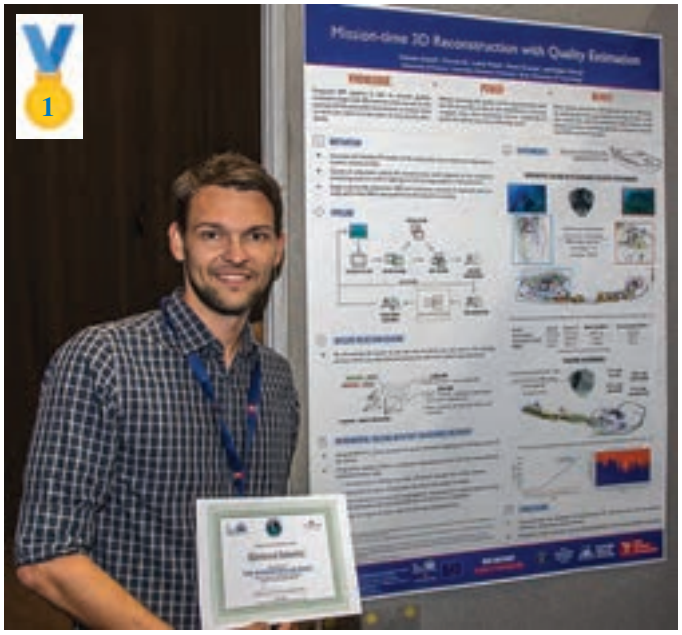
Jianghui Li, University of York
DOA tracking in time-varying underwater acoustic communication channels



Underwater acoustic (UWA) communication channels are characterized by spreading of received signals in directions of arrival (DOAs). The DOAs often vary rapidly within small angular intervals, which are usually produced for the most part by moving ocean surface/internal waves and platforms. In this paper, the time-varying UWA communication channels are investigated. Based on the investigation, a beamforming technique that tracks DOAs is proposed, and used for UWA communications with guard-free orthogonal frequency-division

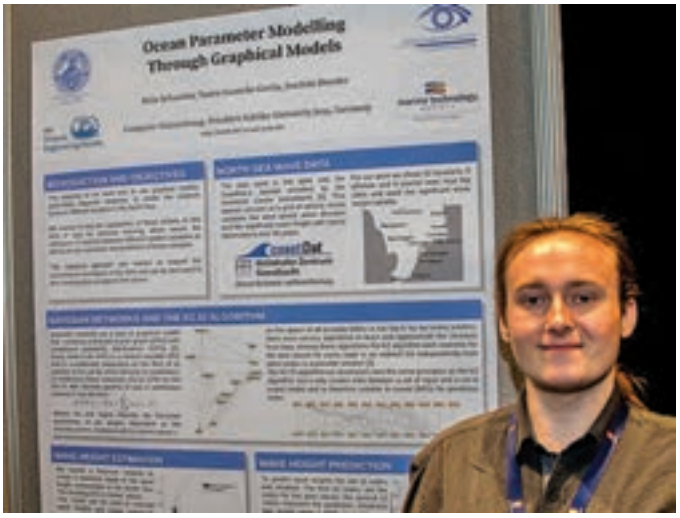
multiplexing (OFDM) signal transmission. This beamforming is compared with a beamforming without DOA tracking, and the results show that the receiver with this beamforming outperforms that without DOA tracking. The comparison is based on data from a 14-element non-uniform vertical linear array in a simulation at a distance of 80 km, and in two sea trials at distances of 30 km and 105 km.

Klemen Istenic, University of Girona
Mission-time 3D Reconstruction with Quality Estimation



Accurate and detailed 3-dimensional (3D) models of the underwater environment are becoming increasingly important in modern marine surveys, since they convey immense information that can be easily interpreted. Techniques such as bundle adjustment (BA) and structure from motion (SfM), which jointly estimate sparse 3D points of the scene and camera poses, have gained popularity in underwater mapping applications. However, for large-area surveys these methods are computationally expensive and not intended for online application. This paper proposes an SfM pipeline based on solving the BA problem in an incremental and efficient way. Furthermore, the new system can provide not only the solution of the optimization (camera trajectory along time and the 3D points of the environment), but also the estimate of the uncertainty associated with the 3D reconstruction. This system is able to produce results in mission-time, *i.e.* while the robot is in the water or very shortly afterwards. Such quick availability is of great importance during survey operations as it allows data quality assessment *in-situ*, and eventual replanning of missions in case of need.

Felix Schneider, Friedrich Schiller University of Jena
Modelling Ocean Parameters Through Graphical Models



Ocean parameter modelling is an important task for many fields. While using simulations and simple statistical models may not yield desired results in reasonable time, using graphical models like Bayesian networks can address this problem. In this paper, we show the application of Bayesian networks to the tasks of estimating and predicting significant wave heights in the North Sea. Additionally we present the K2 IO algorithm, a modification to the K2 algorithm developed for the prediction task. Experiments show the possibilities and problems of estimation and prediction with Bayesian networks. They also show that the K2 IO algorithm produces a structure that is suitable for prediction in a shorter time than the K2 algorithm.

Do not hesitate, join us and be part of our history !!

Winning Poster Paper
Mission-time 3D Reconstruction with Quality Estimation

Klemen Istenič, Viorela Ila†, Lukáš Polok‡, Nuno Gracias*, and Rafael García**
**University of Girona,† Australian National University,‡ Brno University of Technology*
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***Abstract*—Accurate and detailed 3-dimensional (3D) models of the underwater environment are becoming increasingly important in modern marine surveys, since they convey immense information that can be easily interpreted. Techniques such as bundle adjustment (BA) and structure from motion (SfM), which jointly estimate sparse 3D points of the scene and camera poses, have gained popularity in underwater mapping applications. However, for large-area surveys these methods are computationally expensive and not intended for online application. This paper proposes an SfM pipeline based on solving the BA problem in an incremental and efficient way. Furthermore, the new system can provide not only the solution of the optimization (camera trajectory along time and the 3D points of the environment), but also the estimate of the uncertainty associated with the 3D reconstruction. This system is able to produce results in mission-time, *i.e.* while the robot is in the water or very shortly afterwards. Such quick availability is of great importance during survey operations as it allows data quality assessment *in-situ*, and eventual replanning of missions in case of need.**

I. Introduction

Underwater exploration and inspection is a fundamental way to improve our knowledge of the oceans. Accurate and detailed 3D models of the environment obtained from the data acquired underwater yield high added value to any marine survey, as such results convey immense information easily interpretable by humans. The wealth of information enables experts (biologists, archaeologists and geologists, among others) to perform further in-depth investigation of the areas of interest after the missions, and can also serve as base map for long term environmental monitoring.

Recent advances in technology enabled scientists to capitalize on the use of unmanned underwater vehicles (UUVs) to gain access to large marine areas and deep sea regions. While underwater 3D mapping usually relies on multibeam echosounders and sidescan sonars, the relatively coarse resolution of acoustic sensing prevents highly detailed representation of complex structures with concavities. Optical sensing, on the other hand, can be used to recover quality 3D representation of smaller areas of interest in higher resolution.

Image based 3D reconstruction techniques have been studied extensively in the computer vision community. Sparse techniques such as BA and SfM, which jointly estimate sparse 3D points of the scene and camera poses, have gained popularity in underwater surveying and are currently used for producing 3D representations from data provided by commercial and custom built camera systems (e.g., [1]–[4]). To obtain an optimal solution, a nonlinear optimization is performed on a complete set of camera poses and 3D points observed by the camera [5] in a stochastic estimation framework which accounts for Gaussian noise models in the observations. For large scale applications, this is an expensive procedure and it is normally performed offline, after the acquisition process. In this sense, the reconstruction phase is decoupled from the acquisition, and performed offline post-mission.

Due to the unfavourable properties of the underwater medium (such as the rapid attenuation of light, scattering effects, and non-uniform lighting), the outcome of the underwater 3D reconstruction is vastly dependent on the conditions and the strategy applied in the acquisition process. The current offline nature of the processing prevents any feedback about the quality of the reconstruction during the mission. This consequently demands a strong human intervention during the surveys and careful mission planning to ensure the capture of adequate data. Despite the best efforts, several deployments over the same area are still commonly required, significantly increasing the total expenditure of the mission due to high costs of ship-time and highly trained personnel.

Currently, some techniques capable of online reconstruction decouple the problem into a local BA step optimizing over parameters of a few recently added cameras and 3D points and a global camera pose graph optimization [6], [7]. Alternatively, the complexity of the problem can be reduced by marginalizing out the 3D structure from the optimization process: a technique called light bundle adjustment [8]. While the former achieves real-time results in structured environments, the reconstruction is only locally consistent during the execution of large loops, whereas the latter obtains the solution solely for camera poses. Neither case is able to provide an estimate of the uncertainty of the solution encoded in the covariance matrix associated to each of the variables (camera poses and points). This covariance is a valuable indicator of the quality of the reconstruction, which can be highly beneficial for the acquisition process if it can be estimated during the mission.

This paper analyzes several solutions for solving the BA problem in an efficient way, during the mission, in an incre-

mental fashion. Furthermore, it proposes a new system that is able to provide not only the solution of the optimization (pose of the cameras and location of the 3D points in the environment), but also the value of the associated uncertainty of the 3D reconstruction at mission-time. The ability to obtain the reconstruction and its associated uncertainty during the time of the mission enables the possibility of concurrent assessment of the quality of the acquired data (and the 3D structure) as well as the identification of poorly mapped or even missing areas. Endowed with this additional information, skilled pilots and autonomous planning schemes will be able to alter the mission in progress. By guiding the vehicle towards the problematic areas, the quality of the final representation will be significantly improved. As such, these quality-aware surveys not only improve the survey efficiency but also help reduce the need for additional deployments of the vehicle, further reducing the mission time and cost.

II. Related Works

When performing online 3D reconstruction, the state, containing the 3D structure and the camera trajectory so far, is continuously growing, leading to a highly computationally demanding estimation process. There are several solutions to speed up the online processing. One is to reduce the problem to a pose graph optimization where only the poses of key frames are globally optimized and local BA is used to adjust the cameras and the points [6]. Incremental light bundle adjustment [8] is another technique proposed for solving BA incrementally, which it is based on marginalizing out the structure while solving only for the camera poses. Those techniques are not suitable for applications where a feedback about the structure is needed during the acquisition, where a globally consistent solution is required every step.

Efficient incremental NLS methods have been developed in the simultaneous localization and mapping (SLAM) community [9], [10]. Those methods exploit the fact that adding new information into the system only affects a part of the solution. SLAM structure facilitates identifying the affected part. The matters in bundle adjustment are more complicated, since the increments have much higher rank than in SLAM and sometimes affecting large part of the system (e.g. when the same points are seen by most of the cameras).

In general, the existing solutions to NLS provide only the estimate of the mean state vector, its associated covariance being computationally too expensive to recover. Nevertheless, in SLAM applications, knowing only the mean vector is not enough. Quality estimation, active decisions and next best view are only a few of the applications that require fast state covariance recovery. Several approximations for marginal covariance recovery have been proposed in the system matrix, called the Markov blankets. The result is an overconfident approximation of the marginal covariances. Online, conservative approximations were proposed in [12], where at every step, the covariances corresponding to the new variables are computed by solving the augmented system with a set of basis vectors. An exact method for sparse covariance recovery was proposed in [13], based on a recursive formula which calculates any covariance elements on demand from other covariance elements and elements of the Cholesky factorization result. An incremental technique to obtain exact marginal covariances has recently been proposed by Ila et al. [14], and it is based on incremental updates of marginal covariances every time new variables and observations are integrated into the system, and on the fact that, in practice, the changes in the linearization point are often small and can be ignored. However, the BA and SfM problems have a slightly different structure where the number of points is in general much larger than the number of cameras and there are more efficient methods to solve the linearized system. Polok et al. [15] proposed an efficient method to calculate the point covariances in the context of BA. An improved version of this method is integrated in our pipeline.

III. Pipeline overview

The following section presents an overview of the proposed approach for a robust, globally-consistent, largescale 3D reconstruction. Conceptually we can understand the pipeline as divided into two parts; the *front-end* and the *back-end*. The front-end is in charge of tracking 3D points and obtaining, at every time step, an initial estimate for the camera pose, associations with the existing 3D points, and creating newly observed 3D points. For that, features in every new frame are matched with features in the previous frames and based on that an initial estimate of the current pose of the camera and new 3D points is obtained. The new camera and points are refined by the back-end that implements incremental bundle adjustment system to obtain a globally consistent estimate at every step. In order to account for the high level of noise in underwater image processing, the BA is formulated as a probabilistic framework and provides not only the mean estimate but also the uncertainty of each camera pose and 3D points.

An important characteristic of the proposed pipeline is its ability to eliminate outliers which is implemented at several stages, when initializing the camera pose as well as in the global optimization stage. We found this is mandatory when processing noisy underwater images.

The state of our 3D reconstruction is given by the camera poses, $\mathbf{c} = [c_1 \ldots c_{nc}]$ and the 3D points in the environment $\mathbf{p} = [p_1 \ldots p_{np}]$. The camera poses can be parameterized using 6D vectors. It is common to consider a camera pose as an element of the Lie algebra $\hat{c}_i \in \mathbf{se}(3)$ of the special Euclidean group $SE(3)$ with $\hat{c}_i$ being the matrix form of the pose $c_i = [v, \omega]^\top$, $c_i \in \mathbb{R}^6$, with $\omega \in \mathbb{R}^3$, the rotation component and $v \in \mathbb{R}^3$ the translation component. The scale can be better estimated during the optimization process by considering the camera poses as elements of the Lie algebra $\hat{c}_i \in \mathbf{sim}(3)$ of the Similarity group $Sim(3)$ with:

$$\hat{\mathrm{c}}_i = \begin{bmatrix} [\omega]_\times + qI_{3\times 3} & v \\ 0 & 0 \end{bmatrix}, \tag{1}$$

where $q \in \mathbb{R}$ and $\sigma = \exp(q)$ being the scale factor [16]. Thus, now the pose becomes $c_i = [v, \omega, \sigma]^T$, $c_i \in \mathbb{R}^7$. Estimating for the scale component alleviates the scale-drift effect when constructing the map incrementally [7].

The *3D points* can be parameterized either in *Euclidean coordinates* $P = [x, y, z]^T$, or using local *inverse depth* $P = [x/z, y/z, 1/z]^T$. Such point parameterization, as shown by [17], bounds the number of variables affected by updating the system with new measurements, thus reducing the incremental processing time.

IV. Tracking and Mapping

In order to obtain a good estimation, the points are tracked along a sequence of images and tested whether or not they are outliers. Through the process, the map points are assigned with *confidence* values depending on the number of successful observations. The confidence levels are used to decide whether a point is added or not to the *global map* or kept into a *local map* for further processing. In particular, every new 3D point is initially added to a local map, and remains there until its confidence reaches the threshold of minimum number of observations before being moved to the global map. The confidence of the points is increased with successful observation from any frame. The local map points are discarded after a period of inactivity, as they are considered outliers. If their confidence increases in the meantime (seen by new frames), they are added to the global map. By decoupling the two sets, all points are still used in the tracking process while only well observed points are utilized for global map estimation.

A. Feature Extraction

As the estimation of the 3D points together with the motion of the camera is inferred entirely from the sparse features matched across the set of 2D images, it is important to identify distinctive and repeatable features in each frame. Features that can not be matched across multiple frames do not contribute to the localization and mapping efforts and are therefore discarded. The particularities of the underwater medium induces several effects (such as light attenuation, blurring and low contrast) which can deteriorate the performance of some feature detectors/descriptors [18], [19]. In our approach, we currently use scale-invariant feature transform (SIFT) [20] features, which can be extracted using graphics processing unit (GPU) (e.g. Wu [21]) and are widely accepted as one of the highest quality feature descriptors [22] due to their high degree of invariance to scale and rotation, as well as being partially invariant to changes in illumination, noise, occlusions and small changes in the viewpoint.

B. Initialization

In order to start the tracking, the relative pose between two frames (not necessarily consecutive) has to be estimated, together with an initial set of triangulated points. Photometric correspondences between extracted features in both candidate frames are computed using Cheng et al. [23] cascade hashing approach based on the Euclidean distance between the descriptors. Ambiguous matches are discarded using Lowe's ratio test [20].

Relative poses are then computed through the estimation and decomposition of a geometric model. The selection of the most appropriate model should depend on the structure of the viewed scene, the type of motion and the knowledge of the intrinsic parameters of the camera. While homography (4-point algorithm [24]) should be used if the scene is planar/distant or motion is pure rotation, the selection between fundamental matrix (8-point algorithm [24]) and essential matrix (5-point algorithm [25]) depends on the knowledge of the intrinsic parameters of the camera.

To select the best model, we estimate both, homography and fundamental/essential matrix using all-to-all photometric feature matching and a parameter-free robust AC-Ransac [26] statistical method. The best model and its confidence level (automatically adapted to the noise) is estimated by following the Helmholtz principle of meaningful deviations and by regarding any model that is unlikely to be explained by chance as conspicuous. By comparing the confidence levels and number of inliers obtained from the estimation of both geometric models, we select the more appropriate. At the same time, using a robust estimation method also diminishes the influence of outliers on the estimation process.

As a final step of the initialization, the selected model is used to evaluate the behavior of individual matches with respect to the epipolar constraints [24]. Outliers and points with low parallax are omitted, while the rest are triangulated and added to the initial local map. Once the points are seen by a sufficient number of frames they are introduced to the global map.

C. Motion Tracking

Given that the tracking has been successful for the previous frame, the constant motion model is used to predict the pose of a new camera. Based on that, successfully tracked points from a previous frame are projected onto the new frame obtaining a prediction of where the correspondence in the new frame should be $\hat{z}_k = \text{proj}_k(c_i, p_j)$. The features extracted in the new image, which we call observations and denote with z_k, are potentially matched with the predicted features in their vicinity. The matching is successful if the difference of their descriptors is below a threshold and passes the χ^2 test at 95% ($\text{TH}m = 5.991$):

$$\left\| \hat{z}_k - z_k \right\|^2_{\Sigma_k} < \text{TH}_m. \quad (2)$$

It is important to note that if the motion model does not describe well the real motion of the camera, the matches will not be found and the system can easily lose track of the points. In case too many points are unable to be tracked, the system automatically adjusts by widening the search area around the projections $\hat{z}_k$, and in the case that no matches were found, the system uses the last frame added to the global system to re-localize the current frame. This is done by using 3D-2D correspondences, and the pose of the new frame can be estimated using EPnP algorithm [27].

Once the matching is successful, the camera pose is optimized through a camera optimization step, where only the parameters of the camera pose are allowed to change. The newly optimized pose is further improved by attempting to match 3D points seen in neighboring frames (i.e. frames which share a sufficient number of 3D points with current frame) by projection (2) followed by another pose-points refinement.

D. Frame Insertion and Outlier Rejection

In order to maintain a scalable representation, only the frames which exhibit sufficient motion [6] are added to the global system. If the number of tracked features, compared to the last inserted frame, significantly decreases (below 70%), we introduce the frame to the global map and triangulate new points to strengthen the tracking. Similarly, in case of small number of tracked features (e.g. due to poor quality of images) we introduce new frames more frequently to increase the probability of successful tracking.

Once the frame is selected for insertion, previously unmatched features in neighboring frames are tested to match unmatched features in the current frame. As the poses of all the frames have been previously estimated, the search can be restricted to only pairs of features satisfying epipolar constraints. Successful matches are triangulated and inserted only if all matched observations from neighboring frames are consistent with the triangulated point.

In order to eliminate possible point outliers, a local refinement test using BA is required prior to the global map insertion. This includes the points visible in the current frame and all the camera poses from where the points in the local map have been previously observed. The optimization is restricted to the parameters of the current camera and local points, as this step is only used to eliminate possible point outliers before introducing them to the global map. Local points with high re-projection error in frames that they are observed are considered outliers and removed. The remaining points are added to the global map if and only if they achieved sufficient confidence (e.g. seen by sufficient number of frames).

In [6] the goal is to obtain real-time tracking, and thus global BA process is run concurrently with the tracker on distinct processing thread. When the tracker adds new points and cameras to the map, the global BA process is stopped to promote the real time operation. This can prevent the pipeline to provide a global optimization at every step. In contrast, our pipeline is concerned with providing the best estimate all the time so that the result can be used either on-board an autonomous underwater vehicle (AUV) to localize the robot and generate a good representation of the environment, or presented on a remotely operated vehicle (ROV) mission control panel to help the pilot control the acquisition in real-time.

V. Incremental Processing

Bundle adjustment is used to refine the camera poses and the 3D structure. In order to deal with the uncertainty, BA is formulated as probabilistic estimation and solved using non-linear least squares (NLS). Available BA software and applications are able to assemble and process the information from large amount of images and produce accurate solutions; *Bundler*, *Open MVG*, *Visual SFM*, to name just a few. Nevertheless, the majority of the existing applications are designed to be used offline, post-acquisition and do not provide any feedback about the uncertainty of the reconstruction.

SLAM++ [28], [29] is an open source library we are developing and which implements nonlinear least squares solvers for SLAM and SfM applications. The main advantage of the SLAM++ is that it implements incremental solutions for SLAM [10] using sparse block Cholesky factorization and recently also incremental solutions for BA [17]. Those are based on the highly efficient block matrix data-structure that facilitates structural and numerical changes of block matrices as well as arithmetic operations. Both the CPU and the GPU versions were shown to be faster than the SuiteSparse variants of element-wise implementations [30].

A. Bundle Adjustment Step

Formulating the BA as a probabilistic estimation method accounts for the uncertainties in the image measurements. It is common to assume that the point measurements are characterized by zero mean Gaussian noise and to formulate the BA problem as an optimization over a set of variables $\theta = [\theta_1 \ldots \theta_n]$, the camera poses and the 3D points forming the state $\theta = [\mathbf{c}, \mathbf{p}]$. We want to find the optimal configuration satisfying a set of measurements, $\mathbf{z} = [z_1 \ldots z_m]$, given by the re-projected points on the image. This can be done by finding the maximum a posteriori probability (MAP) estimate:

$$\theta^* = \underset{\theta}{\operatorname{argmax}} P(\theta \mid \mathbf{z}) = \underset{\theta}{\operatorname{argmax}} - \log(P(\theta \mid \mathbf{z})). \tag{3}$$

Each point observation is assumed to have zero-mean Gaussian noise with the covariance Σ_k and we measure the re-projection error: $\mathrm{ek}(c_i, p_j, z_k) = z_k - \mathrm{proj}_k(c_i, p_j)$, with $[c_i, p_j] \subseteq \theta$ where proj(·) is the projection function of a point, p_j, onto the camera c_i, and z_k is the actual pixel measurement. Note that even if this paper considers only 3D point observations, other measurement such as IMU or altitude sensors can be easily integrated into the estimation problem. The solution is obtained by solving the following NLS:

$$\theta^* = \underset{\theta}{\operatorname{argmax}} \frac{1}{2} \sum_{k=1}^{m} \left\| z_k - \mathrm{proj}_k(c_i, p_j) \right\|^2_{\Sigma_k}. \tag{4}$$

Iterative methods such as Gauss-Newton (GN), Levenberg-Marquardt (LM) or Dog leg trust region are often used to find the solution of (4). In brief, these methods compute, at every iteration, a linear approximation of the problem, given a linearization point θ^0 and find a correction δ towards the solution by solving a linear system $\Lambda\delta = \eta$. At every iteration, the linear system can be solved either using matrix factorization methods or gradient methods and obtain an update for the current linearization point, $\theta^{i+1} = \theta^i \oplus \delta$. The process iterates until convergence.

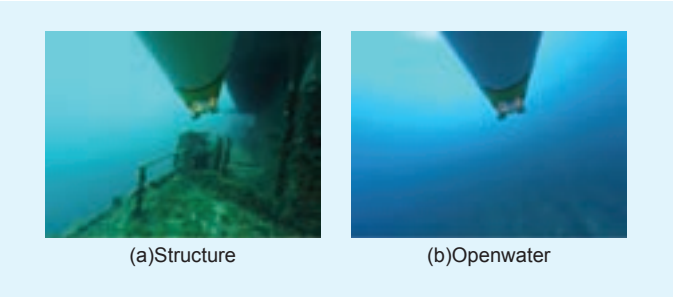

Figure 1. Captured frames: (a) registered and (b) discarded.

B. Incremental Bundle Adjustment with Fast Covariance Recovery

In online applications, at every time step, new measurements are integrated into the system and a globally consistent solution can be found by solving the updated system. In our previous work [10], [29], we showed that, in SLAM applications, the updates only affect a small part of the system. Based on that, we proposed methods to solve the system in an incremental fashion, which translated into very efficient SLAM algorithms that can run onboard vehicles with limited computational capabilities. The proposed methods were based on techniques such as partial, block Cholesky factorization, which, at every step, performs matrix factorization on a small part of the system matrix affected by the update [10].

In general, the solution of the NLS is providing a mean estimate θ^*. In a probabilistic framework, it is important to consider the uncertainty associated with this solution, the covariance matrix in our case. It is a well known fact that the covariance matrix is very computationally expensive to obtain, given that it requires inversion of large matrices. Identifying which variables are affected by the updates led to very efficient solutions for the calculation of important elements of the covariance matrix in SLAM [14]. Our previous work shows that the marginal covariances, representing the uncertainty of each variable, and the crosscovariances of the last pose of the robot and all the other variables can be computed in a time which is a fraction of the solving time. The proposed algorithm outperformed the existing methods by two orders of magnitude and enabled SLAM applications where the state representation is maintained compact and the loop closure is obtained based on the state estimates [29].

Nevertheless, SLAM has a much simpler structure than BA. A typical BA problem is more *dense* and this is due to the fact that many (sometimes up to thousands) of points are seen from a single camera view. This makes incremental methods which are efficient when solving a SLAM problem to become inefficient when applied to BA.This is also the case of the matrix factorization, in SLAM Cholesky factorization has been shown to be very efficient. Whereas in BA, it is well known that the underlying variable graph is bipartite and can be separated in two parts, one corresponding to the camera variables and one to the point variables. An algebraic trick called Schur complement (SC) can be applied in this case. Given that the point measurements are independent and the fact that the number of camera poses is in general much smaller than the number of 3D points ($nc << np$), solving first for the camera poses and then for the points divides the problem to solving a small relatively dense system first and a large sparse system after. This partitioning of the computation is at the core of speeding up most of the batch BA solvers, but can make the matters difficult in incremental processing. Recently, we integrated into SLAM++ a method that can directly update the Schur complement representation with the new measurements obtained at every time step. This method brings up to threefold reduction in solving time in steps where the 3D points are seen from a small amount of cameras and when the size of the update increases, it gracefully degenerates to batch solving.

Moreover, a highly efficient covariance recovery technique was integrated. This method is based on an algebraic manipulation of the operations involved, so that resulting calculations take advantage of the sparsity of the problem, the previously calculated elements of the SC, and requires similar storage as the solving of the SC system. Details about the method can be found in our previous work [15] and an improved version of that will be made publicly available with the new release of the SLAM++ code http://sf.net/p/slam-plus-plus. This method was shown to provide marginal covariances at a time comparable with the solving time and to be more than one order of magnitude faster than the existing implementations.

Although the tracking system in the front-end implements several stages of outlier rejection based on local reprojection errors, the global optimizer can further check for the global consistency of the observations. This is done by using using *robust estimators*. The appealing property of robust estimators or M-estimators (maximum likelihood type estimators) [31] is their simple integration into the ordinary nonlinear least squares framework. The only change is that each observation z_k is assigned a weight. These weights then multiply the measurement covariances Σ_k in (4). With that, our back-end adds another level of robustness to the pipeline.

VI. Results

The proposed pipeline was tested on a large-scale underwater data set acquired by a setup comprising five GoPro Hero 4 cameras, while inspecting a shipwreck near the coast of Palamos, Spain. The total duration of the acquisition was 11 minutes. Views containing plain water and no structure (figure 1b) were automatically omitted by the tracker, as they convey no information to be integrated into the system. Binary masks were used to conceal the view of the robot seen on two cameras. For the back-end performance analysis in section VI-A we aimed to maximize the size of the BA system, therefore we use the images form all five cameras and, from that, a total of 1772 images were successfully registered offline to produce 455776 observations of a total of 170018 3D points. However, our current version of the tracker only supports single camera systems. Therefore for the tracking performance analysis we used the video sequence of the camera that captures the most of the visible structure. In total, the sequence contains 5480 frames out of

the total of 16000. The extension to handle a multi-camera system will be implemented as future work.

A. Back-end Performance

We first tested the incremental optimization and covariance recovery introduced in section V and implemented in SLAM++. For that, we compared performance with two popular NLS solvers in computer vision, g2o [32] and Ceres [33]. The first one, g2o, can solve BA and SLAM problems out-of-the-box. TheBA implementation is restricted to batch solving. The Ceres solver received much attention, as it is used in Google's 3D Maps and Street View applications. It is mostly focused on batch solving.SLAM++, on the other hand, implements incremental solutions for SLAM and recently for BA.

In order to guarantee repeatability and fairness of the evaluation, the same input data was used by all the solvers. Therefore, for time comparison we processed the images with a similar pipeline as described in section IV but instead of actually feeding an incremental, global BA optimizer, the measurements were stored in a file. This file was then parsed incrementally by all three solvers and the data processed incrementally. Here we need to make the distinction between incremental processing and incremental solving. While the former refers to performing the global optimization every time new information is available, the latter refers to actually updating and solving the system incrementally (partially). For example with SLAM++ we process and solve incrementally but with g2o and Ceres we process incrementally and solved batch.

The main characteristic of this dataset is that each point is seen in only a few images, and that makes the updates on the incremental optimizer very efficient. Table I shows how the incremental solver in SLAM++ outperforms the other solvers by a factor of 1.5× while having comparable rootmean-square error (RMSE). Observe that the covariance recovery times using g2o and Ceres are fairly high, clearly showing that those solvers are not suitable for this purpose.

Figure 4 shows an example of how the covariance value helps identifying poorly sampled regions of the reconstruction. For that, we simply color-coded the values of the determinant of marginal covariances for each point in the global map (purple–high uncertainty, red–low uncertainty). This can help in re-planning trajectories of the robot to re-sample high uncertainty regions.

B. Tracking Performance

The tracking approach in section IV successfully reconstructed a scene (figure 5) containing 65355 global 3D points and 801 key-frames out of a total of 5480 frames. Observe

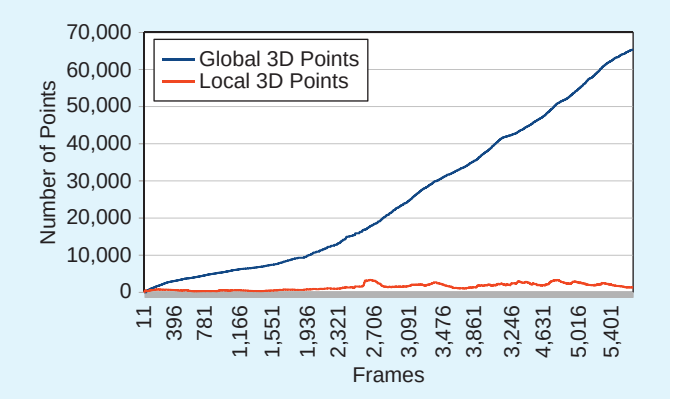

Figure 2. Number of global/local points with respect to number of frames processed.

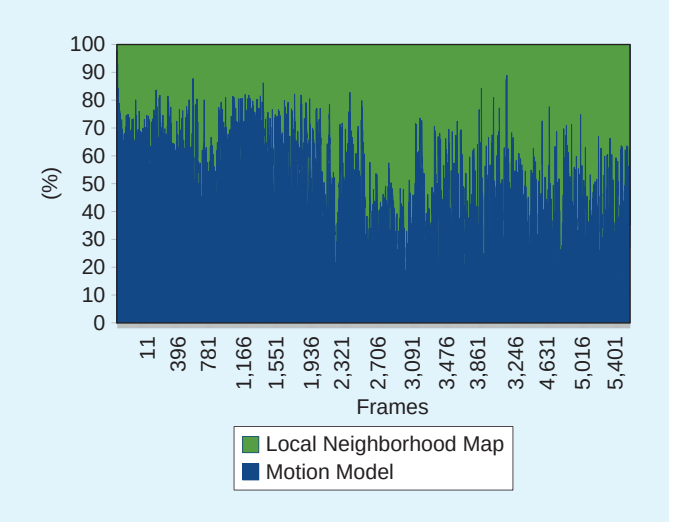

Figure 3. Relation between matches obtained using motion model/local neighborhood map.

that the tracker samples the key-frames, only maintaining the informative ones in the global representation. This is very important for the efficiency of the on-board processing where the computational resources are limited. We further analyze the global vs. local maps. As shown in figure 2, we can see that the number of global 3D points is constantly rising, while the number of local 3D points is limited as inactive points are continuously removed from the map.

As already mentioned earlier, our tracking relies on both, matching with motion model and subsequent matching with points in a local neighborhood map. Both steps are highly important for obtaining an accurate pose estimation which

Table I. Evaluation of the incremental processing on the Boreas dataset. Num. of Cameras: 1772, Num. of Points: 170018, Num. of Observations: 455776.

Solver	g2o	Ceres	Batch SLAM++	Incremental SLAM++
Solve Time	19578.700 sec	15138.994 sec	20876.609 sec	541.680 sec
Covariance Recovery Time	25.65 hours	2478.973 hours	2.839 hours	2.839 hours
RMSE	2.616 px	8.466 px	12.575 px	6.022 px

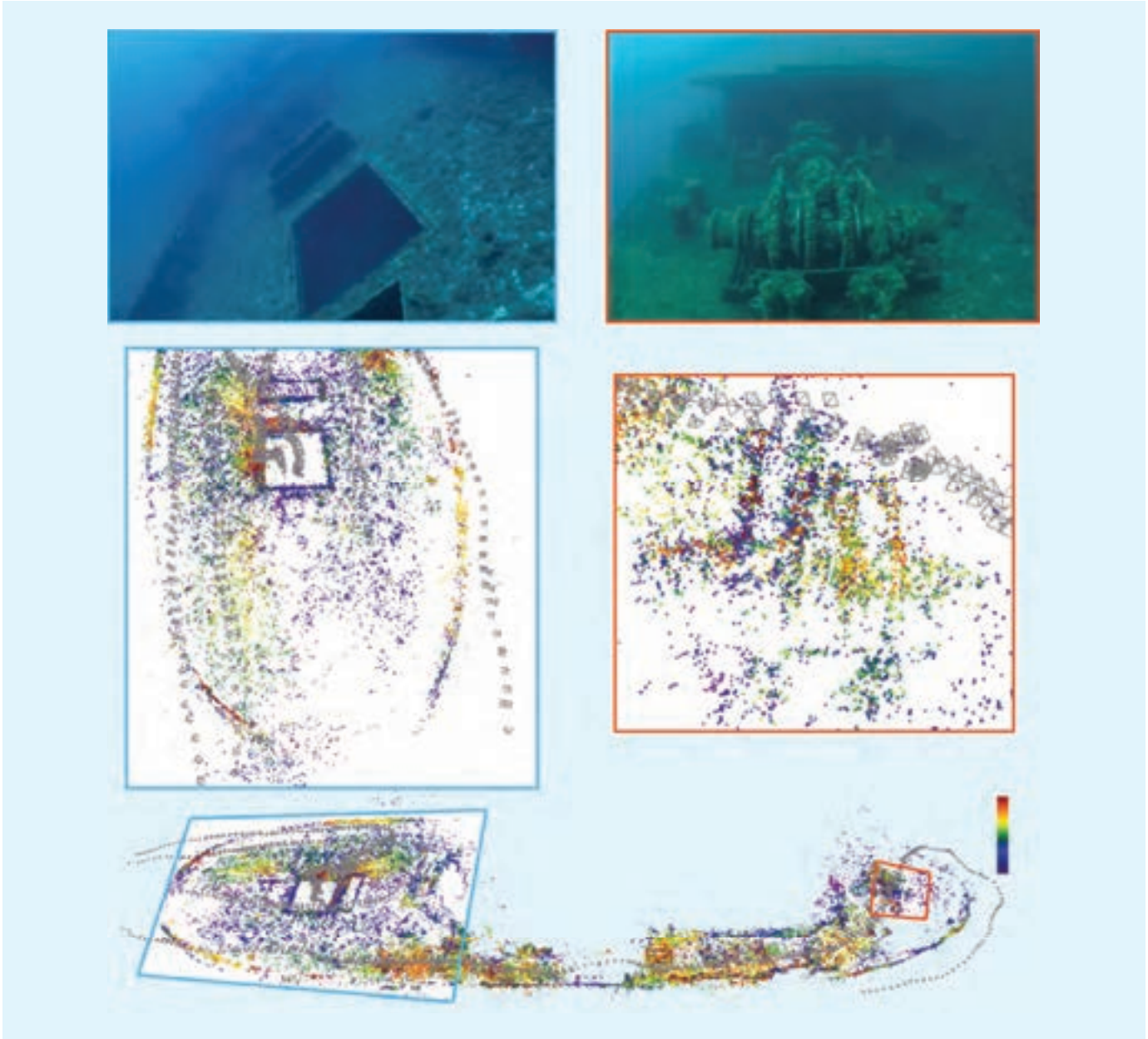

Figure 4. Final sparse 3D reconstruction using multi-camera dataset with color-coded magnitude of the uncertainty estimation (violet-high uncertainty, red-low uncertainty).

enables better outlier rejection. This can be seen in figure 3, where the percentage of successfully matched points with each strategy is shown. After each key-frame insertion into global map, the proportion of points matched using the motion model increases, as the motion and points have been recently optimized by global optimization. As frameto-frame tracking gradually accumulates error, the number of matches using a motion model decreases. However, the camera refinement step enables better matching with the local neighborhood map, resulting in an increased percentage of matched points.

Our current implementation was developed by extending the open-source library OpenMVG [34]. The CPU implementation of the SIFT feature extractor, taking on average 0.2 s per frame could be significantly improved using GPU implementation (e.g. [21]) which we plan to integrate in the future. Matching and triangulation take 0.15 s and the rest of the tracking additional 0.1 s. While the numbers do not indicate real-time performance it is worth noting that the code could be further optimized. Some parts such as feature extraction and matching can be parallelized to gain on time performance. This experiment was performed on Intel Core i7-5500U processor and 8 GB RAM.

VII. Conclusions

This paper contributes to the field by demonstrating the feasibility of mission-time 3D reconstruction and uncertainty estimation. This is the critical component missing for performing quality-aware data acquisitions, which will increase

the quality of both the final acquired data and the survey efficiency as well as concurrently diminish the possibility of performing unsatisfactory optical surveys. In the future we plan to speed up the tracking part by parallelizing parts of the pipeline to obtain real-time, and to exhaustively test the entire incremental pipeline on different scenarios. The final goal is to integrate this system into our Girona500 and SparusII underwater robots and use the uncertainty-aware 3D reconstruction to guide their missions.

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Figure 5. Final sparse 3D reconstruction obtained with tracking with color-coded magnitude of uncertainty estimation (violet-high uncertainty, red-low uncertainty).

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Data Science and Environment Workshop Labeled OES Advance Study Institute

Redouane Lguensat, Student member, OES Student Poster Competition winner
OCEANS'16 Shanghai

Under a shiny sun, the coastal city of Brest witnessed the gathering of two scientific communities whom collaboration is still at its early age. The event "Data Science & Environment 2017" took place at pôle numérique Brest Iroise, and aimed to create new connections and collaborations between researchers that have an expertise in one of the two areas (data science, environmental sciences) and some interest for the other. IEEE OES was featured as the main sponsor launching its "Advance Study Institute" for young scientists concept, and Prof. René Garello, the junior past president of the Society, was among the local organizing committee.

The program of the conference (see http://conferences.telecom-bretagne.eu/dse2017/ for further information) consisted of a 3-day workshop where invited speakers gave their talks, and a 2-day summer school intended only to PhD students in data science and/or environmental sciences. The first day and the last day of the conference were exclusively for the summer school, where the students had to learn machine learning algorithms and apply them to a real case challenge: "Predicting the ENSO (El Niño and Southern Oscillation) index." Organizing the workshop in between offered the students a valuable opportunity to learn about the current research directions that combine data science and environmental science, and also to meet and discuss with scientists before the last day where they had to test their algorithms for the challenge.

The local organizing committee lead by Pierre Tandeo, featuring Prof. René Garello and Redouane Lguensat author of this article, along with Guillaume Maze (Ifremer), Pierre Ailliot (Univ. Bretagne Occidentale), Anne Cuzol (Univ. Bretagne Sud) and Valérie Monbet (Univ. Rennes I).

The first day of the summer school served as an opportunity to break the ice between the 28 selected PhD students coming

The participants attending one of the talks at the workshop.

Another angle.

Coffee break room with the posters.

A souvenir picture with the participants.

Some of the PhD students in a short visit near the castle of Brest.

from all five continents (17 nationalities). After a presentation of the goals of the summer school and the data challenge by Dr. Pierre Tandeo from IMT Atlantique, two courses were given: "Oceanographic data" by Guillaume Maze (Ifremer) and "Data Science methods" by Valérie Monbet (Université Rennes 1).

The next three days were filled with talks from several specialists and renowned researchers, presenting applications of data science ranging from oceanic sciences to atmosphere, meteorology, climate, biogeochemistry and geographic information systems. The talks all had a shared vision on the exponential trend in data availability that is expected to continue in the future, thereby creating many new opportunities, needs and challenges.

The workshop was divided into five sessions where the speakers gave applications of data science in their respective fields. Data sciences were shown to emerge as a wide multidisciplinary dynamic which addresses challenges associated to large and complex data and encompasses diverse fields in applied mathematics and computer science. The applications generated a strong interest among the participants and paved the way for further interesting collaborations.

The attendees could continue the discussions in the coffee break room where several posters of PhD students were exhibited. An official poster session was organized on Wednesday evening.

A social event was held on Wednesday evening in the form of a gala dinner on a boat sailing across the Bay of Brest. Crabs and seafood on the menu plus some nice pastry from the Brittany region.

The fifth day of the conference was the second and last day of the summer school. Two presentations were given: "The use of Google Cloud platform" by Pierre Tandeo, and "the prediction of ENSO index" by Christopher Wikle; the remaining time was left for the students to test their algorithms in a session supervised by the local organizing committee.

A Blast from the Past

Bob Wernli—Vice President for Professional Activities

Is there fun at an OCEANS conference… see for yourself in this

Blast from the Past! from OCEANS ’09 Bilox

Tropical music from the “Landshark” Band.

Conference Chairs Ed Gough & Laurie Jurgan.

Chip Worsinger, Karen Lynn, Kevin Comer, Heidi Wilkers, Donna Kocak & Rick Simonian.

Diane Di Massa, Bob Wernli, Barbara Fletcher Enjoying the Music.

Jim and Peggy Barbera (L) and Tim Janaitis and Claude Brancart (R) enjoy the conference reception.

The OCEANS Conference—Sixty and Counting

Joe Czika, OES Past President and Chief Editor of "The OCEANS Conference-60 and Counting"

OCEANS'17 Aberdeen, the 60th OCEANS conference, witnessed the unveiling of the IEEE/OES and MTS commemorative issue "The OCEANS Conference—Sixty and Counting." The 48-page publication documents the history of the conferences from their beginning in 1971. You can view the document on the OES website, or if you would like a hard copy of the publication, please send an email to jczika@verizon.net. You will enjoy the read.

Welcome to OTO'18
OCEANS'18 MTS/IEEE Kobe/Techno-Ocean2018

May 28–31, 2018 Kobe Japan

We, OTO'18 Kobe team are waiting for your visit to Kobe. Our "Happi" makes you happy!

OES ExCom Members with Kobe happi, Jerry Carroll, Bill Kirkwood, Diane Di Massa, Robert Wernli, Jim Barber (above, L to R) and OTO'18 LOC team with Kobe happi, Yukiko Nakajima, Yuki Hato, Katsuyoshi Kawaguchi, Naoto Yamamoto (below, L to R) in OCEANS'17 Aberdeen Exhibition.

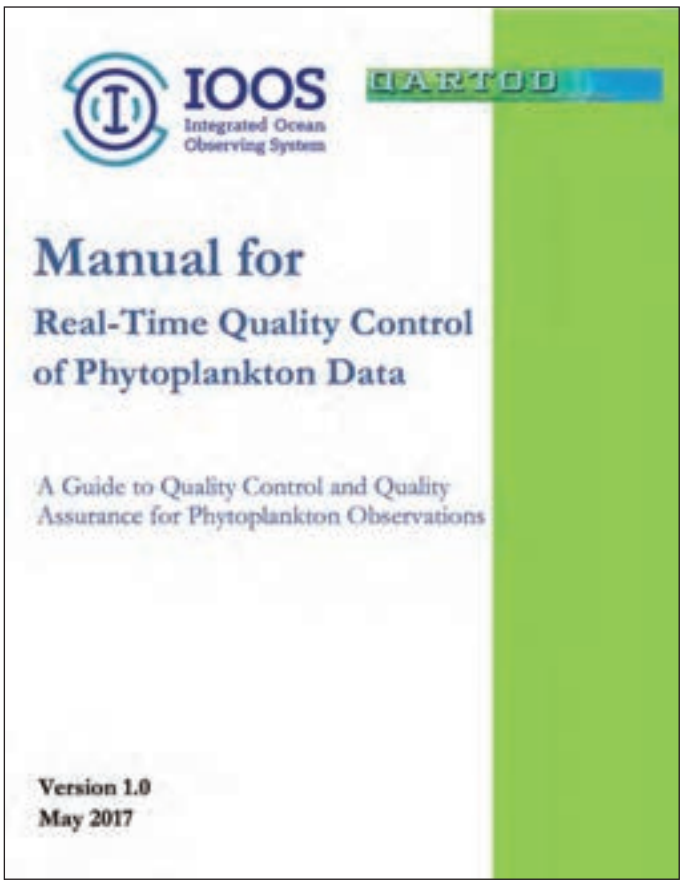
The U.S. IOOS QARTOD Project Publishes
Manual for Real-Time Quality Control of Phytoplankton Data

For further information, contact: Mark Bushnell, Tel: 757.647.0764, mark.bushnell@noaa.gov

The U.S. Integrated Ocean Observing System (IOOS®) Quality Assurance/Quality Control of Real-Time Oceanographic Data (QARTOD) Project has published the *Manual for Real-Time Quality Control of Phytoplankton Observations.* This manual is the tenth in a series of documents that provide guidance to help data providers ensure the quality of data they collect in real time. The manual also represents completion of a National Oceanic and Atmospheric Administration/National Ocean Service milestone that highlights the operational use of new and emerging technologies focusing on ocean observations.

Mark Bushnell

This manual is QARTOD's first venture into the quality control of data for biological variables such as phytoplankton, which is an important food source for marine life from whales to shrimp. The information gained from phytoplankton observations is used to monitor fisheries closures, aquaculture, recreational and potable water source quality, as well as serving as an early warning for harmful algal blooms. Phytoplankton observations also can help scientists conduct satellite ground-truth, implement on-the-fly course corrections for predictive models, and monitor environmental impacts of climate variability. These observations also offer an important window into the health of specific ecosystems in coastal oceans, rivers, estuaries, and lakes.



Implementing automated, real-time quality control for biological variables involves challenges that data providers rarely encounter when collecting data for variables such as waves, currents, and water levels. For example, there might be a greater variability of data within a small spatial area for phytoplankton than for water levels or other variables. Biology is prone to nonlinear jumps that may appear as erroneous spikes and require experienced practitioners to interpret them. Clarissa Anderson, Executive Director of the Southern California Coastal Ocean Observing System (SCCOOS), points out that "having QARTOD standards in place for key biological variables is a crucial first step towards codifying how we deal with these complex datasets at the national level. This manual provides a solid blueprint for managing real-time phytoplankton observations and will continue to be improved with boots-on-the-ground implementation."

Several different technologies exist for collecting phytoplankton data. For some applications, samples are examined using a microscope. Other automated systems include fluorescence-triggered particle imaging, spectral signature, in-vivo fluorometry, and molecular/DNA. Some instruments measure for a specific species of phytoplankton; others measure chlorophyll or species abundance.

Phytoplankton measurements are collected by instruments on a variety of platforms, including buoys and autonomous underwater vehicles, as well as from fixed locations such as oil platforms and piers.

U.S. IOOS QARTOD sought the input from national and international organizations and experts within the ocean-observing community, including sensor manufacturers and academic institutions. Mark Bushnell, QARTOD Technical Coordinator, noted, "Once again, a community of subject-matter experts shared their time, knowledge, and experiences to help create a QC manual. It's very rewarding, a privilege really, to interact with these enthusiastic professionals. We can't thank them enough!"

For more information about the U.S. IOOS QARTOD Project, please visit https://ioos.noaa.gov/project/qartod/

Member Highlights

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

Introduction for Who's who in the OES
Bill Kirkwood, OES Treasurer

Bill's Italkart with a TAG setup.

Bill's new helmet. His wife gave this to him for Christmas, custom hand painted. TLR is his consulting company, so not some form of a subliminal message. Let's see what story starts from the next!

Who's who in the OES and what do they do …outside OES?

Bill Kirkwood, OES Past President and Chief Editor of "The OCEANS Conference—60 and Counting"

Bill Kirkwood, OES Treasurer

Bill Kirkwood has been the OES treasurer for the last 4 years and prior to that was on AdCom for 2 years. His involvement started even earlier as a member for many years, but he really started to get involved when he developed the Autonomous Underwater Vehicle Tutorial back in the early 2000's, a tutorial that is still given today by Brian Kieft and Brett Hobson (OES members), which they have modernized to keep up with the changes in technology over the last 17 or so years.

What Bill does for fun outside OES is what this article is about. Being a mechanically minded guy from a young age he got involved in automobile racing. It started in Southern California when he was 12 years old and a new neighbor moved in next door. The neighbor was a drag racer driving AA/FA race cars… AA being top pro category and FA being Fuel Altered. Altered was the wheel base, shortened with a huge motor… at the time a Chrysler Hemi of the biggest bore they could find and then they maximed that to over 500 cubic inches, with the Fuel being Nitro-Methane with a mix of Ethanol. That was Bill's first job… mixing the fuel with a hydrometer based on the expected air density conditions, usually about 80% Nitro in those days. The picture shows the type of car—this is back in the mid to later 60's.

Bill continued on with this love of cars and all things motorized. At UCLA he joined the Hydrogen Powered Car research project. The team existed and Bill joined right after the first car was running, an AMC Gremlin. This picture shows the exhaust as a big cloud, but it was all water vapor. You could drink the condensed exhaust. Bill then worked on the 2nd generation, a US Mail Truck, and left school while working on the 3rd generation designs. After graduation Bill got into sports cars as a daily driver with an early 70's MGB, and then a late 80's Datsun Z. Later Bill moved to the Monterey area and got involved with the Sports Car

Racing Association of Monterey Peninsula (SCRAMP). This is also when Bill purchased his first Porsche, a 1978 Targa and started to get involved with the Porsche Club of America (PCA).

Bill was a volunteer with SCRAMP in the mid-80's working the pro-events at Laguna Seca. During this time Bill decided to getback into racing. In 1996 he joined the National Hot Rod Association and obtained his drag racing license in the semi-pro ranks of Super Comp Dragster.

Not having any drag racing tracks close to home, Bill decided to take a different turn and go road racing. It was through SCRAMP that Bill connected with the San Francisco Region of the Sports Car Club of America (SCCA). Since the late 1990's Bill has been actively involved in the SCCA as a racer and worked in several official capacities overseeing professional and club races. He has raced in a number of cars including Rx7's, Miata's, Spec Racer Fords, and BMWs. Below are a few images of Bill racing.

About 2008 or so, Bill joined the Historic Motor Sports Association and Classic Sports Racing Group to begin running vintage races, and he purchased a 1961 Elva Courier MkII to campaign as a tribute to one of his racing heroes—Mark Donahue. After selling his Corvette, Mark won his first championship in an Elva Courier Mk II in 1961. Bill has also raced other vintage cars, particularly MG's. Vintage racing is different than SCCA, no contact is allowed and there are no trophies for position. It is meant to be a fun time and to show racing technology through the years, so vintage cars are expected to be period correct. In the 2016 Monterey Rolex Reunion at Mazda Raceway Laguna Seca (formerly the Monterey Historic Races) Bill won two awards, one for being steward of his race group and a Bonham's Cup for best race as determined by a panel of seven judges, seen in the far right picture with Bill's good friends and mechanics. For those who know racing, Bill raced against Patrick Long and Boris Said in his race group in 2015 and 2016, as well as the late Indy Car racer Justin Wilson in 2015 who was sadly lost in a racing incident just two weeks after running in the Monterey Rolex Reunion. Bill says racing is a lot of fun but it does have its risks.

Bill also races Go Karts and has raced those in Asia, Australia, Guam, Germany, Scotland, Canada, and of course many places in the US. But now there are problems… between free hats, racing flags, shirts, pictures and trophies it is hard to escape cars at home and the office. Pam, Bill's wife, is starting to say enough is enough. So, when you see Bill around not doing OEs business he is likely wearing some logo wear because he's cheap and his wife wants it out of the house. ☺

After many years as Chief of Communications in SFR-SCCA operating races, Bill was asked in 2015 to join the SCCA Stewards program. The duties of Steward have slowed down Bill's SCCA racing but he is still an active vintage racer.

Bill has also gotten involved in building show cars. He started showing his Elva at car shows around Monterey California. The car won a number of awards, so Bill went further and built a 1964-1/2 Ford Mustang, which he shows at various venues around California with his wife Pam. She enjoys it so much a new project is underway to build her a 1958 MGA drop head (American's say convertible) sports car to have her own car for attending shows.

Next time you see Bill at OCEANS or another OES event, feel free to talk cars. Bill loves cars and all things racing. Bill will again be at the Monterey Rolex Reunion for 2017 with his vintage Elva Courier, wish him luck and look for him on TV.

You can see Bill racing at one is scary with oil on the track: https://www.youtube.com/watch?v=twR9kV7rMGQ https://www.youtube.com/watch?v=WMlkSxGtpHw&list=PLGvTvFzdMg_Oy78iWCHYtZCbZd-D6tsi_&index=4

AdCom Election Results

René Garello, OES Junior Past President

The election results are in for the 2018–2020 Administrative Committee members. This year we had a great list of 12 candidates from around the world (see their bios in the last issue of the Beacon) and the results were very close. Congratulations to the following six candidates who were elected:

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

GERARDO G. ACOSTA

JEAN-PIERRE HERMAND

WILLIAM J. KIRKWOOD

VENUGOPALAN (VENU) PALLAYIL

HARUMI SUGIMATSU

ROBERT L. WERNLI

Welcome New and Reinstated Members

Australia
Paul Gavin Rigby
Alice Sophia Todd

Bangladesh
S M Altaf Hossain

Brazil
Paulo Lilles Jorge Drews Jr
Marcus Vinicius Da Silva Simoes

Canada
Deborah Egloff
John W Hansen
Maia Hoeberechts
Sri Raghu P R

China
Xuan Li
Gai-Ge Wang

Colombia
Melisa Andrea Acosta Coll

Finland
Christer P Helenelund
Juha Kaaria

France
Paul Cristini
Mathieu Issartel
Thanh Huy Nguyen

India
Saurav Chandel
Kumar S Cheruvu
Farheen Fauziya
Vanishree J
Brejesh Lall
Grace M
Akshaya N
Varshini P
Vijayalakshmi R
Maria Antony Oscar Rajendiran
Aishwarya S

Iran
Mohammad Ghasem Mardani

Iraq
Dr. Thiulfikar Abdulmehdi
Najah Lateef Al Maimuri

Italy
Andrea Buono
Federica Lacirignola

Japan
Shota Chikushi
Jin-Kyu Choi
Katsunori Mizuno
Hiroshi Nagakura
Masanao Shinohara

Kenya
Lucy Patricia Onundo

Korea (South)
Hosin Cho
Yeongjun Lee
Tae Kyeong Yeu

Mexico
Karen Rubi Hernandez
Roman Nunez Ortega
Eddie Santiago Ordonez Sanchez

New Zealand
Alan D Van Gerve

Pakistan
Suleman Mazhar

Peru
Jose Guillermo Balbuena Galvan

Portugal
Jose Miguel Soares Almeida
Hugo Ferreira
Eduardo A Pereira Da Silva

Singapore
Anshu Singh

Spain
Diego Centelles Beltran

Sweden
Andreas Gallstrom

Tunisia
Moez El Gaied

United Kingdom
Benjamin Sherlock

USA
Rj Baker
Dong R Bang
Dylan Gabriel Benoit
Susan Kay Bergman
E.Mel C Celi
Brandon Cochenour
John C Cole
James Collum
Jeffrey B Curtis
Michael Albert Diddams
Dana Enstad
Seva Epsteyn
Bruce E Garrett
Aileen E Geary
Arundhoti Ghatak-Roy
Erica Hansen
Cameron Heckman
Mike R Hughes
Allan Jacobs
Andrew R Jones
Seyong Jung
James Henry Kepper
Chuck Key
Eric James Martin
Jerome Keith Miller
Alanis Yaimette Nazario
Mark Alan Noonchester
Milutin Pajovic
Mark Allen Parsons
Nathan Philipp
Samuel Munoz Preciado
Sara N Rogers
Diana Carolina Ruiz
Dinesh Sachdeva
Rashmi Shah
Bhavin B Shah
Farley Francis Shane
Loren Shure
David R. Stark
Arthur M Teranishi
Michael Y Tu

OES Awards Student Scholarships

OES is pleased to introduce two students who received an OES scholarship award in Fall 2016. Profiled below are Danqing Yin, a master student at the Dalhousie University, and Ashesh Srivastava, an undergraduate student at the University of University of Houston.

Personal statement by scholarship recipient, Danqing Yin

Danqing Yin is currently earning a Master's of Science in Electrical and Computer Engineering at Dalhousie University. During her graduate work, she has worked as a research assistant for the Ultra Maritime Digital Communications Center (UMDCC) focused on characterizing underwater communication channels to serving as a teaching assistant.

Danqing was born in a small inland city in China and had not seen the ocean until she travelled to Qingdao as a young girl. This trip changed her future career path and she started to focus on electrical engineering as an undergraduate in Qingdao and continued her studies in Halifax. During her undergraduate time, Danqing's courses focused on electronics, specifically communications. She used this fundamental knowledge to study engineering in graduate school and began to focus more on digital signal processing and underwater channel modeling and estimation. She has particularly focused on the challenges in implementing algorithms, such as Approximate Message Passing (AMP) and Orthogonal Matching Pursuit (OMP). These challenges mainly come from the long delay spread and Doppler effects of underwater channels and she is working towards different types of tests of tracking methods in real communication channel scenarios.

She is proud to be part of the UMDCC at Dalhousie and the progress this laboratory is making in underwater acoustic communications systems. After finishing her Master's degree, Danqing plans to continue her education. She feels that acoustic communications is an important part of our lives and this field will continue to evolve rapidly. She hopes to continue helping in making underwater communications faster and more reliable. Danqing also plans to pursue research in the development of sonar systems and contribute her expertise in acoustic communications in the further exploration of the ocean.

Personal statement by scholarship recipient, Ashesh Srivastava

Ashesh is currently a graduate student at the University of Houston. He started working on a Master of Science degree in Subsea Ocean Engineering in 2015 and has also been working with the Petroleum Technology Initiative, a collaboration between the University of Houston and Offshore Magazine. His passion for the oceans started at a very young age.

Ashesh first saw the sea when he was 17 years old in Kovalam, India. "That view had a magical effect on me. Those moments seeded the passion for the seas and oceans so deep within me … that I knew this is what I wanted to do." Ashesh's father also introduced him to the world of science and engineering and ocean engineering became a natural choice to pursue.

Ashesh has focused his studies on offshore energy engineering and has immersed himself in courses around the dynamics of offshore structure, riser design, and subsea systems. He has also served on the Subsea Engineering Society and is currently elected as the Treasurer. Part of his role in the Society includes organizing seminars and technical debates on developments in the field of Ocean and Subsea Engineering. In addition to a rigorous course load and active participation in student activities, Ashesh also volunteers at the Subsea System Institute—a national research center established in Houston to develop transformative technologies, engineering and operational practices to safely and sustainably produce deepwater energy resources. For fun, Ashesh is participating with a University of Houston team in the Shell Ocean Discovery XPrize, a global underwater exploration competition to map the seafloor.

For his remaining coursework, Ashesh hopes to continue contributing to technological developments in subsea engineering. He is passionate about technology and plans to continue to pursue a career in subsea engineering while continuing to give back to society. He also plans to mentor young engineers and continue supporting Societies, like the Subsea Engineering Society and IEEE, which continue to support and help students, like him, realize their dream and provide support and exposure to different opportunities.

The Student Chapter—Shanghai Jiao Tong University

Zheng Zeng, Oceanic Engineering Society Shanghai Chapter Secretary

SJTU OES student members conducted the lake trial of hybrid unmanned aerial-underwater vehicle

SJTU OES student members conducted a lake trial of the newly developed hybrid unmanned aerial-underwater vehicle prototype under supervision of Prof. Lian Lian (Chair of OES Shanghai Chapter) and Dr. Zheng Zeng. This research project "Hybrid Unmanned Aerial Underwater Vehicle Prototype" is funded by Qingdao National Laboratory for Marine Science and Technology with the scientific vision to rapidly observe the high spatial and time varying ocean phenomenon, including ocean boundary current, eddy, fronts, internal wave, etc., in the fine scale.

The project presents the attempt to develop a new concept hybrid unmanned aerial-underwater vehicle which can fly from the shore-base or deck, be controlled and guided in the air, land on the surface of a specified target position, then dive and conduct autonomous sampling underwater, and return to the base after the mission. SJTU OES student members from the Marine

Figure 1. The prototype of hybrid unmanned aerial-underwater vehicle launching from the inflatable catamaran.

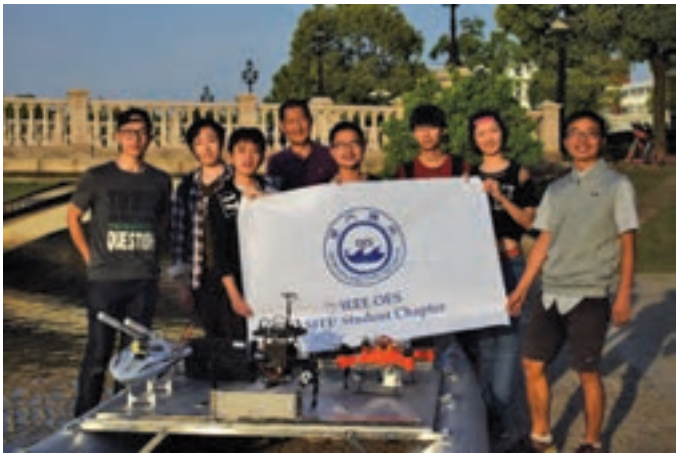


Figure 2. Group photo of SJTU OES student members along with advisor Dr. Zheng Zeng.

Technology & Equipment Research Group focus on the multi-objective design optimization of the hybrid unmanned aerial-underwater vehicle. Some of the design issues student members are working on include the problem of the general layout, aerodynamics and hydrodynamics performance, flight propulsion mode, payload, structural form, high density energy supply, and autonomous detection and transition methods between air and underwater of the hybrid unmanned aerial-underwater vehicle. Some other students are looking at the development of the intelligent switching controller with reasoning and judgment ability for the hybrid unmanned aerial-underwater vehicle operating from air to water (or vice-versa) in a dynamic and uncertain ocean environment.

During lake trial, SJTU OES student members operate DJI drones and an unmanned vessel to shoot the entire movement of the hybrid unmanned aerial-underwater vehicle prototype, including flying from the inflatable catamaran, being controlled in the air, landing on the surface of the specified target point, then diving automatically and returning to the inflatable catamaran after mission completion. From this lake trial, several problems of the prototype were found, which need to be improved before the next lake trial.

In the future, the chapter will continue to develop the hybrid unmanned aerial-underwater vehicle to achieve long-range flight, underwater gliding or autonomous underwater operation while equipped with multiple sensors.

OES Student Chapter formed in Hong Kong

Robin Bradbeer and Philip Woodhead

OES established its first student chapter in Hong Kong at the beginning of the year. Initially based at City University of Hong Kong (CityU), it also caters to students from other local universities, such as Hong Kong Polytechnic University (PolyU).

CityU has nearly 25 years of involvement with underwater systems, focusing on ultrasonic communications, ROVs and remote environmental sensing. In 2006 the university organized their first MATE ROV Contest, and sent school and university teams to the International Contest in North America, a tradition which continues to this day.

CityU, PolyU and Hong Kong University of Science and Technology (HKUST) went to compete in the international competition in 2016 at the NASA Buoyancy Lab, and HKUST this year.

Over the past 12 years some 500 schools have taken part in the local ROV competition, along with the associated workshops, from K-12 as well as tertiary institutions. The local MATE contest is usually run by professional engineers from The Institution of Engineering and Technology (IET), but only at Ranger and Explorer levels.

This year the MATE Navigator and Scout Classes for younger students was organized by the new OES student chapter, made up of CityU and PolyU ROV team members. It is the first time in HK where the underwater robotics competition was hosted by a group of university students.

The competition was held at the King George V School's swimming pool in Hong Kong on the 29th April, 2017. The event had around 50 students participating along with support from their teachers and parents.

Students between the age of 10–15 competed in the MATE Scout and Navigator class or Hong Kong's local classes of Sentinel and Adventurer.

It was a day of fun and learning for the young students with guidance from the university student organizers, teachers and parents.

The aim of the competition is to introduce underwater robotics to younger students through STEM education and test their

An enthusiastic group of participants with Prof. Robin Bradbeer (far right) and Prof. Issac Fung (far left).

The MATE Scout Champions!

A Scout team.

About to begin the competition!

A view of the competition with judges, teams and spectators!

Prof. Robin Bradbeer (middle) doing a safety inspection.

Last minute modification by young participant.

The leaders of the ROV workshop at PolyU, with PolyU ROV Team members and CityU IEEE OES Student Chapter members.

designs to compete in realistic missions. The concept is to learn about the designing, controlling and real world applications of ROV's.

The organizing students believe that STEM is becoming ever more relevant in this age with the speed of innovation in technology and the interconnectivity of software and hardware. They believe that it is important to help young students channel their attention and focus in this area through Underwater Robotics.

The MATE Scout & Navigator also serves as a stepping stone for students to participate in the MATE Ranger and Explorer Classes. These classes are more advanced and are targeted towards seniors in high school and university students who are more experienced in Underwater ROVs. The competition at this level is more intense, as the winners of the regionals have a chance to compete at MATE's International competition.

The universities' ROV teams are also planning to take part in the Singapore AUV Challenge in 2018; this will be supported by the local OES Student Chapter.

Part of the mandate of the IEEE OES HK Student Chapter is to promote Underwater ROVs to both local and international

students in Hong Kong and hope that the promotion of Underwater ROVs through STEM based learning and competition will help foster future talents in engineering sectors. As part of their community outreach the chapter also participated in the annual Makers' Fair, held at PolyU 3 weeks earlier. Here they led the attempt at the World Record for the most ROVs constructed at the same time. 400 attendees, nearly all with no technical experience, assembled and tested 150 miniROVs in 4 hours.

The branch's aim for the next 12 months is to recruit OES student and higher grade members from the other universities in Hong Kong with the eventual aim of establishing a full Chapter by the end of the year.

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OTO'18 *Ocean Planet It's our home*

OCEANS'18 MTS/IEEE Kobe /Techno-Ocean2018

May 28-31, 2018, Kobe Convention Center, Japan

Call for Papers

Invitation:

We are pleased to invite you to the OTO'18 (OCEANS'18 MTS/ IEEE Kobe / Techno-Ocean 2018) which will be held May 28~31, 2018 in Kobe, Japan. The event is hosted by three joint-organizers - the IEEE Oceanic Engineering Society (IEEE/OES), the Marine Technology Society (MTS) and the Japanese Organization of the Consortium for Techno-Ocean 2018 (CJO). The venue will be Kobe Convention Center, a state-of-the-art facility located on Kobe's Port-Island, (Japan' first man-made island). Kobe itself is an international port city facing the tranquil waters of the Seto Inland Sea, and cradled below the surrounding Rokko mountain range. Tourism city Kobe is also conveniently close to the ancient cities of Kyoto, Nara, Osaka and Himeji.
The OTO'18 convention will be an excellent opportunity to focus on the topics that interest you, in every field related to Marine Technology and Ocean Engineering. We look forward to your participation at OTO'18.

Important Dates:

Abstract Submission opens	: September 1, 2017
Tutorial proposals opens	: September 1, 2017
Abstract Submission due	: December 1, 2017
Authors notifications	: January, 2018
Tutorial proposals due	: January 8, 2018
Tutorial notifications	: January 31, 2018
Registration opens	: February 1, 2018
Full papers due	: March 23, 2018
Registration early bird due	: April 15, 2018

Local Topics for OTO'18

1. OCEAN AND SPACE TECHNOLOGY COLLABORATION
2. OCEAN NATURAL HAZARD MONITORING AND SOCIAL IMPLEMENTATION
3. ACOUSTIC AND OPTIC COOPERATIVE APPLICATION FOR UNDERWATER SENSING AND COMMUNICATION
4. FISHERIES, AQUACULTURE AND AQUATIC LIFE RELATED TECHNOLOGIES
5. MARINE RENEWABLE ENERGY AND ENVIRONMENTAL ASSESSMENT
6. OCEAN RESOURCE EXPLORATION TECHNOLOGIES
7. SUB-SEAFLOOR ENGINEERING AND OPERATIONS (DRILLING, CORING, MONITORING AND MINING)
8. COASTAL ZONE MANAGEMENT APPLICATIONS
9. MARINE LAW AND POLICY FOR SUSTAINABLE OCEAN DEVELOPMENT

General OCEANS Topics

1. UNDERWATER ACOUSTICS AND ACOUSTICAL OCEANOGRAPHY
2. SONAR SIGNAL / IMAGE PROCESSING AND COMMUNICATION
3. OCEAN OBSERVING PLATFORMS, SYSTEMS, AND INSTRUMENTATION
4. REMOTE SENSING
5. OCEAN DATA VISUALIZATION, MODELING, AND INFORMATION MANAGEMENT
6. MARINE ENVIRONMENT, OCEANOGRAPHY, AND METEOROLOGY
7. OPTICS, IMAGING, VISION, AND E-M SYSTEMS
8. MARINE LAW, POLICY, MANAGEMENT, AND EDUCATION
9. OFFSHORE STRUCTURES AND TECHNOLOGY
10. OCEAN VEHICLES AND FLOATING STRUCTURES
11. OTHER

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