# OES BEACON

## Newsletter of the Oceanic Engineering Society

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# From the President

Greetings to you all for this winter time holiday season.

This year, 2013, besides being the first one with the first 4 digits since more than 700 years, has been very prolific for OES. We had two OCEANS conferences with a highly attended one in San Diego, CA in September. We strongly participated at two OTC conferences (Houston, TX and Rio, Brazil) by running technical sessions and displaying a booth. Finally, we had several successful workshops all over the world: UT13 in Tokyo, Japan; RIO Acoustics in Rio, Brazil; SYMPOL 2013 in Cochin, India.

We are also involved in several large European and North American programs, which are the right vehicle for research and development, with a role of dissemination of information to the whole community. So OES is truly international and reaching out to the members and the community is one of our driving forces. As an illustration, we had our November ExCom (Executive Committee) in Paris, France (the first time ever outside North-America).

In order to have more interactions, I am also soliciting the chapters for describing the activities developed in their surrounding (Prefectures, Regions, States, etc…) and related to the engineering of the ocean. To start the series, I have written a first paper on the activities in my own place and domains of R&D (see "ICT Ocean" in this issue).

To further involve the OES members I have asked our web people to set up a mechanism gathering discussions and ideas from all of the members through a forum-like tool and in connection with 3 think tank committees I have created: "Members outreach", "New technologies" and "21st century conferences".

In 2014 we will be even more international than usual with our two OCEANS conferences: Taipei, Taiwan in April and St John's, Newfoundland and Labrador, Canada in September. We will sponsor OTC conferences in the USA, Brazil, and Asia and a series of workshops in Europe (Estonia, France), Asia (Japan, Singapore) and the USA (Mississippi) and I probably forgot some …

I promised to give you some idea of what the IEEE TAB (Technical Activity Board) is about. In this issue you will find a section summarizing what TAB is about (6 slides excerpted from a global IEEE/TAB presentation). The complete presentation is visible on our website (www.ieeeoes.org).

Finally, I would like to deeply thank our two outgoing officers: Elizabeth L. Creed (VP Professional Activities) and Diane D. Di Massa (Treasurer) for their outstanding work. They will be missed in our ExCom as they were the only WIE (Women in Engineering) members we had at this level.

**René Garello,**
**OES President**

# Welcome New and Reinstated Members

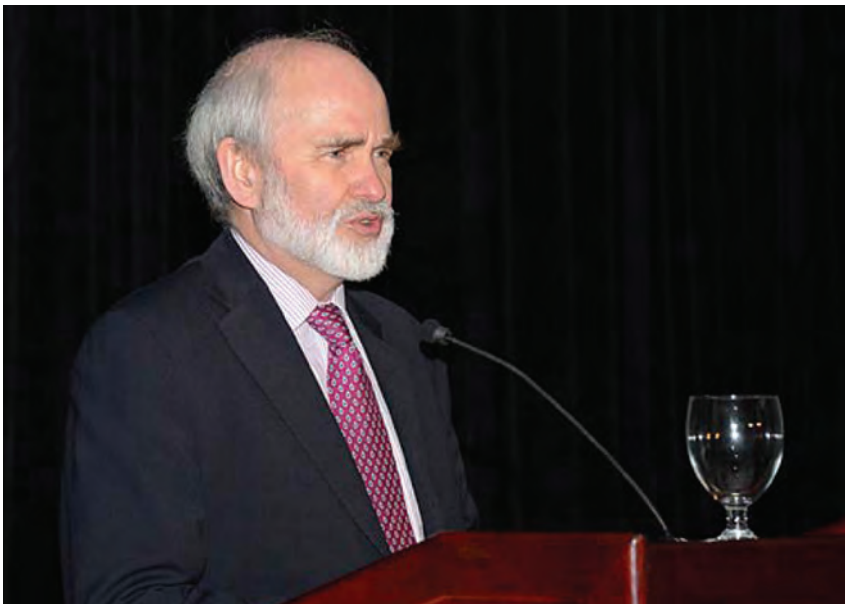
| | | | |
|---|---|---|---|
| Jery Althaf | India | Akihisa Fukami | Japan |
| Murat Deniz Aykin | USA | Alan Thompson Gardner | USA |
| David Baird | USA | David Gerez | Norway |
| Andrew Nelson Barron | USA | Patricia Ellen Giardina | USA |
| Joshua Dane Bass | USA | Marcos Gonzalez | Netherlands |
| Keith James Biesecker | USA | Ronald W. Goodwin | Australia |
| Diane S. Bishop | USA | Martie M. Goulding | Canada |
| Kevin A. Bohanan | USA | Jamie Carson Griffith | USA |
| Blair Bonnett | New Zealand | William T. Grimm | USA |
| Raphael Bourdon | France | Brian Grubel | USA |
| Brandon A. Boyd | USA | Jeonghwe Gu | South Korea |
| John Kenneth Boyle | USA | Regina A. Guazzo | USA |
| Boris Braginsky | Israel | Kip Schafer Hacking | USA |
| Stockman L. Brittany | USA | Jun Han | China |
| James David Broesch | USA | Johanna Hansen | USA |
| Daniel Brown | USA | Supriya M. Hariharan | India |
| David A. Brown | USA | Madeleine E. Harvey | USA |
| Eric G. Brown | USA | Konrad Michael Hausman | USA |
| Cailin B. Burmaster | Canada | Isaac Robert Heine | USA |
| Nancy Burns | USA | Hans-Martin Heyn | Germany |
| Elmer E. Burruss | USA | Daniel S. D. Hong | South Korea |
| Serena M. Calcagno | USA | Farid Ishartomo | Indonesia |
| Katherine C. Cameron | USA | Douglas Jacobs-Perkins | USA |
| Carissa Joyce Cesarotti | USA | Michael James | USA |
| Shaohua Chen | China | Hangil Joe | South Korea |
| Zhenrui Chen | China | Ulf Johannsen | Germany |
| Harold Arthur Cheyne | USA | Kathleen Johansson | USA |
| William L. Cole | USA | Laura Jane Johnson | United Kingdom |
| Daniel S. Coles | United Kingdom | Kevin Mark Jones | USA |
| Seth Costigan | USA | Damien Trent Jorgensen | Australia |
| William E. Courduff | USA | Jerome Jouffroy | Denmark |
| Amelia Rebecca Crane | USA | Samar Kaddouri | France |
| Tenzin Crouch | Australia | Carl Kaiser | USA |
| Milivoj S. Davidov | Australia | Anup Kale | Australia |
| Max Deffenbaugh | USA | Bharath Kalyan | Singapore |
| Zakary Dillon | USA | Nicholas W. Kean | USA |
| Jody E. Eaton | USA | Gary W. Kenward | Canada |
| Paul Eglitis | Germany | Dave Kiehl | USA |
| Carter Eltzroth | USA | Katherine H. Kim | USA |
| Robert Engel | Germany | Minsung Kim | South Korea |
| Meredith Ann Epp | USA | Tae Ho Kim | South Korea |
| Gregory T. Estes | USA | Yongjune Kim | South Korea |
| Eric Leonard Ferguson | Australia | Thomas Benjamin Knesl | USA |
| Nancho Foo | Singapore | Matthew Koessler | Australia |
| Brandon Thomas Foster | USA | John Christopher L'Esperance | Canada |
| Donya P. Frank | USA | Ellsworth Ledrew | Canada |
| Lorenzo Di Fresco | Italy | Kirsten N. Lehman | USA |
| Yasuhiro Fujii | Japan | Blaine Alexander Levedahl | Japan |
| Yasuo Fujishima | Japan | Wen Fang Liu | China |

| | |
|---|---|
| Michael L. Louis | USA |
| Shyam Kumar Madhusudhana | Australia |
| Aaron Ming Marburg | New Zealand |
| Nicole Robina Marshall | Canada |
| Filippo Masci | Italy |
| Lynn M. Mckenzie | United Kingdom |
| Israel Metal | USA |
| Dandan Miao | USA |
| Sage Andrew Mitchell | USA |
| Matthew Molo | USA |
| Carina Bianca Cornejo Moya | USA |
| Andrew David Mullen | USA |
| Rajesh R. Nadakuditi | USA |
| Masaru Nagaso | Japan |
| Takeshi Nakatani | Japan |
| Perry W. Naughton | USA |
| Aaron Needles | USA |
| Carlos A. Negreira | Uruguay |
| Arvin W. Nelson | USA |
| Rachel L. Nolan | USA |
| Odalys Febres Ocasio | USA |
| Derek R. Olson | USA |
| Paul Ozog | USA |
| Julie A. Ozols | USA |
| Geoff Page | Australia |
| Sagar Pai | Singapore |
| Walter Babcock Palmer Iii | USA |
| Douglas Pargett | USA |
| Kiwon Park | South Korea |
| Kyle Pattison | USA |
| Nicolas Pinel | France |
| Luca Pivano | Norway |
| Bhuneshwar Prasad | Singapore |
| Heikki Puuri | Finland |
| Juhyun Pyo | South Korea |
| Fabien L. Ravet | Switzerland |
| Gaultier Real | France |
| Chandrahas Reddy | USA |
| Coquille O. Rex | USA |
| Edward L. Richards | USA |
| Marco Righi | Italy |
| Deppe Walter Robert | USA |
| Brandon Rodrigues | USA |
| Craig G. Ross | USA |
| Steven Ruberg | USA |
| John Michael Rudzinski | USA |
| Luke Keith Rumbaugh | USA |
| Alexandra C. Russell | USA |
| Garik Cruise Sadovy | Indonesia |
| Michael Brien Sager | USA |
| Nicolas Sassow | United Kingdom |
| Kirk Sato | USA |
| Max E. Schlereth | USA |
| Otto Schulze | USA |
| Crystal Ann Sherman | USA |
| Yang Shi | China |
| Asher Simmons | USA |
| Amanda Burgoon Skelton | USA |
| Cheryl Slade | Canada |
| Ronald Stamm | USA |
| Douglas J Stanjeski | USA |
| Farris M. Stevens | USA |
| Andrew J. Stewart | Australia |
| Jonathan Stine | USA |
| Shailabh Suman | Singapore |
| Dajun Sun | China |
| Juan Mario Sutija | USA |
| Budi Syihabuddin | Indonesia |
| Randy V. Thomas | USA |
| Alexander E. Thornton | USA |
| Daniel J. F. Toal | Ireland |
| Christopher Krzycztof Tomaszewski | USA |
| Thomas Topping | USA |
| Tom L. Tran | USA |
| Trevor J. Uptain | USA |
| Sebastian Aldo Villar | Argentina |
| Hari Vishnu | Singapore |
| Eric Vize | USA |
| Veli Voipio | Finland |
| Lada Vybulkova | United Kingdom |
| Jamie S. Wagner | USA |
| Sean Walstead | USA |
| Changhong Wang | China |
| Yong Wang | China |
| Robert Ward | United Kingdom |
| Alex Webb | United Kingdom |
| David A. White | USA |
| John S. Williams | USA |
| Tara Lynn Willis | USA |
| Hans Christian Woithe | USA |
| David T. Wright | United Kingdom |
| Lingji Xu | China |
| Masashi Yamada | Japan |
| Shefeng Yan | China |
| Son-Cheol Yu | South Korea |
| Mehmet Kerim Yucel | United Kingdom |
| Meng Zhou | China |
| Shengli Zhou | USA |
| Yue Zhou | China |
| Yiwu Zhu | China |

# 2013 Distinguished Technical Achievement Award

Professor Gwyn Griffiths is the recipient of this year's Distinguished Technical Achievement Award for his work on Acoustic Doppler Current Profiling instruments and autonomous vehicle technologies. The award was presented in September at the OCEANS '13 conference in San Diego.

Professor Griffiths' career began with his early work on current measurements in the upper ocean where he worked on problems of off-axis flow and turbulence in EM logs. He subsequently developed an acoustic Doppler profiler (prior to RCA) and resolved issues of errors due to ships heading in hull mounted ADCPs. His ADCP work extended into displaying and analyzing the causes of acoustic backscatter due to biological populations and the subsequent development of ADCPs as routine multidisciplinary tools which can provide a range of data and information for both physical and biological oceanography. Parallel to these activities there was development of AUTOSUB.



*Gwen Griffiths accepting the Distinguished Technical Achievement Award.*

Gwyn's involvement began in 1988 with a report on options for mission control systems for vehicles at the time. By 1993 Gwyn was Head of Ocean Technology at IOS Wormley (now NOC) and since then has regarded AUTOSUB as the core of his professional career. Gwyn played a major role in persuading the UK government to keep funding the development of AUTOSUB in the late 1980s/early 1990s when questions were raised as to whether it was appropriate to host such high technology development.

In his capacity as Head of Ocean Technology/Ocean Engineering at Southampton, he has actively promoted the use of autonomous vehicles, including gliders, expanding on their scientific capabilities and becoming an international expert on aspects of risk, reliability and power sources. The breadth of Gwyn's expertise can be seen from his publication list and he is universally regarded as an international authority on the development and uses of ocean technology, engineering and instrumentation.

Gwyn was also the chair of AUV2012 held in Southampton. The Symposium was a great success and the results of the Conference are funding the student poster session for AUV2014.

Now retired, Gwyn retains a part-time academic appointment in the School of Engineering Sciences.

## Request for Nominations for The Distinguished Technical Achievement Award 2014

The IEEE Oceanic Engineering Society is hereby soliciting nominations for the society Distinguished Technical Achievement Award for significant accomplishments in oceanic engineering. A nomination form can be downloaded from the OES website under Professional Activities—Honors and Honorees—Award Forms. Nominations should be forwarded to the Awards Chair, Jerry Carroll at jerrycortez@charter.net. The dead line for nominations is 1 May 2014.

# 2013 Distinguished Service Award

The recipient of this year's Distinguished Service Award is Robert T. Bannon for establishing and furthering the objectives of the Oceanic Engineering Society (OES) by ensuring the financial security and technical leadership by developing and chairing technical symposia and conferences in accordance with the OES Strategic Plan. As an IEEE Fellow and Distinguished Lecturer, Bob set a standard for program participation, author guidelines, and speaker selection and evaluation.


*OES President René Garello presents the Distinguished Service Award to Bob Bannon.*

Mr. Bannon is the founder of Bannon International Consulting LLC (1998). He is a recognized technical leader in the underwater communications and unmanned subsea robotics industries and has over 40 years of design engineering, operations and program management experience in global fiber optics communications, underwater systems, advanced sensor technologies, SONAR, and development and integration of commercial Autonomous Underwater Vehicles (AUVs) for communications, oil and gas industries, and military operations. Bob also provides Submarine Telecommunications and Power Industries technical and litigation support to multiple law firms involved in domestic and international Alternative Dispute Resolution (ADR) and Appellate Practice (AP) suits.

Formerly, Bob was a Director with AT&T and Bell Labs. He has been instrumental in development of special underwater protection, maintenance and repair techniques for AT&T and other Trans-Oceanic Communications Companies. He was responsible for designing special application ROVs, AUVs, and towed arrays and devices for government and commercial applications. Bob was the Chair of the International Systems Maintenance and SCARAB Committees. He was the lead scientist and Sr. Systems Engineer of Digital Signal Processing for sensor data real time detection and identification for the U.S. Navy and other government group applications. Bob made significant contributions to the use of DSP technology for underwater detection and Sonar applications. He has integrated non-conventional sensor suites into pressure vessels for underwater applications for related special programs. As a Director - Custom Systems Integration Laboratory (CSIL), Distinguished Member of the Technical Staff (DMTS), and a MTS Supervisor at Bell Laboratories, Bob's work on submarine battery design and telemetry systems resulted in his receiving 3 Spirit of Communications Awards from AT&T. He has published over 150 technical papers. In addition, Mr. Bannon served as a lead scientist for several major defense contractors for special sensor technologies associated with "classified" underwater programs. Mr. Bannon is a National Defense Industry Association (NDIA) Blue Ribbon Panelist on "Restoring Cueing in the Contested Littorals", and other Undersea Warfare initiatives at the invitation of the USN and defense contractors. Bob was appointed by Congressman Curt Weldon as the technical lead for the US-Russian Homeland Security Congress 2005 in Moscow, and addressed the Russian Duma on behalf of the US. He is considered a leading expert on Maritime Security and Critical Infrastructure Protection.

Bob holds a BSEE, MS, and multiple MBA's from Pennsylvania State University, Wharton School—University of Pennsylvania, George Washington University, and a certificate for Computer Graphics from Harvard Graduate School of Design. Bob also holds a certificate from the London Power Engineering School.

## Request for Nominations for The Distinguished Service Award 2014

The IEEE Oceanic Engineering Society is hereby soliciting nominations for the society Distinguished Service Award to honor an individual IEEE member for outstanding contributions towards furthering the objectives of the Oceanic Engineering Society. A nomination form can be downloaded from the OES website under Professional Activities—Honors and Honorees—Award Forms. Nominations should be forwarded to the Awards Chair, Jerry Carroll at jerrycortez@charter.net. The deadline for nominations is 1 May, 2014.

# Chapter News

## India

A one day workshop on Underwater Technology was successfully organized by NIOT on 21 October 2013 in association with IEEE OES India Chapter and IEEE Japan Chapter. Dr. Shailesh Nayak, Chairman Earth System Sciences Organization and Secretary Ministry of Earth sciences, Government of India inaugurated the workshop. He highlighted the importance of research in the field of deep-sea technology and ocean mining. Dr. M. A Atmanand, Director, NIOT welcomed the gathering and Dr. G. A. Ramadass, Organizing Secretary briefed about the workshop.

The inaugural session was attended by representatives from research institutes such as NIOT, Indian Institute of technology (IIT), Madras, Ocean Engineering industry, Directors of many Research Organizations and seniors scientists from Ministry of earth sciences. Prof Tamaki Ura expressed his appreciation for arranging the workshop and announced that Underwater Technology symposium will be held in Chennai during February 2015. Prof. R. Bahl, Vice-chairman UTW2013, briefed on the activities of IEEE OES India Council. The inaugural session ended with a vote of thanks by Dr. R. Venkatesan, Joint Secretary UTW2013.

About 100 professionals and students working in this area from different Research & Development Organizations and Educational Institutions participated in the same and derived benefit from the interaction with the renowned experts. Twelve


*Technical Session*

*Poster Presentation*


*From left Dr. G. A Ramadass, Prof. PRS Pillai, Dr. M. A. Atmanand.*

*Cultural Program*

*Invitees, Participants & Organizers*

lectures were delivered by leading national and international scientists working in the area of underwater technology on the following themes:

- Deep Sea Technologies & Ocean Mining
- Underwater Vehicles
- Underwater Acoustics
- Ocean Observations

Seventeen posters by graduate and postgraduate students were selected for display during the workshop. Three of them were selected for best student paper awards.

## Italy

***Andrea Trucco***

The inaugural technical meeting of the OES Italy chapter was held at the University of Genova, Dept. of Electrical, Electronic, Telecommunications Engineering, and Naval Architecture (DITEN), in Genoa, Italy, on Friday October 18, 2013. The meeting included two key lectures.

*There were 25 attendees from two universities and two research centers.*

In the first key note lecture, Dr. René Garello, Professor at Télécom Bretagne, President of the IEEE-OES and one of the OES Distinguished Lecturers, gave an overview on the ICT potential for the marine environment. After a general introduction, he focused on the signal and image processing applications for the radar observation of the oceans, providing stimulating insights on the engaged statistics and many interesting examples.

*Professor René Garello presenting a talk on the ICT potential for the marine environment.*

In the second key note lecture, Dr. Andrea Caiti, Professor at the University of Pisa and Past Director of ISME (Interuniversity Center of Integrated Systems for the Marine Environment), focused on the autonomous underwater vehicles development at ISME during the last 10 years. Different philosophies in vehicle design were presented and compared, and several exciting videos showing the tests at sea of the autonomous vehicles developed by ISME were projected.

*Dr. Andrea Caiti expounds on the development of Autonomous Underwater Vehicles at ISME.*

## NSW, Australia

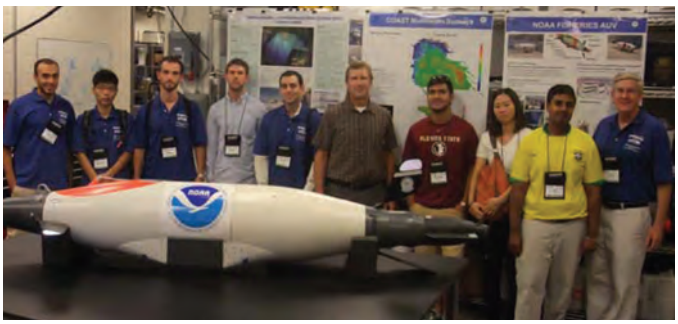
***Antony Zaglas***

A technical meeting was held on August 8, 2013 in Syndney, NSW. The meeting, with 42 attendees, featured two technical talks. The first talk was *Wave Glider Autonomous Surface Vehicles and the Pacific Crossing*, given by Mr. Darren Burrowes. Dr. Brian Ferguson gave the second talk, *Problems with Wide Aperture Acoustic Arrays for Source Localization*.

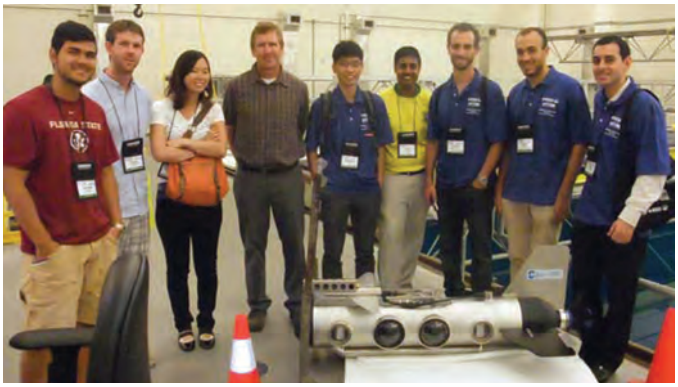
## San Diego

***Kevin Delaney***

In conjunction with the OCEANS 2013 San Diego conference, the San Diego OES Chapter organized a tour of the NOAA Southwest Fisheries Research Center for the students participating in the conference's student poster competition. Dr. David Demer, the Center's director of the Advanced Survey Technology program, hosted the students, showing them the new facility's ocean technology development tank, as well as the sensors and research vehicles under development at the Center. Dr. Demer pointed out the unique features of the research



facility, which supports the Center's mission of applying technology to "improve the accuracy, precision and efficiency of fisheries surveys."



## Victoria, Canada

***Jim Collins***

In May IEEE OES Victoria Chapter had the benefit of a vacation visit to Victoria by Dr. Mal Heron, IEEE Oceanic Engineering Society Distinguished Lecturer. The Chapter took the opportunity to sponsor a seminar by Dr. Heron. Twenty people including members and others attended the seminar, held in the format of a brown bag lunch.

Dr. Heron spoke on Coastal Ocean Radars and their application. A descriptive overview of the Australian Coastal Ocean Radar Network (ACORN) was given with some background about how sites are selected and configured. A suite of results and applications emanating from the ACORN network was presented, including Lagrangian Tracking; assistance to management in the Great Barrier Reef Marine Park; assistance in the salvage of a grounded ship; and the observation of cold fronts in the Southern Ocean.

**Professor Heron** is an Adjunct Researcher in the Marine Geophysical Laboratory at James Cook University in Townsville, Australia. His PhD work in Auckland, New Zealand, was on radio wave probing of the ionosphere, and that is reflected in his early ionospheric papers. He changed research fields to the scattering of HF radio waves from the ocean surface during the 1980s. Through the 1990s his research has broadened into oceanographic phenomena that can be studied by remote sensing, including HF radar and salinity mapping from airborne microwave radiometers. Throughout, there have been one-off papers where he has been involved in solving a problem in a cognate area like medical physics, and paleobiogeography. Occasionally, he has diverted into sidetracks like a burst of papers on the effect of bushfires on radio communications. His present project is about the development of new processing methods and applications of HF radar data to address oceanography problems. He is currently promoting the use of high-resolution VHF ocean radars, based on the PortMap high resolution radar. He may be contacted at mal.heron@ieee.org.

# Request for Nominations to The Administrative Committee Class of 2014

***Jerry Carroll, OES Junior Past President***

The IEEE OCEANIC ENGINEERING SOCIETY is governed by an Administrative Committee of 18 members. Six are elected each year to serve three-year terms. Members are limited to two consecutive terms, although they may be reelected after a lapse of one year.

The Nominations and Appointments Committee is chaired by the Junior Past President with the Senior Past President completing the Committee. They are charged with proposing a slate of nominees and with conducting the election, which is done electronically to the entire membership. The electronic election requires each member that wishes to vote to have an IEEE account. Therefore, visit IEEE.org to establish your account if needed.

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

The nomination Packet should include a Letter of Nomination accompanied by a one page biographical sketch of the proposed candidate with picture and a one-page statement from the proposed candidate giving his or her views of the opportunities and challenges facing the Society and steps to be taken to advance the IEEE Oceanographic Engineering Society.

The election will be conducted in accordance with our Bylaws. You can read them by going to the Society's Web Site (www.ieeeoes.org), and pointing to Bylaws under Governing Documents. The Bylaws specify that general nominations close on March 1, and nominations by petition close by April 15, 2014.

Please submit nominations to the undersigned. Please do not delay your efforts in finding and nominating qualified candidates.

**Jerry Carroll**
**Chair, IEEE/OES Nominations**
**and Appointments Committee**
**411 Country Club Drive**
**Picayune, MS 39466 USA**
**+1 601-798-0277**
**jerrycortez@charter.net**

# Conference Development Report

***Robert L. Wernli, OES Vice President, Conference Development (2010–2013)***

This will be my final report as the OES Vice President for Conference Development (VPCD). Beginning in 2014, based on recent elections, Sandy Williams will take over as VPCD. I will then take over the Vice President for Professional Activities position, previously held by Liz Creed, who did an excellent job organizing and increasing the efficiency of that position. Also, I will continue to chair the OCEANS RECON Committee, reporting to Sandy, VPCD.

We not only organize the OCEANS conference twice a year now, but we are also planning and conducting many workshops and symposia around the world including:

- Underwater Technology 2011 was to be held in Tokyo, cancelled due to the tsunami. Combined with Oceans '11 Hawaii
- Current, Waves and Turbulence Measurement (CWTM 2011) Workshop held in Monterey, California
- Technical co-sponsor of International Symposium on Ocean Electronics (SYMPOL 2011), Kerala, India
- Baltic 2012 International Symposium held in Klaipeda, Lithuania
- AUV 2012 held in Southampton, UK
- Underwater Technology 2013 Symposium held in Tokyo, Japan
- Underwater Technology 2013 Workshop held in Chennai, India

So, what has RECON accomplished since my initial report in the July 2010 issue of this newsletter in? It's been a busy few years. RECON team members have made the following trips to meet with representatives of the local organizing committees (LOC) and professional conference organizers (PCO) who were seeking approval for a future OCEANS conference:

## 2011
- February – Hampton Roads – OCEANS ’12
- March – Bergen, Norway – OCEANS ’12 (Europe)
- April – Shanghai, China – OCEANS ’16 (Asia-Pacific)
- May – Marseille, France – OCEANS ’19 (Europe)
- May – St. John’s, Newfoundland – OCEANS ’14
- July – Monterey, California – OCEANS ’16
- August – Washington, DC – OCEANS ’15

## 2012
- August – Monterey, California – OCEANS ’16
- September – Anchorage, Alaska – OCEANS ’17
- November – Kobe, Japan – OCEANS ’18 (Asia-Pacific)

## 2013
- March – Singapore – OCEANS ’20 (Asia-Pacific)
- July – Anchorage, Alaska – OCEANS-17
- August – Charleston, South Carolina – OCEANS ’18
- October – Marseille, France – OCEANS ’19 (Europe)

The previous trips have set us up nicely for our future conferences. We start seven years ahead of time with a goal to receive society approval at least four years out. That will give the LOC time to ramp up their team and be ready to begin promoting their conferences three years out with prior OCEANS conference attendance and training beginning two years out. Presently, we are on track to seek approval at OCEANS ’14 St. John’s for Marseille, France (OCEANS ’19) and Charleston, SC (OCEANS ’18), which will be five and four years ahead of time, respectively.

We are presently in the process of seeking sites or beginning the approval process for the following conferences:
- OCEANS ’19 – Bid received from Vancouver, Canada
- OCEANS ’20 (Asia-Pacific) – Bid received from Singapore
- OCEANS ’20 – Looking into New England states
- OCEANS ’21 (Europe) – Bid received from Canary Islands, Possible return to Germany

OES is also supporting many other conferences including:
- Offshore Technology Conference held annually in Houston, TX
- Offshore Technology Conference Brazil—held in Rio de Janeiro every other odd year
- Offshore Technology Conference to be held every other even year, beginning in Kuala Lumpur, Malaysia in 2014.
- Arctic Technology Conference held every other year.
- SYMPOL conference held in India every other odd year.

And, last but not least, is participation in the annual IEEE Panel of Conference Organizers (POCO) held in:
- Budapest, Hungary in 2012
- Portland, Oregon in 2013

Bottom line is that it’s been a busy four years, but my honor to serve the OES membership as VPCD. And, in particular, I’d like to thank the OES RECON team for their continued support during my tenure including: Jerry Carroll, Jim Barbera, Sandy Williams, Bob Bannon, Joe Vadus, Harumi Sugimatsu, Tamaki Ura, John Watson, Rene Garello, Todd Morrison and Diane DiMassa. See you all at the next conference.

# SYMPOL 2013 held at Kochi, India 23–25 October 2013

***Professor P. R. S. Pillai, Chairman, Dr. Supriya M. H., Coordinator***

## Introduction

The 2013 International Symposium on Ocean Electronics (SYMPOL 2013), addressing the Global Oceans, Systems and Technologies, organized by the Department of Electronics of the Cochin University of Science and Technology, Kochi with the technical co-sponsorship of the IEEE Oceanic Engineering Society (IEEE-OES) and Acoustical Society of America (ASA) was held during 23–25 October 2013. SYMPOL is organized as a biennial program; the first symposium of the series was held in the Cochin University of Science and Technology, during 18–20 December 1991 to highlight the formal opening of the Center for Ocean Electronics established in the Department of Electronics as a joint venture of the University Grants Commission and Ministry of Human Resource Development, Government of India. Various Government of India Agencies and Departments as well as some of the premier Academic Institutions in India cater some of the system requirements in the area of Ocean Electronics in the country towards exploring the rich resources of the Indian Ocean. Though various professional societies such as the Acoustical Society of India, Ocean Society of India, etc. organize conferences periodically, the SYMPOL, which is being organized under the aegis of the Centre for Ocean Electronics of the Department of Electronics, Cochin University of Science and Technology, as a biennial event, has been rated as one of the globally acclaimed international conferences addressing the Global Oceans, Systems and Technologies.

SYMPOL is intended to provide a forum for the researchers in the area of Ocean Electronics to interact with each other and present their innovative ideas and findings. As a precursor to SYMPOL 2013, a one day International Workshop on Ocean Technology (UTW 13) was organized on 21st October 2013 by the National Institute of Ocean Technology, Chennai with the co-sponsorship of the IEEE OES India and Japan Chapters. The dates of SYMPOL 2013 have been chosen such that the participants of UTW 13 can attend the SYMPOL 2013 as well.

## Venue

The venue of the 2013 International Symposium on Ocean Electronics (SYMPOL 2013) was the Convention Center of The Hotel Airlink Castle, Cochin, which is one of the best-known landmarks in the airport area and a lavish four-star property in Kochi. The inaugural function, keynote address, technical sessions and presentations were held in this Convention Center. With a location close to the airport, the hotel is easily a favorite with the business and leisure travelers. The presence of good business amenities and conference facilities give an extra advantage to the corporate travelers to the place. The Hotel Airlink Castle has taken care to ensure that the guests enjoy a good culinary experience too. Restaurants here served multi-cuisine dishes and there was a seafood special restaurant too.

## Inaugural Function

The three day 2013 International Symposium on Ocean Electronics (SYMPOL 2013) was inaugurated on 23rd October 2013 by Dr. Avinash Chander, Scientific Advisor to the Raksha Mantri, Secretary of the Department of Defense Research and Development (DDR&D) and Director General of Research and Development, Ministry of Defense in the function presided over by Dr. Ramachandran Thekkedath, Vice-Chancellor, Cochin University of Science and Technology. While inaugurating the symposium Dr. Avinash Chander said that the Indian Ocean has emerged as one of the most strategically important areas in the 21st century. He also indicated the need and requirement for the development of technologies for the monitoring of the Indian waters in all the three dimensions.


*Dr. Avinash Chander, Scientific Advisor to the Raksha Mantri, Secretary of the Department of Defense Research and Development (DDR&D) and Director General of Research and Development, Ministry of Defense, is delivering the inaugural address during 2013 International Symposium on Ocean Electronics, SYMPOL 2013. Vice-Chancellor, Dr. Ramachandran Thekkedath, Chairman of Sympol, Dr. P. R. S. Pillai, The SYMPOL Lifetime Achievement Awardees, Prof. C. S. Sreedhar, Prof. K. G. Nair & Dr. D. Srinivasan, Sri S. Anantha Narayanan (NPOL), Dr. V. Bhujanga Rao (DRDO), Dr. Albert J. Williams 3rd (IEEE- OES), Dr. M. A. Atmanand (Chair, IEEE—OES, India Chapter), Dr. C. K. Aanandan (Professor & Head) & Dr. Supriya M. H. (Coordinator) are also seen.*

He further elucidated that the maritime domain awareness, providing seamless coverage of areas of interest that demands intelligent synergy among many platforms like unmanned aerial vehicles, space based indigenous navigational systems and communication satellites for real time multi-mode formation, is the need of the hour. Proximity of the Indian Ocean was both an opportunity and a threat to India. The Indian Ocean features the transit routes for 70 percent of the global trade in oil and navigational access to 50 percent of international shipping. The development and growth of ocean technologies help in harvesting the untapped resources and energy as well as in harvesting the potential and resources of the region.

Dr. Ramachandran Thekkedath, who presided over the inaugural function, also elucidated the importance of promoting research and development activities in the area of Ocean Systems and Technologies for the exploitation of the rich resources of the ocean. Shri. S. Anantha Narayanan, Naval Physical and Oceanographic Laboratory released the proceedings of SYMPOL 2013. Dr. C. K. Aanandan, Professor & Head, Department of Electronics welcomed the gathering and Dr. Supriya M. H, Co-ordinator, SYMPOL 2013 proposed the vote of thanks. Dr. Albert J. Williams and Dr. M. A. Atmanand felicitated on the occasion.

## SYMPOL Lifetime Achievement Award

The Organizing Committee of the International Symposium on Ocean Electronics (SYMPOL 2013) has instituted the SYMPOL Lifetime Achievement Award in January 2013 to honor the professional standing and academic achievements as well as the leadership qualities over the whole of the career of eminent professionals/academicians, who contributed boundlessly for nourishing the research activities in Ocean Electronics in the Department of Electronics of the Cochin University of Science & Technology and for the popularization of the Symposium on Ocean Electronics (SYMPOL) as an Internationally Acclaimed Conference addressing the Global Oceans, Systems and Technologies.

The meeting of the Organizing Committee of SYMPOL 2013 held on 29th August 2013 recommended to confer SYMPOL Lifetime Achievement Awards to Professor K. Gopalakrishnan Nair, Professor Chetlur S. Sridhar and Dr. Devanatha Srinivasan in recognition of their leadership qualities as well as

*Dr. Avinash Chander presents the SYMPOL Lifetime Achievement Awards to Professor K. G. Nair, Professor C. S. Sreedhar & Dr. D. Srinivasan. Dr. Ramachandran Thekkedath is also seen.*

commitments for the initiation of research activities in Ocean Electronics and SYMPOL developmental activities.

The SYMPOL Lifetime Achievement Award consists of a Plaque and Citation.

Dr. P. R. S. Pillai, Chairman of SYMPOL 2013 and Chairman of the SYMPOL Lifetime Achievement Award Committee delivered the citation address prior to honoring the awardees with the SYMPOL Lifetime Achievement Award on the occasion of the inaugural function of SYMPOL 2013. Dr. Ramachandran Thekkedath adorned the awardees with the traditional ponnada or the golden shawl, while Dr. Avinash Chander presented the Plaque and Dr. Bhujanga Rao presented the Citations to the awardees.

## Technical Program

The technical program of SYMPOL 2013 had a pleasant kick off with a keynote address on Underwater Stealth Technology, by Dr. V. Bhujanga Rao, Director General (Naval Systems & Materials), Defense Research and Development Organization. With suitable anecdotes, he illustrated the importance of stealth technology and explained the various measures for over-riding counter attacks.

The following four state of the art invited talks on emerging topics in Ocean Electronics were delivered by eminent and distinguished engineers/scientists.


*Dr. V. Bhujanga Rao, Director General (Naval Systems & Materials), Defense Research and Development Organization, delivers the key-note address on Underwater Stealth Technology.*


*Dr. M. A. Atmanand delivers a plenary talk on Technology Developments for Ocean Observations.*


*Professor Tamaki Ura of the University of Tokyo delivers an invited Talk on Images of Deep Sea Floor Captured by Autonomous Underwater Vehicles.*

Dr. M. A. Atmanand, Director of the National Institute of Ocean Technology, Chennai and Chairman, IEEE-OES India Chapter delivered a plenary talk on Technology Developments for Ocean Observations. In this talk, he discussed the various technological advancements to forecast tsunami. The fully instrumented buoy systems, which were designed and proved to withstand the cyclonic conditions, help in the real time monitoring of meteorological and oceanographic parameters.

Professor Tamaki Ura of the University of Tokyo delivered an invited Talk on Images of Deep Sea Floor Captured by Autonomous Underwater Vehicles. He presented the highlights of the cruising and hovering AUVs that have been developed in the URA Lab. He also demonstrated how the AUVs are deployed in the ocean and recovered back to the deck for data analysis.

Dr. Katsuyoshi Kawaguchi of the Japan Agency for Marine Earth Science and Technology (JAMSTEC) delivered an invited talk on Submarine Cabled Real Time Sea Floor Observatory for Earthquake and Tsunami Monitoring in which he stressed the need for real time and long term monitoring of oceans using submarine cabled observatories. He also presented the salient highlights and operational features of the DONET


*Dr. Katsuyoshi Kawaguchi of the Japan Agency for Marine Earth Science and Technology (JAMSTEC) delivers the invited talk on Submarine Cabled Real Time Sea Floor Observatory for Earthquake and Tsunami Monitoring.*


*Professor Arunkumar delivers the invited talk on Overview of Instantaneous Frequency Estimation and its Applications to Acoustic Imaging Problem.*

(Dense Ocean floor Network System for Earthquakes and Tsunamis) developed, installed and operated by JAMSTEC.

Professor Arunkumar of the Indian Institute of Technology, Delhi, presented an invited talk on Overview of Instantaneous Frequency Estimation and its Applications to Acoustic Imaging Problem. In this talk, he presented the salient highlights on the use of instantaneous frequency parameter in signal processing applications and introduced the novel concept of instantaneous frequency selective filtering and acoustic imaging concepts.

The technical program of SYMPOL 2013 was further featured by 46 original research papers and one student paper in areas such as Signal Processing, Ocean Acoustics, Navigational Aids & Instrumentation, Acoustic Data Telemetry/ Sensor Networks, Localization and Underwater Sensors & Applications.

## Recommendations of the Technical Panel of SYMPOL 2013

A meeting of the Technical Panel of SYMPOL 2013 comprising of the Chairpersons of various technical sessions, invited speakers, representatives from OES, etc. was convened at 6.30 p.m. on 24th October, 2013. Dr. P. R. S. Pillai formally welcomed the panelists to the meeting and sought the comments and suggestions as regards to the technical programme of SYMPOL 2013. Dr. Albert J. Williams, the Technical Program Co-Chair briefed the yardsticks that have been adopted for the review of the full paper texts submitted by the authors. The technical panel made the following recommendations, based on the deliberations at the panel meeting.

- The quality and standard of the papers presented and published in the Proceedings of SYMPOL 2013 are very good. Dr. Albert J. Williams suggested that a sizeable percentage of the SYMPOL papers with suitable modifications as stipulated by the editorial board of JOE, can be considered for publication in the Journal of Oceanic Engineering.
- To maintain the quality of papers, the technical panel of SYMPOL 2013 resolved to strictly adhere to the two level review process for the forthcoming SYMPOL 2015 too.
- The technical panel of SYMPOL 2013 further resolved to place on record its gratitude and acknowledgements to the IEEE-Oceanic Engineering Society and Acoustical Society of America for extending their support and co-operation by way of rendering the technical co-sponsorship for SYMPOL 2013. The panel also resolved to place on record its appreciation and gratitude to all the reviewers for rendering their intellectual services by promptly completing the technical review of the papers within the prescribed time limits.
- The technical panel noted that CUSAT has decided to organize SYMPOL 2015 during 18–20 November, 2015.
- Dr. James S. Collins presented the salient highlight of the meeting convened at 9:00 pm on 23rd October, 2013, as regards to the formulation of the strategies and preparations for the forthcoming UT 15 and SYMPOL 2015.

## Valedictory Function

A Valedictory function was organized at 3.00 p.m. on 25th October 2013.

During the valedictory function, Dr. Albert J. Williams, the SYMPOL 2013 Technical Program Co-Chair, announced the winner of the Best Paper presented and published in the Proceedings of SYMPOL 2013. The paper *Near-field/Far-field Source Localisation in Ocean with an Acoustic Vector Sensor Array using Polynomial Rooting*, coauthored by V. N. Hari, Xionghu Zhong and A. B. Premkumar of the National Technical University, Singapore, emerged as the winning paper. Professor K. Paulose Jacob, Pro-Vice-Chancellor of the Cochin University of Science and Technology during the valedictory function, presented the Best Paper Award for SYMPOL 2013.

During the valedictory function, the delegates were also given an opportunity to express their views and observations as regards to the organizational issues of SYMPOL 2013. All the delegates unanimously opined that they were all impressed by the way in which the local logistics arrangements and scheduling of the Technical Programs of SYMPOL 2013 were made.


*Professor K. Paulose Jacob, Pro-Vice-Chancellor of the Cochin University of Science and Technology addresses the gathering during the valedictory function of SYMPOL 2013.*

## Socio-Cultural Evening

Traditional social and cultural art forms, including kathakali, thiruvathirakali, bharatanatyam and mohiniyattam were performed during the socio-cultural evening of SYMPOL 2013 at 6.00 p.m. on 23rd October 2013.

- Kathakali, one of the oldest theatre forms in the world and a highly stylized classical Indian dance-drama peculiar with


*Kathakali*


*Mohiniyattam*


*Thiruvathirakali*


*Bharatanatyam*

the attractive make-up of characters, elaborate costumes, well defined body movements, etc. The theme of kathakali which was portrayed on the occasion of SYMPOL 2013 was narakasuravadham performed by talented and professional artists.

- Thiruvathirakali (also known as Kaikottikkali), a very popular dance form of Kerala, presented by women folk to attain everlasting marital bliss.
- Bharatanatyam, a classical dance form of South India, originated in Thanjavoor in the state of Tamil Nadu during 500 BC.
- Mohiniyattam, a traditional South Indian dance from Kerala, which has elements from the two South Indian dance forms, viz., Bharatanatyam and Kathakali.

## Sponsorship

SYMPOL 2013 had the technical/financial co-sponsorship from the following Government Agencies/Departments and Professional Bodies:

- IEEE Oceanic Engineering Society
- Acoustical Society of America
- Naval Research Board, Defense Research & Development Organization, New Delhi
- Council of Scientific and Industrial Research, New Delhi
- University Grants Commission, New Delhi
- Kerala State Council for Science, Technology and Environment, Government of Kerala
- Science and Engineering Research Board, New Delhi
- Department of Science & Technology, Government of India.

## Announcement of SYMPOL 2015

The thirteenth biennial Symposium on Ocean Electronics (SYMPOL 2015) is scheduled to be held at Cochin during 18–20 November 2015 with the technical co-sponsorship of the IEEE-Oceanic Engineering Society (IEEE-OES) and Acoustical Society of America.

## Conclusions

An Activity Report on SYMPOL 2013, touching upon the background and rationale in organizing the Symposium on Ocean Electronics as a biennial event along with the salient highlights of the technical program has been presented. The entire Ocean Engineering community in India takes pride in placing on record the fact that the SYMPOL has emerged as one of the acclaimed international conferences, organized in this subcontinent, addressing the Global Oceans, Systems and Technologies.

# IEEE WIE Event at OCEANS 2013 MTS/IEEE San Diego

***Marinna Martini***

An IEEE Women in Engineering (WIE) reception was held at the MTS/IEEE OCEANS meeting in San Diego, CA on Sept. 24th, 2013. The OCEANS meeting is jointly sponsored by the Marine Technology Society (MTS) and the Oceanic Engineering Society of the Institute of Electrical and Electronic Engineers (IEEE/OES), OCEANS meetings are a major international forum for scientists, engineers, and responsible ocean users to present the latest research results, ideas, developments, and applications in Oceanic Engineering and Marine Technology. IEEE-WIE is the largest international professional organization dedicated to promoting women engineers and scientists and inspiring girls around the world to follow their academic interests to a career in engineering. In San Diego, OCEANS and WIE came together.

*Words of welcome*

Women of the OCEANS meeting had been sitting together at the luncheons now and then over the years, but it all was happening by word of mouth. It was Barbara Fletcher who started the chocolate tradition. I was approached during OCEANS in Vancouver in 2007 by Barbara who was coordinating a group of women to go to dinner together. That was followed, on and off as conference schedules allowed, by more gatherings and much discussion about a fondly remembered chocolate fountain at aprevious OCEANS. Since Barbara was Technical Chair of OCEANS this year, and I was a new OES liaison to WIE, I tried to step it up a little bit. Well, a lot really, thanks to OES' very generous support.

*Some of the IEEE OES female leadership and chocolate aficionados: From the left, Marinna Martini, Diane di Massa, Elizabeth Creed and Barbara Fletcher.*

We reserved one of the smaller meeting rooms at the conference venue and arranged for desserts, sodas, coffee and tea, and most importantly, a chocolate fountain. It was timed to follow the very large and generous exhibitors' reception which is always on Tuesday night at OCEANS. WIE giveaways were provided, and posters hung. About thirty people came through the WIE reception, mostly women, including some Massachusetts Maritime Academy cadets, and some men. This was a good turnout, many public and private evening receptions are held at this same time, and WIE was competing with the St. John's, Newfoundland, Canada, party with its band, bar, and ice carving demonstration next door. What was really neat to see was the distribution of age groups, that most stayed to chat for quite a while, and that only some folded posters were left of the WIE giveaways. I look forward to hosting another WIE reception or to helping anyone else who would like to create similar synergy.

More information can be found at:
For OCEANS: http://www.oceansconference.org/
For IEEE-OES: http://www.ieeeoes.org/
For WIE: http://www.ieee.org/women

# NSWC PCD Leadership Presents Dr. Dan Sternlicht with Navy Meritorious Civilian Service Awards

***From NSWC PCD Public Affairs***

PANAMA CITY, FL—Naval Surface Warfare Center Panama City Division (NSWC PCD) leadership presented Dr. Daniel Sternlicht, Head of the Sensing Sciences Division the Navy Meritorious Civilian Service Award Oct. 31, 2013. Sternlicht was chosen along with 11 other NSWC PCD employees to be presented the prestigious award.

NSWC PCD's newly-appointed Commanding Officer (CO) Capt. Phillip E. Dawson III, USN, explained the significance of these particular medals and why they are awarded to Department of Navy Civilians.

"The Navy Meritorious Civilian Service Award is a medal presented to civilian employees in the Department of the Navy for meritorious service. It is an award reserved for those whose work has resulted in contributions resulting in high value benefitting the Navy and/or the Marine Corps," said Dawson.

Dawson said the award consists of a certificate and citation signed by the activity's head and includes a medal and lapel emblem, and is also considered to be the Navy's third highest civilian award, ranking just behind the Navy Superior Civilian Service Award, but ahead of the Navy Distinguished Public Service Award.

PHOTO BY SUSAN TRAHAN

*Naval Surface Warfare Center Panama City Division's (NSWC PCD) Technical Director Ed Stewart (left) and Commanding Officer Capt. Scott Pratt right) present the Naval Meritorious Civilian Service Award Oct.31, 2013 to Dr. Daniel Sternlicht.*

NSWC PCD Technical Director Ed Stewart said Dr. Sternlicht is recognized as an expert in the development of undersea surveillance technologies and has distinguished himself in his position as the NSWC PCD Sensing Sciences Division Manager.

"Dr. Sternlicht's background in advanced sensors and unmanned systems science and technology makes him uniquely qualified to lead the transition of new technologies to the Fleet," said Stewart.

According to Stewart, Sternlicht has published 30 articles in these fields and regularly presents at and chairs Navy workshops and technology conferences. In 2009 he was the guest editor for the prestigious IEEE Journal of Oceanic Engineering Special Issue on Synthetic Aperture Sonar.

"NSWC PCD is proud to present the Navy Meritorious Civilian Service Award to Dr. Daniel Sternlicht for having provided leadership in the development of many of the advanced sensors for Mine Countermeasures in the Navy, as well as the signal and information processing that supports automation for successful integration and operation on board unmanned maritime vehicles," said Stewart. "These accomplishments and his total dedication to serve are indicative of his commitment to excellence and reflect great distinction on himself, NSWC PCD and the Department of the Navy."

In addition to Sternlicht, 10 other NSWC PCD employees were presented the Navy Meritorious Civilian Service Award. Those additional employees recognized included: Todd Doucett, Robert Benjamin, Robert Walker, Roxane Batyski, Pat Howerton, Vickie Seldenright, William Sawyer, Dale Garwood, John Camperman, Peter Adair, and Ronald Allgood.

NSWC PCD is a Technical Center of Excellence for Littoral Warfare and Coastal Defense.

# 2013 IEEE/OES Acoustics in Underwater Geosciences Symposium RIO Acoustics 2013

*J.-P. Hermand and A. Ayres Neto*


**First of its kind in South America, in the heart of Rio, a IEEE/OES symposium dedicated to underwater acoustics responds to the demand of professionals and researchers**

Rio de Janiero was the site of the IEEE/OES Acoustics in Underwater Geosciences Symposium at the Centro Empresarial July 24–26, 2013. The Symposium was the first of its kind in South America, an IEEE/OES symposium dedicated to underwater acoustics responding to the demands of practitioners and researchers. This Symposium drew 151 delegates, of whom about half were students pursuing advanced degrees. The majority of delegates were from Brazil.

The Symposium featured 53 technical papers including both oral (23) and poster presentations (30). All sessions were well attended. While all symposium topics were explored, the four most popular topics were acoustic characterization of the seafloor, fisheries acoustics, geo-acoustic inversion, and marine geophysical surveys. Other emerging topics such as underwater mining and passive acoustics also drew attention.

The idea of organizing the symposium arose during the 2011 Congress of the Brazilian Geophysical Society. A special session on shallow water geophysics at that conference brought together a group of enthusiastic South American researchers who were all involved in the use of off-the-shelf acoustic survey equipment or development of new approaches. There, a clear demand emerged for a more specific event covering a wider spectrum of applications along with intelligent solutions from equipment makers and survey companies. State-of-the-art and emerging acoustic sensing techniques to investigate the water column, seafloor, and near-surface sediment of the ocean and inland waters would be presented and discussed together with their applications in ocean engineering, environmental management, fisheries and mineral exploration.

With the support of IEEE Oceanic Engineering Society the project took off with the objectives of developing discussion groups, building up a strong network around the themes proposed, and demonstrating the related market potential in South America.

For the whole continent the expectations are many. On the Atlantic side, Brazil with one of the world's longest coastline and adjacent territorial waters is today the world's 11th-largest oil producer; by 2020Brazil will likely be in the top five. A wide range of acoustic sensing techniques are needed to prospect mineral resources on the continental shelf and in the deep ocean beyond, to survey underwater infrastructures, and to assess and forecast the environmental impacts of a fast-growing exploitation. Management of the many Brazilian ports located in estuarine areas is another concern with the mud accumulating in access channels or basins needing to be regularly dredged. Inland, sediment building up behind the many

hydroelectric dams needs attention. Itaipu Dam, the world's largest hydropower producer, is of particular concern. Further, thousands of kilometres of waterways have to be maintained to preserve navigability. On the Pacific coast, the waters off Chile and Peru contain one of the world's most productive upwellings. Sustainable management of the fish stocks require better acoustic survey tools and practices.

The symposium was organized by Professors Arthur Ayres Neto of the Universidade Federal Fluminense (UFF) (Fluminense Federal University) of Rio de Janiero and Jean-Pierre Hermand of the Université libre de Bruxelles (ULB) (the French-speaking Free University of Brussels) in the framework of a cooperation agreement between the two institutions. The symposium became a reality thanks to one and half years of sustained efforts and dedication of the organizing committee. Special thanks go to the symposium secretary Arlette Grave (ULB) and the group of student volunteers from Brazil (UFF) and Belgium (ULB) who gave a very precious hand on the spot.

The Keynote Speakers were a highlight of the Symposium. The first three presentations clearly illustrated the diversity of demands and the strength of the future market for underwater surveys in South America. The PETROBRAS representative, Filipe Modesto, provided insights in offshore pipeline inspections using synthetic aperture sonar techniques. Mr. Luiz Carlos Torres involved with the LEPLAC (Brazilian Continental Shelf Survey Plan) Project, tackled the use of acoustic tools in the establishment of maritime boundaries. This is a hot topic currently in Brazil with some major countries extending the definition of their Economic Exclusive Zone and re-evaluating the outer limit of their territorial waters. Mr. Paulo Gamaro from ITAIPU BINACIONAL addressed the importance of hydro-acoustic techniques for assessing the sediment buildup in riverine environments to maintain navigable waterways, and in the water reservoirs of hydroelectric power plants to guarantee electricity production. Last but not least, an IEEE Distinguished Lecture on model-based oceanic signal processing by Prof. James Candy, UCSB, was highly appreciated.

The RIO Acoustics initiative has been raised the interest of forward-thinking private companies of the survey sector. Brazilian companies Umi-San, EGS Survey, IMS, Hydromosaic and Ambidados responded to the call by providing generous support. Further support was supplied by Kongsberg (Norway), Caris (Canada), Teledyne Reson (USA), Meridata (Finland) and Geospectrum (USA). And no one regretted it! Research funding agencies from Belgium (FNRS, WBI) and Brazil (CNPq, CAPES, Faperj) backed up the event together with the Office of Naval Research Global (ONRG). The Brazilian Geophysical Society (SBGf) and Brazilian Association of Engineering Geology (ABGE) endorsed the symposium.

The dedicated Patron's Day was very well attended by many end users creating business opportunities. The companies presented their equipment, new technologies and study cases demonstrating new features for seafloor mapping, geophysical and geotechnical investigation, fishery and plankton research, navigation and geographical information system.

Patron representatives also participated in the sessions of the previous days. They thought it was a great opportunity for them to get a closer contact with researchers exchanging ideas and creating demands for their equipment. And the student attendees did not miss the opportunity to discover the job market!

RIO Acoustics 2013 was a resounding success. With its substantial attendance, the broad scope of its Technical Program, and its international Patron support, the RIO Acoustics Symposium is another example of the support that the IEEE Oceanic Engineering Society gives to the technical community.

# Student Poster Competition, OCEANS 13 San Diego

***Christophe Sintes, OES Student Activities Coordinator, Photos by Stan Chamberlain***

The 33rd Student Poster Program of the OCEANS Conferences was held at the OCEANS'13 MTS/IEEE San Diego conference at the Town and Country Resort, San Diego, USA, September 23–26, 2013. Once again outstanding posters described the work that the students were presenting. The program was organized and directed by Kevin Delaney as local coordinator and by the student activities coordinators of both organizing societies, Jill Zande from MTS and Christophe Sintes from IEEE OES. 16 student posters were accepted from the 100 abstracts received. Once again the program was supported by funding from the US Navy Office of Naval Research, which enabled the students to attend the conference.

The roster of students and their schools are:

- Murat Aykin, University of Miami
- Daniel Coles, University of Southampton
- Bruno Ferreira, Instituto de Engenharia de Sistemas e Computadores do Porto (INESC TEC)
- Donya Frank, University of New Hampshire
- Akihisa Fukami, University of Tokyo
- Natalia Hurtos, University of Girona
- Wen Liu, Hangshou Dianzi University
- Masaru Nagaso, Institute of Industrial Science, University of Tokyo
- Samir Ouelha, DCNS
- Eric Piper, Florida State University
- Edward Richards, University of Rhode Island
- Luke Rumbaugh, Clarkson University
- Ken Sooknanan, Trinity College
- Tomoko Takahashi, University of Tokyo
- Christopher Tomaszewski, Robotics Institute, Carnegie Mellon University
- Sean Walstead, University of California, San Diego

The posters were judged by a team organized by MTS and IEEE OES. The student award winners were announced at the Thursday exhibitor's luncheon. Dr. Sintes opened the awards ceremony and introduced Jill Zande and Kevin Delaney, who presented each student with a Certificate of Participation in the OCEANS'13 MTS/IEEE San Diego. The students were than all introduced as a group and received a round of applause from the conference attendees. The students were announced as members of the "OCEANS Student Poster Alumni Association". This year Norman Miller could not attend the conference; to commemorate his founding of the poster competition and the 600th student participating in the Student poster competition, MTS and IEEE OES have decided to name the first prize after him.

René Garello and Drew Michel, presidents of IEEE OES and MTS, announced the winning student posters and presented the awards to the students.

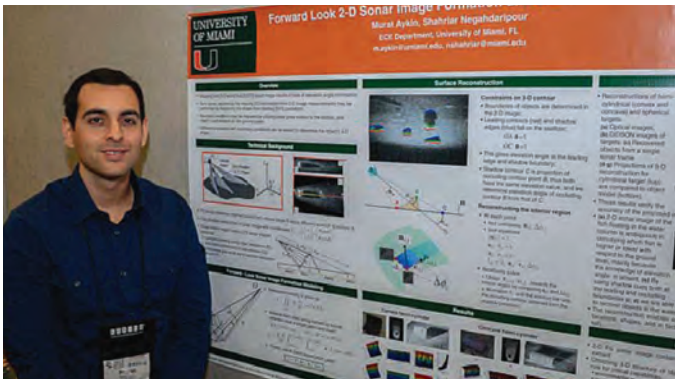
- The honorable mention prize was given to Donya Frank.
- The third prize was given to Sean Walstead who received an award of $1,000 for his research.
- The second prize was presented to Luke Rumbaugh with an award of $2,000 for his work on laser for underwater remote sensing.
- The first prize, the Norman Miller award, with $3,000 was presented to Natalia Hurtos for her research in sonar processing.

The winning students all received a round of applause for their accomplishments and participation in the Student Poster Program of SanDiego!

The abstracts for each of the presented posters are reprinted below. The full poster paper of the first place winner is included following this article.

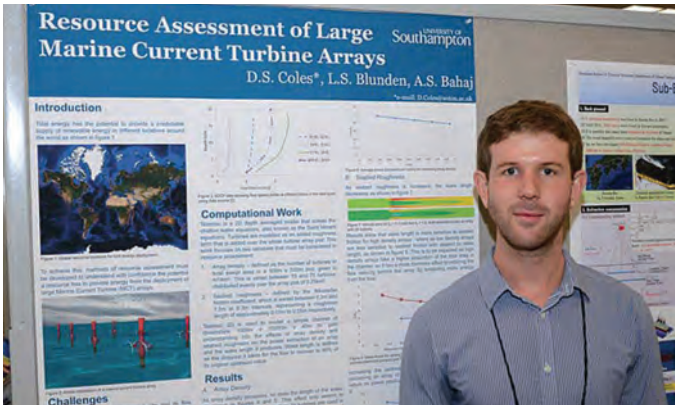
*Society Presidents and Student Poster Competition winners (l to r): Drew Michel, Sean Walstead, Donya Frank, Natalia Hurtos, Luke Rumbaugh, René Garello.*

**Murat Aykin**, University of Miami, *Forward-Look 2-D Sonar Image Formation and 3-D Reconstruction*



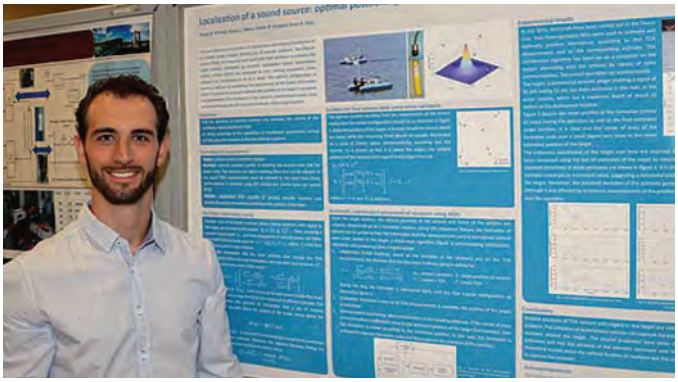

*Abstract*—Sonar imagery deals with transmitting acoustic signals and measuring the reflected sound from the scene surfaces. The recorded signal encodes information about the shape and material properties of these surfaces. The relationship of the scene geometry to the image irradiance can be established by modeling the physics of the sonar image formation process. The inherent ambiguities in the interpretation of the 3-D world based on visual cues in a 2-D forward-scan sonar image arise as a result of both operating as a ranging device and loss of elevation angle information due to the projection geometry. One aspect of this work is modeling the image formed by a new class of high-resolution 2-D forward-looking sonar systems which supports our complementary aim of recovering the unknown zenith angles from image brightness and thus reconstruct 3-D objects. Our method applies to a single forward-scan sonar image, assuming that the scene objects have smooth surfaces that vary monotonically in terms of distance from the sonar, and cast visible shadows on a flat background. We present the results of experiments with real data to demonstrate the performance of our 3-D reconstruction technique.

**Daniel Coles**, University of Southampton, *Resource Assessment of Large Marine Current Turbine Arrays*



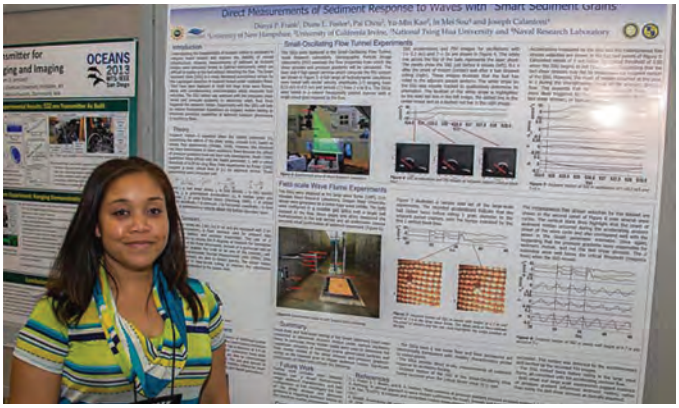

*Abstract*—At present, simple analytical and numerical models exist that give approximations for the energy that can be extracted by marine current turbine arrays (MCTAs) from an available resource. This paper first presents an analysis of different methods for conducting a resource assessment to outline the considerations that must be made whilst also identifying areas where more detail is required. Resource assessment using 2-D depth averaged numerical modeling software Telemac-2D is presented to give analysis of the behaviour of the flow in the presence of MCTAs and the effects of array density and seabed roughness on wake length and power generation.

**Bruno Ferreira**, Instituto de Engenharia de Sistemas e Computadores do Porto (INESC TEC), *Localization of a sound source: optimal positioning of sensors carried on autonomous surface vehicles*




*Abstract*—This paper addresses the problem of optimal, three-dimensional, localization of an acoustic pinger. Making use of acoustic receivers, the time-of-arrivals are computed and fused with their positions to estimate the target position. Motivated by practical applications where autonomous surface vehicles are employed to carry sensing equipment, these receivers are constrained to lie in a plane. The optimal configuration of sensors is derived by maximizing the determinant of the Fisher information matrix. A method to track and estimate the position of the target is proposed and implemented in a formation of four vehicles. Experimental results show very motivating results with successful estimates of the target position.

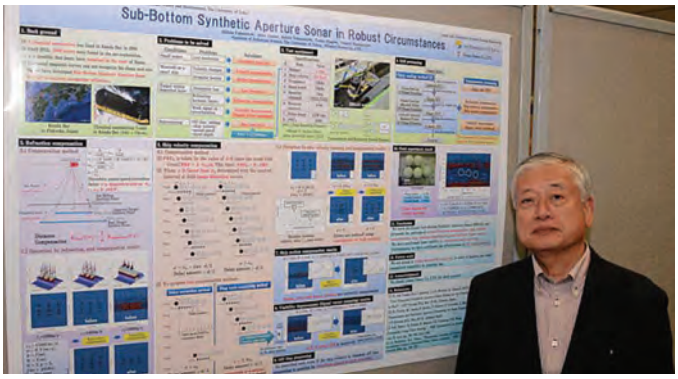
**Donya Frank**, University of New Hampshire, *Direct Measurements of Sediment Response to Waves with "Smart Sediment Grains"*




*Abstract*—Measurements of sediment motion have been primarily limited to indirect observations with acoustic and optical instruments. A micro-electro-mechanical systems

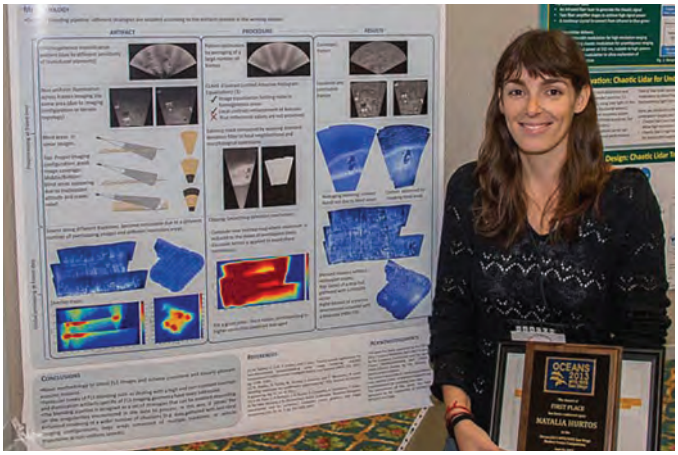
device that can measure and record Lagrangian observations of coastal sediments at incipient motion has been developed. These sensors move freely, measure acceleration in the six degrees of freedom and their mobility characteristics are similar to coarse gravel. Experiments conducted in a small oscillating flow tunnel and a large wave flume verified that the sensors detect incipient motion under various hydrodynamic conditions. Analysis of complementary fluid velocity measurements suggests the influence of pressure gradient induced sediment motion.

**Akihisa Fukami**, University of Tokyo, *Sub-Bottom Synthetic Aperture Sonar in Robust Circumstances*



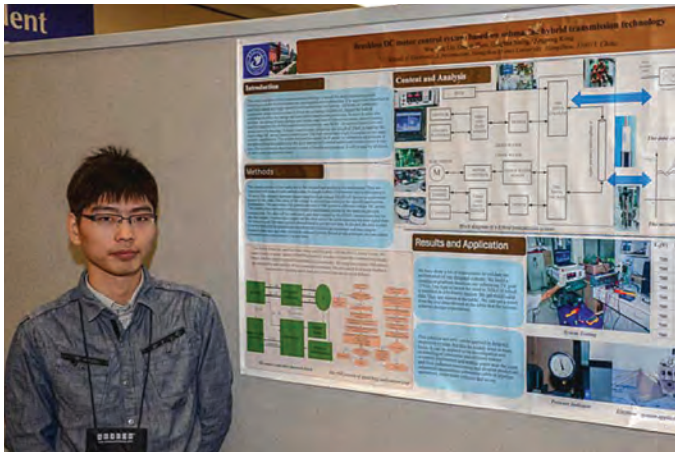

*Abstract*—In Kanda Bay of Fukuoka, Japan, 2,996 pieces of chemical ammunitions were detected in the exploration until 2012. Therefore, we have developed sub-bottom synthetic aperture sonar for high resolution at low frequency to explore the targets of the deposited layer. Sonar can be mounted on a small ship under the robust circumstances of environment. We have considered next five issues; refraction at the deposited layer, the frequent velocity change due to tide and wave for small ships, also frequent movement of sensors, weak signals in the deposited layer, and flexibility in offline processing, and have developed the solutions. We have carried out the detection test of targets buried in the seabed sediments at Kanda Bay in July and September 2012, and we report the processing method and the result in this paper.

**Natalia Hurtos**, University of Girona, *A Novel Blending Technique for Two-Dimensional Forward-Looking Sonar Mosaicing*



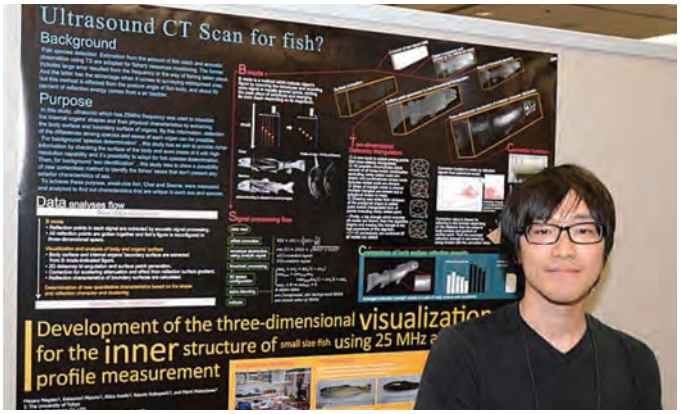
*Abstract*—High-resolution forward-looking sonars are becoming a tool of choice for exploring underwater environments under low visibility conditions. Their imagery can be mosaicked to obtain a global overview of submerged areas of interest and the spatial arrangement of different target features. However, in order to achieve an informative and smooth image composition, the individual sonar frames must be fused. Unlike the blending in optical mosaics, this implies dealing with a high number of overlapping images as well as with sonar specific artifacts arising from its image formation geometry. This work presents a novel blending pipeline designed to cope with these artifacts involving strategies to diminish the impact of all the photometric irregularities that might be present when mosaicing forward looking sonar imagery. Results of blended mosaics, including data gathered with different sonar models and presenting several artifacts, are presented here to show the applicability of the method.

**Wen Liu**, Hangshou Dianzi University, *Brushless DC motor control system based on submarine hybrid transmission technology*



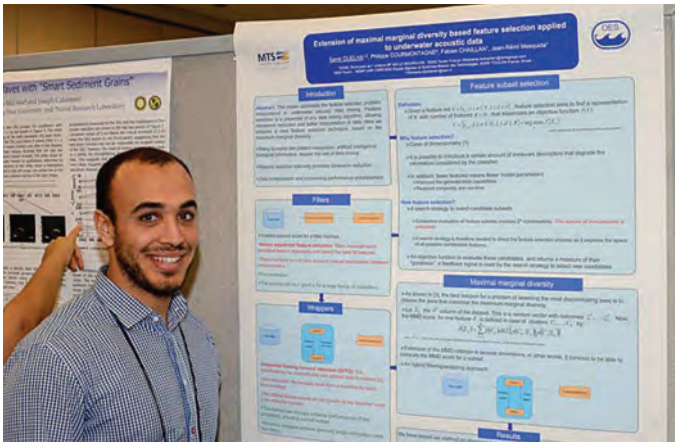

*Abstract*—The energy and data hybrid transmission technology is one of the most important technologies in the field of submarine investigation and exploitation. It is urgent to study high-power and high-speed hybrid transmission technology. All kinds of submarine equipment, using electric motors to drive the actuating mechanisms, require the kind of technology to solve the energy and data hybrid transmission problem. In order to solve this problem, our research team designed and verified one kind of submarine motor control system, which is based on the Hybrid transmission technology and BLDC (Brushless Direct Current) motor control technology. A single coaxial cable, with a length of 10 km, is used for the high-voltage DC power source transmission. The high-speed data is coupled on the same cable by capacitance. The system can supply 3 KW power to submarine equipment. It has achieved good results that the platform on the deck can monitor and control underwater motor system in real time. The experiments show that the system is feasible and practical. It will be used by all kinds of underwater equipments widely.

**Masaru Nagaso**, Institute of Industrial Science, University of Tokyo, *Development of the three-dimensional visualization method for the inner structure of small size fish using 25 MHz acoustic profile measurement*



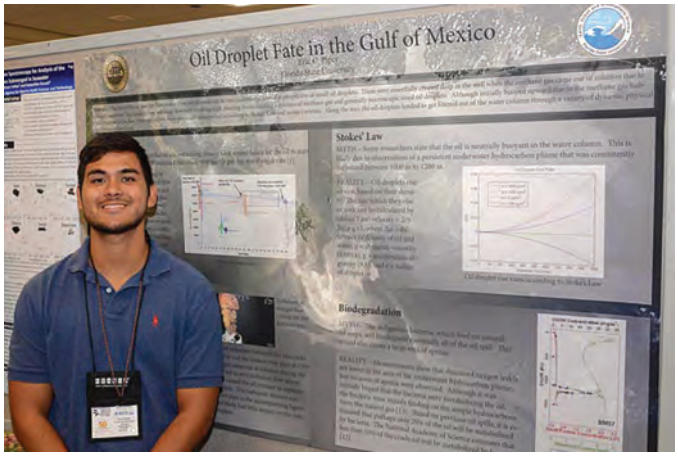

*Abstract*—A visualization method using ultrasonic acoustic profile measurement was introduced and inner structures of small size fishes were examined. Detection of external and internal body surface were executed. Two kinds of fishes are chosen in this experiment and measured using a 25 MHz medical probe. Then signal processing and visualization of three dimensional structure including inner part of the body, abstraction of the skin and organ boundary surface and mapping of reflection signal strength on their surfaces with corrections for surface gradient acoustical loss and scattering attenuation by referring the reflection strength change rate data, relating on the gradient and distance from the probe to target surface. Data for correction was taken from cylindrical silicon model are carried out. Three-dimensional acoustic images are obtained and the result shows that the detection of organs is possible even if these are small size organs of small size fishes. Then the reflection signals from the boundary surface of organs could also be seen clearly. Surface abstraction and reflection strength mapping shows points which has strong hardness and has great change of acoustic impedance. Application for fish species classification by reflection signal amplitude on body surface were tried and its capability was confirmed.

**Samir Ouelha**, DCNS, *Extension of maximal marginal diversity based feature selection applied to underwater acoustic data*



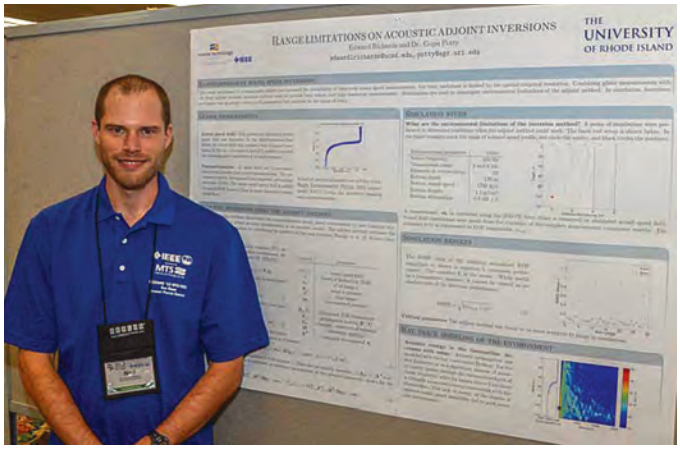

*Abstract*—This paper addresses the feature selection problem encountered in underwater acoustic data mining. Feature selection is a preamble of any data mining algorithm, allowing a priori dimension reduction and better interpretation of data. Here, we propose a new feature selection technique, based on the maximum marginal diversity principle. Our approach is applied on various real dataset, including underwater acoustic data.

**Eric Piper**, Florida State University, *Oil Droplet Fate in the Gulf of Mexico*



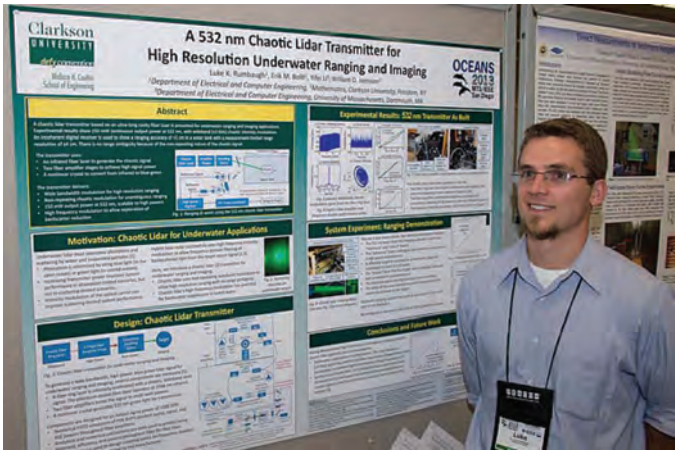

*Abstract*—The fate of the oil from the Deepwater Horizon blowout can be best understood from the perspective of small oil droplets. These were essentially created deep in the well when the methane gas came out of solution due to reduced pressures. This caused a very turbulent flow with resulting high shearing forces creating a mixture of methane gas and generally microscopic sized oil droplets. Although initially buoyed upward due to the methane gas bubbles entrained in the flow, these oil droplets were eventually transported according to Stokes' Law and ocean currents. Along the way, the oil droplets tended to get filtered out of the water column through a variety of dynamic physical and biological processes.

**Edward Richards**, University of Rhode Island, *Range Limitations on Acoustic Adjoint Inversions*



*Abstract*—Measurement of range dependent ocean sound speed is an important to many ocean acoustic problems, including source localization and tomography. The recent prevalence of low cost robotic platforms such as oceanographic gliders has increased the availability of long-term measurements of the ocean environment, but in many cases their usefulness is limited by the spatial-temporal resolution of their measurements. Combining them with additional acoustic inversion sampling of the same sound speed field may increase these measurements' resolution. This paper investigates a method of combining the adjoint method, a local acoustic inversion, with glider measurements to create reliable sound speed measurements at high sampling rates. The performance of this method is found to be highly sensitive to the total range study area with a simulation study comparing root mean squared error over 30 simulated inversions. This limitation may be an effect of the limited ensonification of the water column at longer ranges, which is shown using a ray trace model.

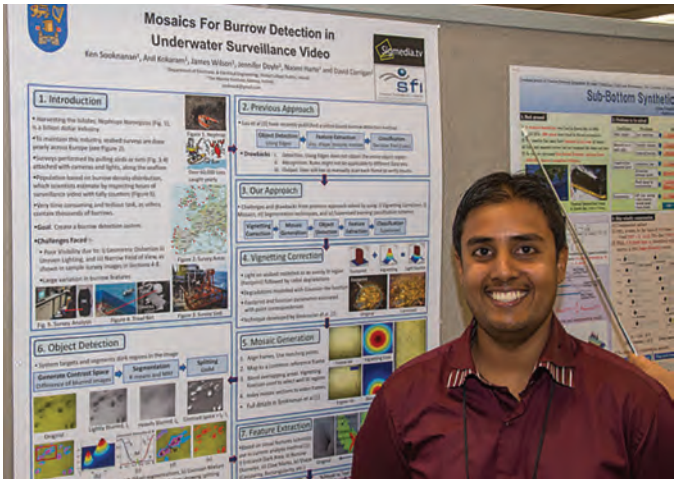
**Luke Rumbaugh**, Clarkson University, *A 532 nm Chaotic Lidar Transmitter for High Resolution Underwater Ranging and Imaging*




*Abstract*—A chaotic lidar transmitter based on an ultralong cavity fiber laser is presented for underwater ranging and imaging applications. Experimental results show 150 mW continuous output power at 532 nm, with wideband (>3 GHz) chaotic intensity modulation. An incoherent digital receiver is used to show a ranging accuracy of 1 cm in a water tank with a measurement-limited range resolution of –4 cm. There is no range ambiguity because of the non-repeating nature of the chaotic signal.

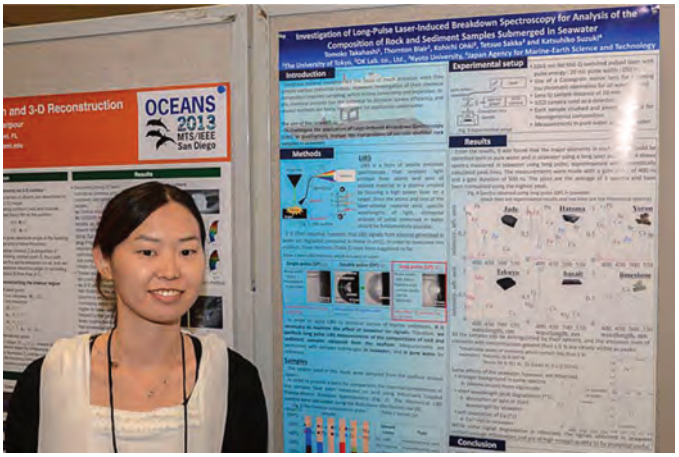
**Ken Sooknanan**, Trinity College, *Mosaics For Burrow Detection in Underwater Surveillance Video*

*Abstract*—Harvesting the commercially significant lobster, Nephrops norvegicus, is a multimillion dollar industry in Europe. Stock assessment is essential for maintaining this activity but it is conducted by manually inspecting hours of underwater surveillance videos. To improve this tedious process, we propose the use of mosaics for the automated detection of burrows on the seabed. We present novel approaches for handling the difficult lighting conditions that cause poor video



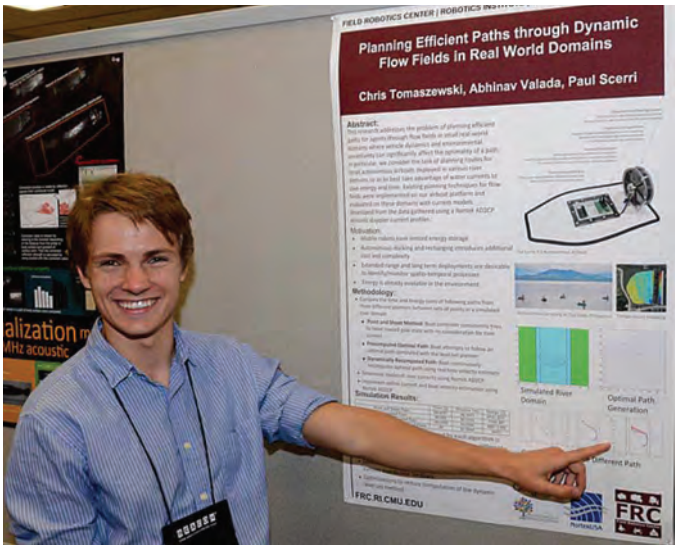

quality in this kind of video material. Mosaics are built using 1–10 minutes of footage and candidate burrows are selected using image segmentation based on local image contrast. A K-Nearest Neighbour classifier is then used to select burrows from these candidate regions. Our final decision accuracy at 93.6% recall and 86.6% precision shows a corresponding 18% and 14.2% improvement compared with previous work [1].

**Tomoko Takahashi**, University of Tokyo, *Investigation of Long-Pulse Laser-Induced Breakdown Spectroscopy for Analysis of the Composition of Rock and Sediment Samples Submerged in Seawater*



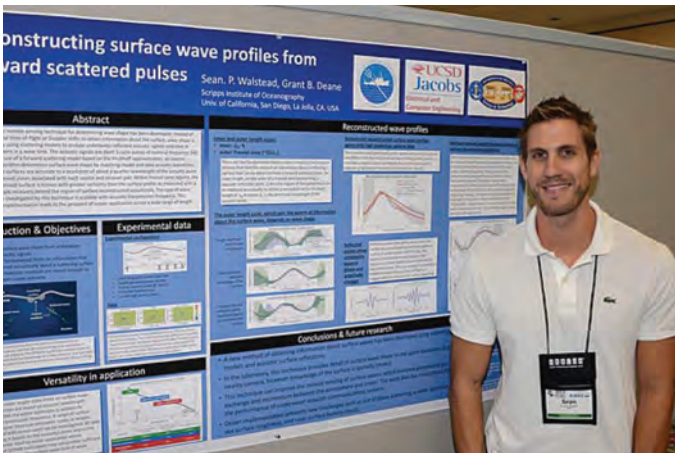

*Abstract*—The aim of this paper is to investigate the application of Laser-Induced Breakdown Spectroscopy (LIBS) to qualitatively analyze the composition of various seafloor rock samples in seawater. Well-resolved emission spectra of submerged samples were achieved by using a long laser pulse of duration 250 ns. It was found that the main elements in each rock sample could be successfully identified both in pure water and in seawater. When comparing the measurements made in pure water and in seawater, some effects of the seawater could be seen, however these effects are negligible and do not have any significant detrimental effect on the analytical value of the signal obtained. The results suggest that long-pulse LIBS may be applicable for in situ, multi-element chemical analysis of sediments and rocks in the marine environment.

**Christopher Tomaszewski**, Robotics Institute, Carnegie Mellon University, *Planning Efficient Paths through Dynamic Flow Fields in Real World Domains*




*Abstract*—This research addresses the problem of planning efficient paths for agents through flow fields in small real-world domains where vehicle dynamics and environmental uncertainty can significantly affect the optimality of a path. In particular, we consider the task of planning routes for small autonomous airboats deployed in various river domains so as to best take advantage of water currents to save energy and time. Existing planning techniques for flow fields were implemented on our airboat platform and evaluated on these domains with current models developed from the data gathered using a Nortek AD2CP-Glider acoustic doppler current profiler. The real-world performance of these algorithms were compared to theoretical estimates and several modifications are suggested to improve their performance in specific domains.

**Sean Walstead**, University of California, San Diego, *Reconstructing surface wave profiles from forward scattered pulses*




*Abstract*—Surface wave shape is determined by analyzing underwater reflected acoustic signals collected at multiple receivers in a wave tank. The acoustic signals are short 3-cycle pulses of nominal frequency 300 kHz. With the use of a forward scattering model based on the Kirchhoff approximation, an inverse processing algorithm determines surface wave shape by matching model and data acoustic waveforms. Reconstructed surfaces are accurate to a resolution of about a quarterwavelength of the acoustic pulse only within Fresnel zones associated with each source and receiver pair. Within Fresnel zone regions, the acoustically derived surface is known with greater certainty than the surface profile as measured with a camera. Multiple receivers extend the region of surface reconstructed acoustically. The type of wave features to be investigated by this technique is scalable with acoustic transmission frequency. This versatility in implementation leads to the prospect of ocean application across a wide range of length scales.

## Winning Poster Paper

# A Novel Blending Technique for Two-Dimensional Forward-Looking Sonar Mosaicing

Natàlia Hurtós, Xevi Cufí and Joaquim Salvi
*University of Girona, Edifici Politecnica IV, Campus Montilivi 17071 Girona, Spain*
{nhurtos,xcuf,qsalvi}@eia.udg.edu

***Abstract*—High-resolution forward-looking sonars are becoming a tool of choice for exploring underwater environments under low visibility conditions. Their imagery can be mosaiced to obtain a global overview of submerged areas of interest and the spatial arrangement of different target features. However, in order to achieve an informative and smooth image composition, the individual sonar frames must be fused. Unlike the blending in optical mosaics, this implies dealing with a high number of overlapping images as well as with sonar specific artifacts arising from its image formation geometry. This work presents a novel blending pipeline designed to cope with these artifacts involving strategies to diminish the impact of all the photometric irregularities that might be present when mosaicing forward-looking sonar imagery. Results of blended mosaics, including data gathered with different sonar models and presenting several artifacts, are presented here to show the applicability of the method.**

## I. Introduction

The increasing development of two-dimensional forward-looking sonars (FLS) which deliver high-resolution acoustic images at near-video frame rate is playing a key role in underwater inspections where water visibility does not allow the use of optical cameras. Inspection of harbour underwater structures, ship hulls, dams or the monitoring of rivers and lakes are some of the applications that can benefit from this growing technology. Following this line, several authors [1], [2], [3] have studied the development of mosaicing techniques specifically suited to FLS imagery with the aim of providing an overall view of an area of interest even in the presence of turbid waters.

The general pipeline for mosaicing consists of several steps. First, the pairwise registration of sonar images is performed to obtain an initial guess of the trajectory, either by using feature-based techniques [1] or frequency-based registration [3]. This trajectory can then be refined through global alignment techniques by using information of loop closure situations [3]. As a result, the acquired images can be projected and rendered onto a single and common reference frame. However, without any image fusion mechanism, the seams along the different images boundaries become noticeable due to photometrical differences between the individual sonar frames or due to geometrical registration inaccuracies. Therefore, it is necessary to perform one last step to give a continuous and uniform appearance in the form of a single large mosaic. This is achieved by means of image blending techniques. It is worth highlighting that generating the sonar mosaic with a convincing and natural appearance has not only aesthetic but informative purposes. The interpretation of a given scene becomes more intuitive and effective when its features are emphasized and it has a global smooth and continuous appearance.

The basic principles of image blending were established four decades ago [4] and the topic has been extensively studied in the field of optical imaging, including underwater environments [5]. However, the inherent nature of FLS imagery poses some particular challenges that need to be specifically addressed to obtain a proper sonar blended mosaic. In this paper we present a novel methodology to blend mosaics obtained from FLS imagery. We start in Section II by reviewing related work and analyzing the specific problems to be faced in the blending of FLS mosaics compared to the traditional approaches adopted on optical photomosaics. Section III presents the proposed methodology, describing the main steps performed to correct photometric irregularities both at frame level and at a global mosaic scale. Results of mosaics rendered by using the proposed blending pipeline are show in section IV, involving data gathered with different sonar models and affected by different artifacts. Finally, section V provides some concluding remarks and points out future work.

## II. Background

There is a wide variety of image blending techniques in the literature, but at a high level two main approaches can be distinguished [5]. On one hand, we have transition smoothing methods (also known as feathering or alpha blending methods) which attempt to minimize the visibility of the image boundaries by smoothing the common overlapping region of the stitched images. On the other hand, there are optimal seam finding methods which attempt to find the optimal location to place a cut along the two images so that it minimizes the photometrical and geometrical changes between them. Furthermore, there are also hybrid techniques which take advantage of the benefits of each approach.

Hence, regardless of the particular technique, one can see that optical blending generally deals with a low number of images at a given position (most of the times pairwise) and treats only their intersecting region. This prevents us from directly leveraging traditional blending techniques designed for video images since blending a FLS mosaic requires dealing with multiple overlapping images involving high overlap percentages. High overlap is usual in FLS data, not only because of the high frame rate of the FLS sensors, but also because when acquiring images in an across-range fashion high overlap is a must to achieve good coverage due to the sonar fan-shaped footprint. Moreover, presuming that a correct registration has been performed, it is of interest to keep as much of overlapping images as possible to be able to improve the signal-to-noise

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ratio (SNR) of the final mosaic. This is again opposed to other approaches typically adopted on optical mosaicing such as trying to select only the best image for a given location. Therefore, for blending FLS mosaics it is necessary to deal not only with the seam areas, but with the whole image content.

In addition to this main divergence on the mosaicing approach there are several sonar-specific issues at frame level that can also have an impact on the blending step. FLS imagery is affected by two sorts of illumination artifacts. Firstly, sonar frames often present a constant inhomogeneous insonification pattern due to the different sensitivity of the lens or transducers across the field of view. Additionally, FLS images are subject to illumination alterations due to changes in the point of view or changes in the underlying scene topology. When an object or a scene is imaged while the sonar is in motion, the object's vertical displacement fluctuates within the elevation angle of the sonar, receiving more or less incidence and thus causing variations on the illumination profile, similar to the well-known parallax effect that occurs in optical images.

Furthermore, the main parameters that configure the imaging geometry, namely tilt angle of the sensor, altitude from the seafloor and minimum and maximum range of the image, play a key role for acquiring a proper image. FLS insonify the scene with an acoustic wave spanning its field of view in azimuth $(\theta)$ and elevation $(\phi)$ directions (Fig. 1). The acoustic return is sampled by an array of transducers as a function of range and bearing, resulting in an image with the backscattered intensities at each point $(r, \theta)$. Usually due to the narrow elevation angle of the FLS sensors (around 12 to 20 degrees) the sonar is tilted at a grazing angle from the scene so as to maximize the coverage of the insonification area. However, due to inappropriate setup of the imaging configuration (i.e. navigating at too high altitudes or not tilting the sonar enough for the established ranges) or due to the deviation of the scene from the planar assumption that the mosaicing techniques presume [3], there are cases where the imaged area becomes just a portion of the sonar image footprint (Fig. 2). Although this is a problem that could be avoided by adopting a proper setup according to the underlying scene, our experience suggests that this is sometimes difficult, especially when the inspection area is unknown and there is no mechanism to dynamically detect and adapt to the underlying topology (such as a pan and tilt unit). Hence, it is important for a blending technique to be able to cope with these artifacts so as to preserve the area of the image where there is information and prevent blind areas to cover the real content when all images are registered.

Finally, FLS images suffer also from heterogeneous resolution. This is due to the fact that the sonar image is originally formed in the azimuth-range sampling space. Therefore, when it is mapped to a Cartesian coordinate system, the resolution is reduced depending on the distance of the pixel from the sonar origin (i.e., one pixel is mapped to a group of pixels). Although this does not usually have a strong visual impact on the mosaic, it is also a particularity that must be considered in the blending process.

The state of the art does not include precise solutions to cope with all the aforementioned factors and, in fact, little work can be found in the literature regarding sonar image blending. In [6] side-scan sonar data is mosaiced and blended using a wavelet-based technique that allows to select which

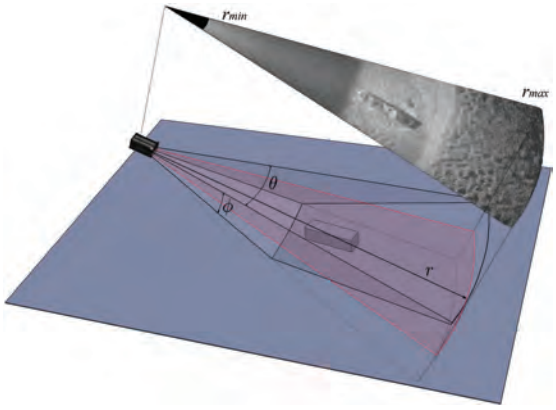



Fig. 1. Imaging sonar geometry ($r$: range, $\theta$: azimuth, $\phi$: elevation).

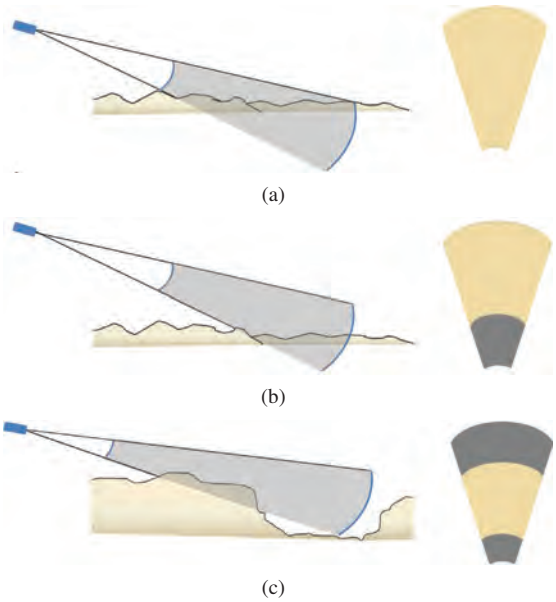



Fig. 2. Schemes illustrating different sonar-scene configurations and their corresponding acquired images showing blind regions in dark grey. (a) Proper imaging configuration where the altitude over the scene, the tilt angle and the minimum and maximum ranges are adjusted for a good image coverage. (b) Imaging configuration where the sonar is located too high or not tilted enough for the established ranges. (c) A change in the scene relief causing the apparition of a blind region.

kind of features are emphasized in the final mosaic. Kim et al. [7] proposed a probabilistic approach in the context of a superresolution technique for FLS frames. They model the blending problem of fusing a low-resolution image into a high-resolution one in terms of a conditional distribution with constraints imposed by the illumination profile of the observed frames so as to maximize the SNR of the resulting image. In our previous work on FLS mosaicing [3] as well as in the work of Wei Yong [8], results have been rendered by averaging the intensities of all overlapping sonar frames at every mosaic pixel. Averaging the overlapping sonar intensities results in denoising of the final mosaic, achieving an improvement in terms of SNR compared to a single image frame. Although this approach is a good starting point and may give satisfactory results in some imaging configurations, it diminishes details in those places where there are a large number of frame

contributions, as well as shows image boundaries where the number of overlapping images is not constant. Therefore, a better blending procedure should be devised in those situations in order to achieve a visually pleasant result.

## III. METHODOLOGY

The proposed methodology consists of a set of strategies to address the problems explained in the previous section associated with FLS image composition. Our approach takes as a basis the fusion by intensity averaging and incorporates strategies to correct for the different artifacts and modify the number and/or the intensity of the averaged pixels for the final image composition.

It is important to stress that the proposed blending concentrates on solving the different photometric artifacts that can arise both at individual frame level and at global mosaic scale but does not focus in possible problems caused by geometric registration errors. Therefore, a correct registration is assumed from previous steps, otherwise the averaging principle leads to blurred areas of mixed content. In the same way, other geometric issues such as object shadow alterations due to the viewpoint change are handled implicitly by the averaging principle. For instance, when imaging a protruding object while navigating over it, its shadow gets shortened as the sonar becomes closer to the object. The final shadow representation in the mosaic will then be the mean of all shadow positions yielding an intermediate solution which we consider to be a reasonable description of the scene.

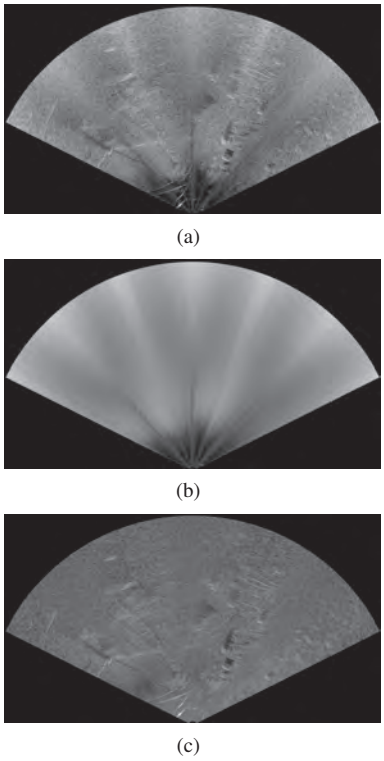
Each of the strategies presented here can be enabled or disabled in the blending pipeline according to the characteristics of the dataset. Therefore a dataset gathered in ideal conditions (i.e. with a sonar that would not present inhomogeneous insonification patterns, with the proper altitude, tilt and range settings, imaging a planar scene and performing just a single trackline at constant speed in order to keep a uniform number of overlapped images) would be blended through a standard intensity averaging only benefiting from the local contrast enhancement step to emphasize its features.

It is worth noting that the proposed blending pipeline is designed to work in an off-line fashion as it requires using all gathered frames with the aim of producing a final high-quality map of the inspected area. Note also that although the images can be projected and fused using the registration result at pixel level, if the mosacing method provides subpixel accuracy the final image locations can be rendered in a higher resolution grid thus being able to take into account these subpixel displacements and obtain a higher resolution mosaic.

### A. Individual image pre-processing

The described photometric artifacts that occur at image level can affect the global appearance of the mosaic composition. Hence, it is important to pre-process individual sonar frames to correct for some possible irregularities.

*1) Inhomogeneous insonfication pattern correction:* Some sonar models show evidence of non-uniform insonification patterns due to the different sensitivity of the transducers across the field of view (Fig. 3(a)). If a sufficient number of images is available, the underlying illumination profile can be computed by averaging all the dataset frames (Fig. 3(b)). Then, the illumination profile can be compensated in the original image thus yielding a pattern-free image (Fig. 3(c)). If the pattern is strong, this step should be performed earlier in the mosaicing pipeline (i.e. prior to the pairwise registration of the sonar images) since its presence may influence the registration result.



(a) (b) (c)

Fig. 3. Correction of non-inhomogeneous insonification. (a) Original frame. (b) Estimated illumination pattern. (c) Corrected frame.

*2) Contrast Limited Adaptive Histogram Equalization (CLAHE):* Besides non-uniform insonification related to the sensor's hardware, FLS data can exhibit other non-constant illumination patterns. Due to imaging configuration and/or terrain curvature the images can exhibit weaker backscattered intensities in some areas (e.g. weaker intensities further away from the sonar origin). This results in considerable intensity offsets when registering images that insonify the same portion of the scene but from different locations (Fig. 4(a),4(b)), turning into visible seams when blending the mosaic.

To deal with this, we first equalize the intensity histograms of the sonar frames so as to match a uniform distribution, thus minimizing the intensity offsets on the registered areas. To this end, we employ the CLAHE technique [9] whose advantages are twofold: first, it equalizes the images limiting the noise in the areas that are more homogeneous by setting a clip limit on the histogram equalization; second, it locally enhances the contrast of the images alleviating the attenuation of target features due to the low SNR that characterizes FLS images. Although, as stated before, the SNR is greatly enhanced by the averaging nature of the blending, a local contrast enhancement can help to further emphasize the scene features.

Note that this procedure does not preserve the true reflectance values of the scene. However, we believe that for

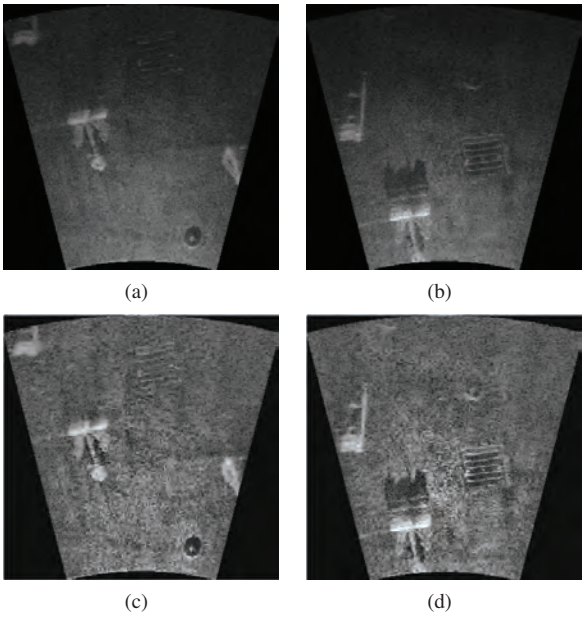


Fig. 4. Image equalisation and contrast enhancement. (a)-(b) Example of two frames imaging the same area from two different viewpoints. Notice the difference in intensities around the grid in the center. (c)-(d) Same frames preprocessed with CLAHE. The images present a uniform distribution that allows to merge them without arising visual seams. Notice also that the local contrast is preserved, emphasizing the scene features.

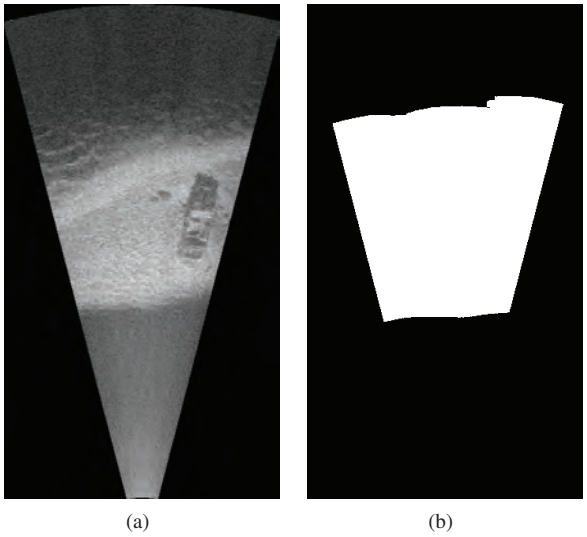


Fig. 5. Example of mask computed to discard blind regions. (a) Original image. (b) Mask (black areas will not be taken into account for the blending).

inspection purposes, it is more important to obtain a continuous and smooth representation that emphasizes the features and facilitates a better scene interpretation rather than preserving the true scene reflectances.

*3) Masking out blind regions:* Extreme cases of non-uniform intensities across the images are those situations described in Section II, where either an inappropriate imaging configuration or significant relief variations cause blind regions in the sonar frames. Even applying CLAHE and working with the equalized images, those blind regions have a negative impact on the final blending. Since they do not contain information at all, they cause the actual scene content to fade out when they are averaged with other images.

Our strategy for those cases is to compute a saliency mask for each frame (Fig. 5), which will be used to mask out the blind regions when performing the fusion by averaging. The mask M is obtained by applying standard deviation to local neighbourhoods:

$$M(u,v) = \sqrt{\frac{\sum (I(x,y) - \bar{I}(x,y))^2}{n-1}}, \qquad (1)$$

where $n$ is the number of pixels in the neighbourhood, $I(x,y)$ is the intensity of the pixel under consideration and $\bar{I}(x,y)$ is the mean of all neighbourhood pixels. The shape and size of the local neighbourhood are parameters that can be adjusted so as to take into account the standard deviation generated by the residual noise of the images. This standard deviation filter acts as a texture classifier. The blind regions of the image, which are characterized by the lack of backscattered intensities report low values. On the other hand, scene backscattered intensities generate higher filter responses even in homogeneous parts. Hence, a threshold is set to segment both type of regions and finally morphological operations are applied to ensure that isolated pixels are not remaining as part of the mask.

### *B. Global mosaic blending*

Despite the illumination corrections performed at individual frame level, the fusion of images from different tracklines will unavoidably create noticeable seams along the tracks due to the presence of a higher number of image contributions in the overlapping area (Figure 6(a)). If the tracks are combined along-range, seams may be also noticeable as a consequence of merging two different image quality areas (low/high resolution).

To reduce these artifacts, we compute an overlap map that reflects the number of images projected at each pixel location, taking into account the possible masks that might have been computed previously if the images contain blind regions. In the presence of multiple tracklines, the intersection area will present a significantly higher number of overlapped images compared to their surroundings (Fig. 6(b)).

To avoid these artifacts we propose a mechanism consisting of three main steps: clipping, smoothing and selection. First, the number of overlapping images are clipped to a threshold thus reducing the range of possible different overlaps. While it helps to reduce the overload of pixel contributions at a given location it is also of interest to keep a significant number of overlapped images to diminish the noise of the final mosaic. A trade off solution consists of cutting up to the mean of the overlap map. Second, the new overlap map is smoothed with a gaussian kernel to avoid sharp transitions caused by a different number of pixel contributions. A normalization is required so as to avoid any new computed overlap to exceed the number of actual overlapping images. Finally the mosaic is blended by averaging the number of pixels indicated by the new overlap map. To select from the images that are projected to a given pixel which ones will be discarded and which ones

will be taken into account on the final averaging, the following procedure is implemented: for each pixel of the final mosaic we store the list of all values that are projected to that location together with a weight that reflects its position in its original frame. A weighting mask is used to reflect the location, and therefore the resolution, of each pixel (from higher to lower as measurement sparseness increases with the range on Cartesian space). In this way, candidate pixels are sorted according to their weight and the first $N$ ones of higher weight (being $N$ the number of overlapping pixels in the newly computed overlap map) are used to compute the final pixel intensity by averaging. In this way we give priority to those frames that depict the region with higher resolution.

## IV. Results

In this section we present several results to validate the effectiveness of the proposed blending pipeline.

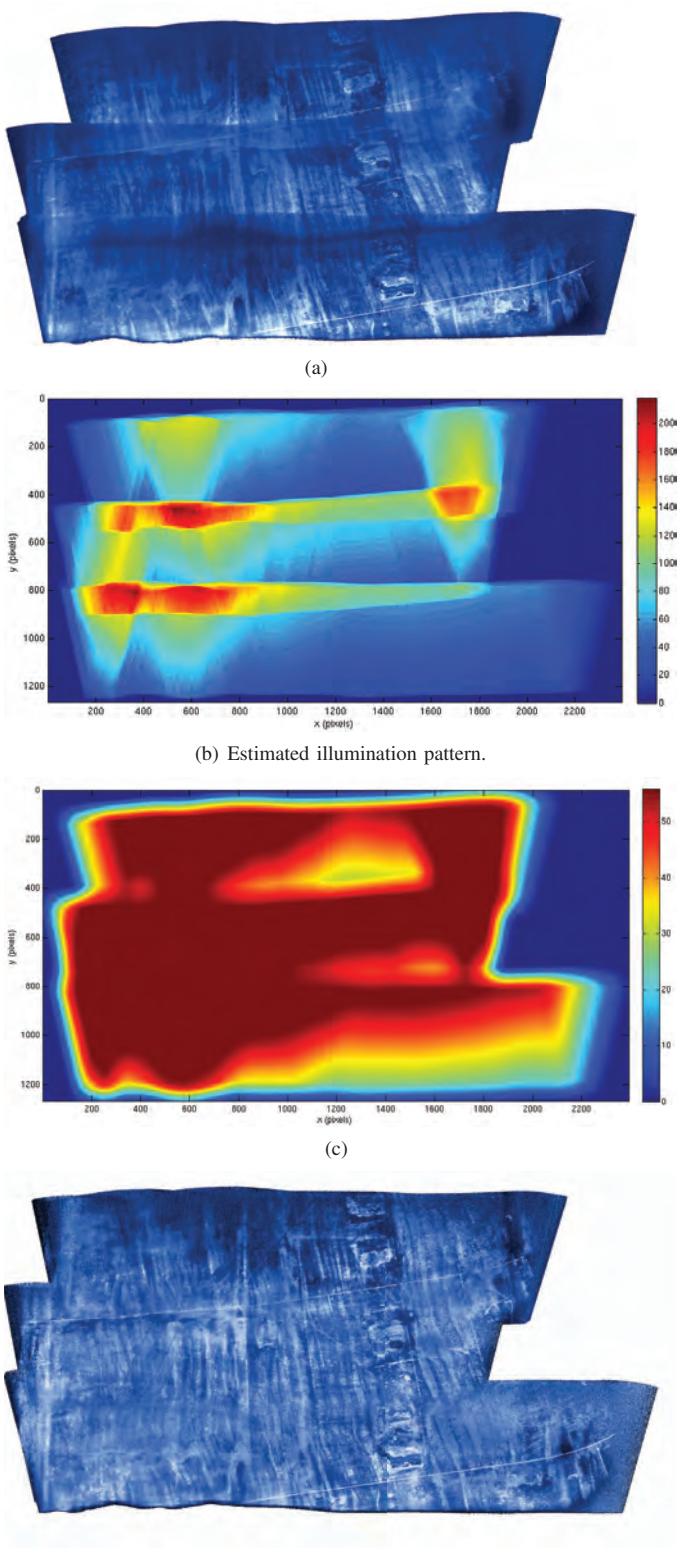
The first example consists of a small dataset gathered with the ARIS sonar [10] navigating over an underwater target lying on a sandy bottom. As the viewpoint changes, different scene features can be observed in the sonar frames, including the sand ripples at the bottom part, the target itself and the sand ripples located at the top, while several blind regions appear as a consequence of an inadequate imaging setup. After mosaicing the frames and blending them by using a straightforward intensity averaging it can be observed that some of the features disappear and others attenuate as a consequence of being merged with the blind regions (Fig. 7(c)). Processing the mosaic with our blending pipeline with CLAHE and masking of blind regions we obtain the result of Fig. 7(d), in which all the scene features are clearly preserved. In addition to this, note that the SNR has been greatly improved in comparison to an individual sonar frame.

A second test consists of a DIDSON [11] dataset imaging a ship hull along three different horizontal tracklines. Due to the imaging setup involving a small tilt angle (about 15 degrees with respect to the imaged plane) and a slight curvature of the hull the backscattered intensities at longer ranges appear attenuated (Fig. 6(a)). Therefore it is required to enable the CLAHE step in addition to the overlap clipping-smoothing-selection mechanism to correctly blend the different tracklines. The final mosaic blended according to the overlap map of Fig. 6(c) and averaging the values of the best available images in terms of resolution can be seen in Fig. 6(d).

Finally, an example is shown with a BlueView P900-130 [12] performing a trajectory on a harbour environment with multiple tracklines. The images have been preprocessed to correct for a strong inhomogenous insonification pattern before computing the registrations (Fig. 3) and have been equalized and with the CLAHE step. The original overlap map can be seen in Fig. 8(b) while the final blended mosaic is shown in Fig. 8(c). It can be seen that scene features are emphasized and no seams are noticeable despite the presence of multiple tracks and areas of non-constant overlap concentrated in the rotation regions.

## V. Conclusion

This paper has presented a novel strategy to blend FLS images in order to achieve consistent and visually pleasant



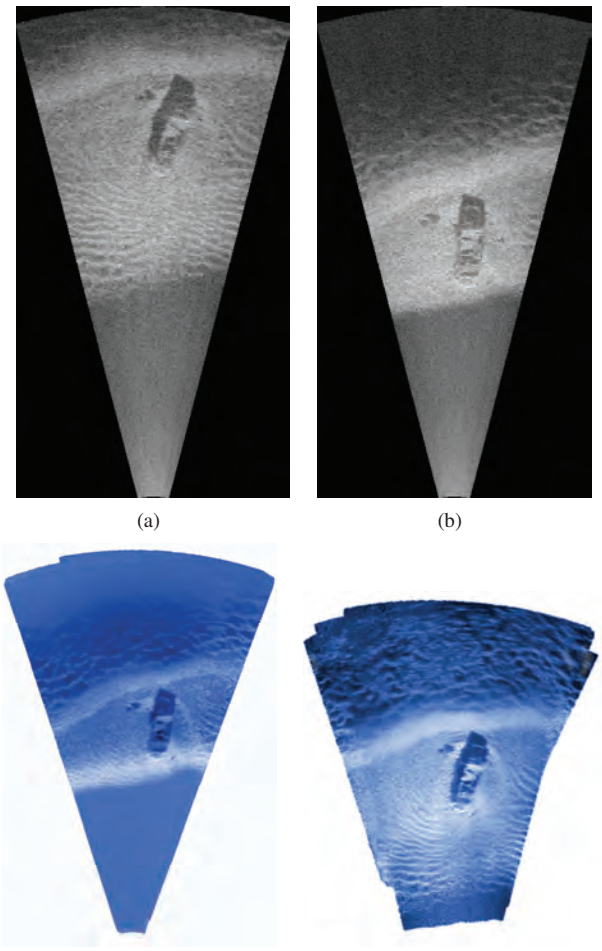
(a)

(b) Estimated illumination pattern.

(c)

(d)

Fig. 6. (a) Detail of a DIDSON sonar mosaic presenting three different straight tracklines. Note the visible seams at the regions of track intersection. (b) Overlap map showing large differences in the number of overlapping images across the mosaic. (b) Computed overlap map clipping the highest overlap values and applying smoothing to avoid abrupt changes. (d) Blended mosaic.



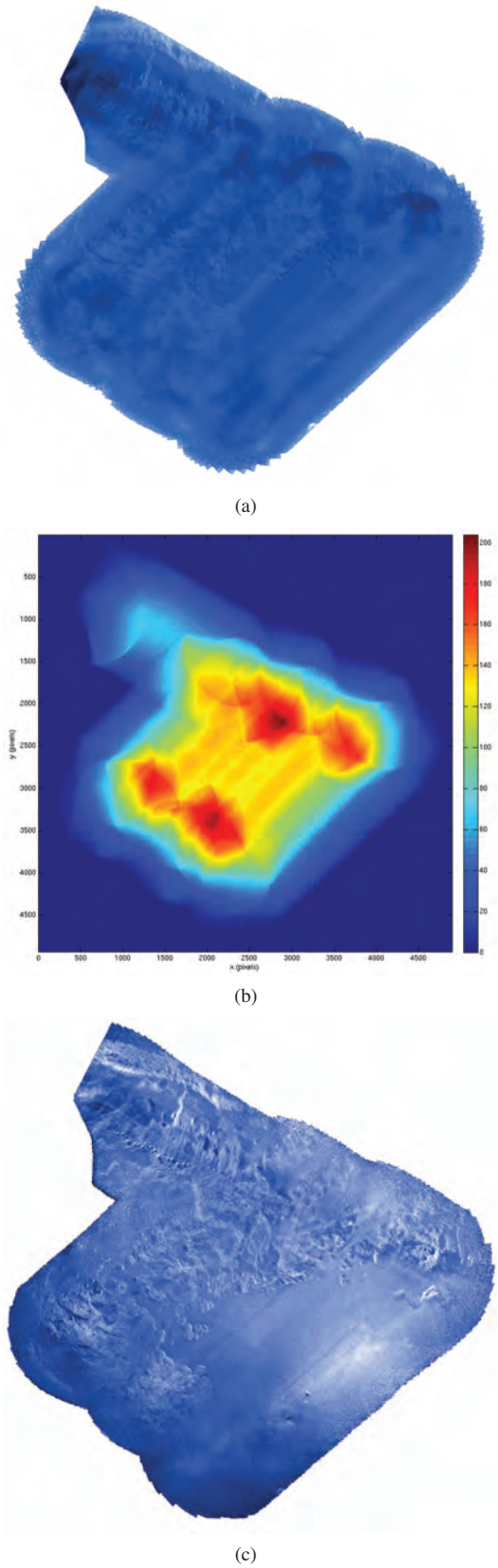
(a) (b) (c) (d)

Fig. 7. Example of blending under illumination. (a)-(b) Example of dataset frames affected by varying illumination depending on the imaging viewpoint. (c) Result after standard intensity averaging. (d) Result blended by applying the CLAHE enhancement and the masking of blind regions. Note that features are emphasized, and the sand ripples above and below the center target can be clearly appreciated.

acoustic mosaics with applications to underwater inspection in turbid waters. The main differences with respect to the blending of optical mosaics, such as dealing with a high number of overlapping frames at a given location and the illumination artifacts particular to the imaging geometry of FLS, have been addressed.

The proposed blending pipeline is designed as a set of multiple strategies that can be enabled depending on the different photometrical irregularities encountered in the data to process. In this way, it allows the enhanced rendering of a wider number of situations, involving data gathered with non-ideal imaging configurations, large areas composed of multiple tracklines or vehicle trajectories at non-uniform speeds.

As a future work, a more optimized implementation should be devised for large mosaics where the global blending step can become memory demanding.



(a) (b) (c)

Fig. 8. Mosaic of a harbour area gathered with BlueView P900-130 (a) Mosaic rendered averaging the non-preprocessed images. (b) Original overlap map, note the different level of overlaps caused by rotational movements between tracks. (c) Blended mosaic after insonification pattern correction, CLAHE and clipping-smoothing-selection on the overlap map.

## ACKNOWLEDGMENT

The authors would like to thank SoundMetrics Inc. and the Center of Maritime Research and Experimentation for providing sonar data.

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[12] "Blueview," 2013, retrieved July 26, 2013, from http://www.blueview.com.

# Decadal Survey of Ocean Sciences

The National Research Council is conducting a Decadal Survey of Ocean Sciences (DSOS 2015) and wants to hear from you!

The purpose of this decadal study, sponsored by the NSF, is to review the current state of knowledge, identify compelling scientific questions for the next decade, analyze infrastructure needed to address these questions vs. the current NSF portfolio, and identify opportunities to maximize the value of NSF investments.

The DSOS committee feels strongly that this report must be informed by broad and thoughtful community input from across the entire spectrum of ocean sciences supported by NSF. One of the ways we are soliciting community input is through a Virtual Town Hall: http://nas-sites.org/dsos2015/. The site provides more detailed information on the statement of task, as well as a complete list of the DSOS committee members. Please go to the website and contribute your comments regarding the top ocean science priorities for the next decade. Thank you!

# Call for Papers

## The 3rd International Conference on Synthetic Aperture Sonar and Synthetic Aperture Radar, 17–19 September 2014, Villa Marigola, Lerici, Italy

The Institute of Acoustics has previously held two successful international conferences on Synthetic Aperture Sonar and Radar (2006 and 2010). These drew together people from both communities to discuss the developments in both fields and to establish where there are common areas of interest and where cross-fertilization may prove beneficial.

Traditional Sonar and Radar both emerged during the early parts of the 20th century and it was recognized there were many areas of common interest. These include; detection, classification, localization and tracking of targets against a background of reverberation, noise or clutter, using either acoustic or electromagnetic energy.

Over the past few decades there have been significant advances in both domains in the use of synthetic aperture imaging techniques—in radar for high resolution imaging from aircraft and satellites, for defense surveillance purposes, for geophysical and oceanographic remote sensing and for environmental monitoring. In Sonar it has been applied in high resolution imaging of objects on the seabed (including clutter) for the offshore industry and maritime mine countermeasures.

Despite these common goals there had previously been very little cross-fertilization between the two communities and the first two IOA conferences on this topic were held in order to try and address this. The aim of this 2 ½ day conference is to build on the success of the previous conferences and provide a forum for comparison of systems techniques, signal and image processing, experimental results and to stimulate new ideas in each domain. The Institute of Acoustic will therefore be hosting this conference in September 2014 in the Villa Marigola, Lerici, Italy. Particular topics of interest for conference are, but not restricted to:

- Synthetic Aperture from Autonomous vehicles (AUVs and UAVs)
- Processing schemes and algorithms
- Automated and computer aided target recognition, Computer aided detection and classification
- Interferometry and differential interferometry
- Change detection
- Low frequency and UWB synthetic aperture
- Bi-static, multi-static and MIMO synthetic aperture
- Passive synthetic aperture sonar
- Satellite synthetic aperture radar
- Motion compensation, navigation and autofocus
- Spotlight and squint mode
- Performance assessment (systems, algorithms and operational use)
- Image registration, fusion and 2D/3D reconstruction

Prospective authors are invited to submit a title and single page summary to linda.canty@ioa.org.uk by 28 March 2014. Authors will be notified by 14 April 2014 and invited to submit a full paper by 16 July 2014. Papers will be fully refereed. Completed papers may be up to 8 pages long, including diagrams. The proceedings will be available on IEEEXplore, and must be prepared in the correct electronic format.

## The 2nd International Conference and Exhibition on Underwater Acoustics, 22–27 June 2014, Isle of Rhodes, Greece

The ***1st international conference and exhibition on Underwater Acoustics*** was held on the Greek island of Corfu in June 2013. This conference became a great success with more than 350 registered participants from 35 countries and with 302 papers presented. 6 companies showed their most advanced underwater acoustical instruments in the exhibition. The conference was based on the recent merger of the two international conferences, the Underwater Acoustic Measurements: Technologies and Results (UAM) conference and the European Conference on Underwater Acoustics (ECUA).

The success of the 1st international conference and exhibition on Underwater Acoustics oblige. It has, therefore, been decided to organize the ***2nd international conference and exhibition on Underwater Acoustic*** on the Greek island of **Rhodes** during the days **Sunday 22nd through Friday 27th June, 2014**. The conference venue will be the 5-star **Rodos Palace Hotel** http://www.rodos-palace.com with which an attractive agreement for the conference participants has been settled.

The conference will comprise a prominent series of structured oral sessions with invited papers given by leading international scientists. These Structured Sessions will be organized by key persons actively engaged in the fronts of research in underwater acoustics. Moreover, most recent research results will be presented in contributed papers forming basis for regular oral and poster sessions. All papers presented at the conference will be published in proceedings to be made available to all registered participants on the first day of the conference. Papers published in the Proceedings will, like papers from the 1st Underwater Acoustic Conference, be freely available on the Conference Website with the address: www.uaconferences.org, and the Proceedings of the conference will be indexed on Reuters. To boost the interest in Underwater Acoustics a ***competition*** among younger scientists and graduate students on the presentation of the best papers will traditionally be arranged, and medals will be handed over at a ceremony at the end of the conference.

An ***exhibition*** by leading international manufacturers of state-of-the-art technologies, equipment and services for underwater acoustic measurements, surveys and control of underwater processes will be arranged in the central area of the conference space.

## Abstracts and Full and Final Papers

The abstracts, in English and no more than 300 words, shall provide sufficient information to allow a fair assessment of the research and its results. The abstract must begin with the full title of the paper, the author(s) name(s), affiliation, full postal address, and e-mail address. It must in a clear way give pertinent information about the purpose of the work, the scientific method of approach and the technologies used, the main results obtained and the conclusions to be drawn. The abstract must also indicate which of the conference topics above it is addressing, if any.

Abstracts of Contributed papers shall be submitted electronically using the online *General Abstract Submission Form* not later than January 15th, 2014. Notification to authors of contributed papers will be sent on January 31st 2014.

Abstracts of Invited papers shall be sent initially to the Structured Session Organizer who has invited the paper using the template *Abstract Submission Form for Structured Sessions*. After notification of acceptance has been received from the Structured Session organizer concerned, the authors must submit their abstracts electronically to the Conference Secretariat using the online *General Abstract Submission Form* not later than February 15th, 2014.

Abstracts of papers submitted to Structured Sessions shall be sent initially to the Structured Session Organizer concerned who will review the abstract and notify the authors. The template *Abstract Submission Form for Structured Sessions* shall be used. After notification of acceptance has been received from the Structured Session organizer, the authors must submit their abstracts electronically to the Conference Secretariat using the online *General Abstract Submission Form* not later than February 15th, 2014.

The *Abstract Submission Form for Structured Sessions*—to be used for Invited papers and abstracts submitted to Structured Sessions—as well as the online *General Abstract Submission Form,*—to be used for all abstracts, *contributed and invited*—are available on the Conference website: ttp://www.uaconferences.org/index.php/2nd-uac/abstracts/abstractsform

All full and final papers in electronic form worked out according to Instructions to Authors and by the use of a template to be obtained from the conference website primo January 2014 must be submitted electronically to the Conference Secretariat using the *Full Papers Submission Form* no later than April 15th 2014 to be included in the Conference Proceedings.

## Who Should Attend

Scientists and engineers from universities, research institutes, government organizations and industry dealing with all aspects of underwater acoustics should attend, as well as representatives from naval material commands and procurement offices. The conference will provide a forum for exchange of recent research results, for discussion of future challenges in implementation and application of underwater acoustic technologies, and the exhibition will display the latest advances in instrumentation.

## Language

The official language of the conference is English. All oral presentations and discussions will be in English, only.

# Oceanic Engineering Research Activities in BREST, FRANCE; ICTO—ICT Ocean, Information, Communication and Technologies for the Ocean

***René Garello, OES President***

## Introduction

At the western tip of Brittany stands the city of Brest on the territory of Finistère—Land's End or Penn Ar Bed in Breton. For many, it is not an end but a beginning due to its opening on the ocean. R&D mixing geophysical understanding with engineering approaches is found within the research unit LabSTICC: Science and Technology for Information, Communication and Connaissance (Knowledge)—www.labsticc.fr—with an emphasis on several applications, among them the oceanographic domain is of importance.

Indeed, long-term observation and monitoring of the oceans is necessary in order to maintain and increase maritime activity security and sustainable ocean exploitation. In this context a need for better sensors, vehicles and processing for limiting human exposure is of great concern. Fine-tuning these different elements requires the ability to bring and test equipment at sea in the case of acoustic sensors or underwater vehicles, for instance. New technologies and new processing algorithms are relying on better access to data, which is critical when dealing with Earth observing satellite or other remote sensing devices. This step is mandatory in any research and development project process and implies techniques rather difficult to implement as well as expensive.

## LabSTICC Research Unit

Analyzing and managing the flow of data from so many different sources and sensors is a challenge. Future sensor networks will also put forward new scientific problems not yet completely formalized: how to collect, and use in almost real-time this humongous set of data and information. Indeed, the data are the first "basic" level: from there models must be run and assessed, ground truth (more data) must be supplied for the unavoidable calibration and validation phases. Furthermore, we will have to insure sustainability of these databases and its corollary, maintenance.

The research unit LabSTICC, in Brest proposes a large set of competences based on its research teams coming from five main University and Research Institutes[1]. They range from works developed in domains such as acquisition (sensors, on-board systems, drones, control & systems, etc.), observation and data analysis (multi-modal data, modeling, signal and image processing), data processing (especially in the context of big data). In this respect, the LabSTICC motto (From sensor to knowledge) applies very well here. The ICTO transverse axis is built on several of the LabSTICC research teams and its strategic positioning is on first and simplified approach divided into two main domains:

- Applications: a very solid anchoring for insuring a long-term presence on many society topics: environmental protection, risk assessment, natural or man-made disaster, expertise on the maritime domain (halieutic resources, underwater activities, satellite observations...), etc.
- Methods: our researchers are on top of the development of new processing tools based on advance methods directly tailored to the above applications. Some of the prospective fields are:
  - Very high resolution processing
    - Spatial resolution: sonar, radar, optics;
    - Spectral resolution: hyperspectral imaging;
    - Temporal resolution: change detection;
    - Modal résolution: multi sensors, multi modalities
  - Innovative sensors and sensor networks
    - Drones (surface and underwater);
    - Integrated systems for environmental observations;
    - Passive systems, stealth

The following section will present four main R&D approaches for a better understanding of the ocean data and their relationship with the physical properties at stake.

### a. From the bottom of the ocean …

Underwater Observatories are a major field for developing new and innovative concepts in terms of sensors able to perform many different tasks (multi parameters, multi modalities, embedded intelligence…). These developments in turn are essential for correctly dimensioning the observatories from a physical point of view (size, number of sensors) as well as a virtual one (information system related) such as intelligent sensors, on board processing, data management, etc.

So far two test sites are in activity: the Sea Test Base (http://www.seatestbase.com) platform installed in the bay of Brest and the EMSO observatory near the Molène island (http://medon.ensta-bretagne.fr).

New equipment and new tests are needed in order to evaluate and validate the contribution of these observatories to the users at a scientific level (research institutes, companies) as well as at a more general level (end-users, citizens). Data access, data dissemination will be one of the challenges to face, as these platforms are located in difficult environments.

### b. … up to the surface …

The maritime domain (made of the water column and the surface) is difficult to explore and to monitor. Increasing significantly robotic means by considering a global collaborative approach is one of the goals sought here. For the last two decades, robotic platforms have proven all their potentialities, especially in the maritime environment. A very large number of

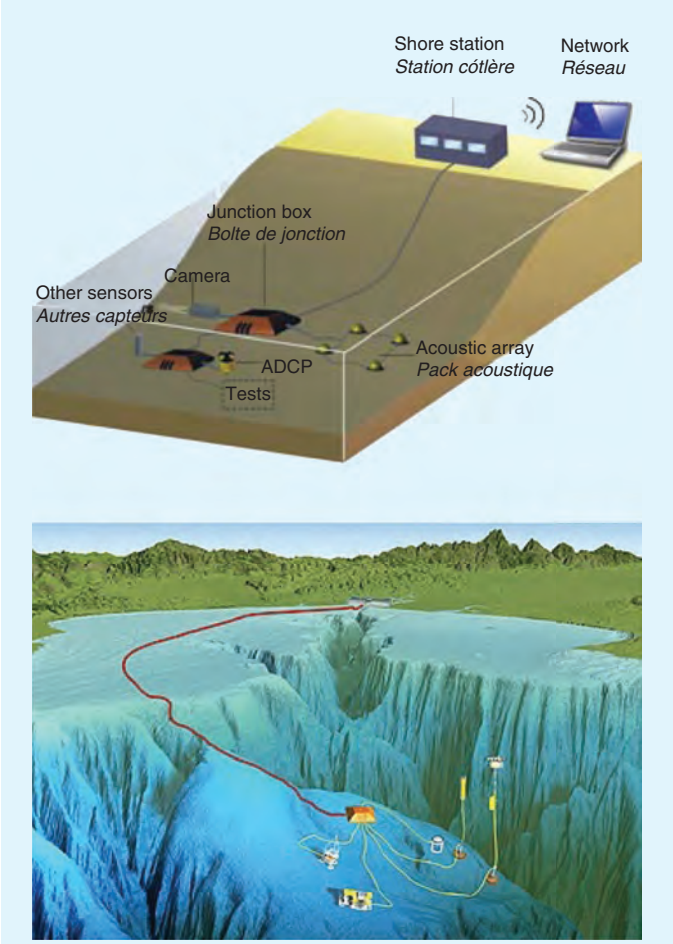



*Fig. 1—Example of the Medon underwater observatory and of a sensor network.*

applications, ranging from military concerns to applied science and oceanography research developments, have contributed to the rise of these technologies.

Furthermore the maritime environment is multi-media (underwater, surface and aerial), and so the robotic system must take advantage of these different media. Recently, collaborative underwater drones (AUV—Autonomous Underwater Vehicles) were deployed and tested within the COMET project (http://www.poleaph-mer-bretagne.com/comet01.php). To better sense the oceanic environment, AUVs must be associated with surface (ASV—Autonomous Surface Vehicle) and aerial (UAV—Unmanned Aerial Vehicles) drones. It has been shown that this coupling improved significantly the efficiency of the underwater operations and the data quality as well, especially when the AUVs are communicating between them. The capability of the robotized sailboat VAIMOS (http://en.wikipedia.org/wiki/Vaimos) to autonomously acquire oceanographic data at very shallow depths is a good example of complementary with AUVs (performing not so well close to the sea surface) The cooperation and the coordination of multiple robots, operating in air, at the sea surface and underwater, are the main research axis leading to a robotic system fully adapted to the complexity of the oceanic environment.

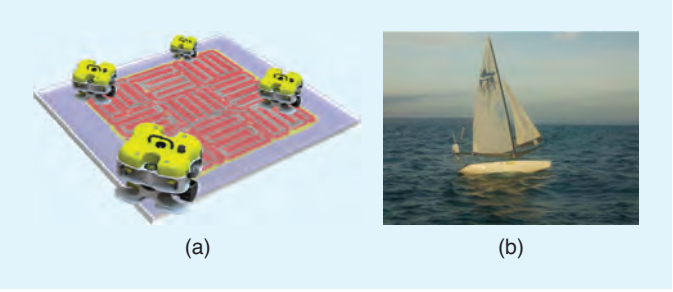



*Fig. 2—(a) Example of coordinated exploration with multiple AUVs (b) VAIMOS autonomous sailing boat conducting near surface oceanographic data acquisition.*

### c. … to coastal zones …

Two main challenges for underwater robotics are on-board energy and decisional autonomy. That is why ROVs (Remotely Operated Vehicles) offer a greater availability in shallow waters, not mentioning legal problems. The ROV being linked to the surface via a cable, there is no energy problem left, but the challenge of the robot autonomy and its ability to take decisions remain. A key element in this domain will be to develop a way to come up to a decision with incomplete information. In this regard, intermediate steps such as perception, obstacle avoidance, communication management, etc., are needed. One of the missions of the ROV is to send back a 3D view of the terrain. For such a task it must have special collaborative sensors on-board for allowing image reconstruction. Local techniques do not presently provide a global view of the zones near the coast, either for estuary monitoring or harbor surveillance.

Developments are underway for assessing the concept of a submarine sentry, with enough autonomy for being eventually deployed operationally, moving then from an ROV to an AUV platform.

### d. … and to the sky (and beyond)

Exploitation of high resolution satellite data is an essential part for many research works associated with the understanding of physical phenomena describing our environment such as the ocean and in particular the coastal zones where the phenomena are more complex due to the land/sea interactions. All weather, night and day capacity with high spatial resolution coverage is a trademark of SAR (Synthetic Aperture Radars) and provides an invaluable source of information. This technology is nowadays present in all coastal monitoring dealing with environmental concerns (for instance, CleanSeaNet services for the monitoring of marine oil pollution, within EMSA—European Maritime Safety Agency), maritime security (within GMES/COPERNICUS) and spatial oceanography.

The synergy with other data sources (other active sensors, passive sensors) complementing the processing methods and co-registering time/space access to data constitute a fundamental axis for the development of ocean observations. The availability of an extremely large amount of data, optical as well as radar, for a large scientific community will eventually increase our knowledge in these phenomena and will allow us to bring

*Fig. 3 – Example of ROV deployment and harbor surveillance.*

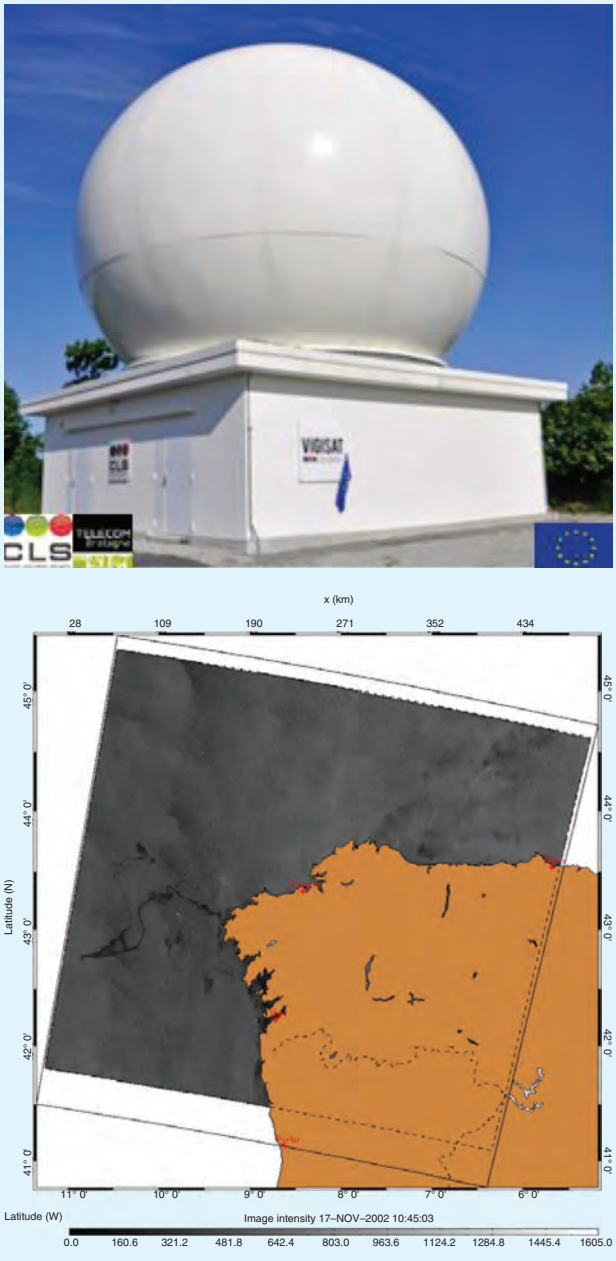



*Fig. 4 – The receiving ground station and a detected pollution.*

some advances in the climate change consequences. It means, of course, being able to manage these data.

Several research teams[2] are the founding partners of the GIS (Groupement d'Intérêt Scientifique) BreTel (Bretagne Télédétection; www.bretel.eu)—Scientific Cluster—Brittany Remote Sensing. The GIS was created with teams from the Brittany region, but one of its first goals is to bring the developments into a European context. Indeed the Brittany region is part of the European initiative NEREUS[3] (Network of European Regions Using Space technologies). The VIGISAT (www.vigisat.eu) project (a radar data receiving ground station), supported and carried by the GIS BreTel, and operated by the company CLS (Collecte Localisation Satellites) has been in place since 2009. Several very large research projects took advantage of an easy access to the data and were dedicated to marine thematic (wind, wave and current measurements, pollution and ship detection, …) as well as coastal and terrestrial zones: flooding, wet zones, …) and collaborative ones within the ESA scheme, such as MCGS (Marine Collaborative Ground Segment). They were set within the former European Frame Program (FP7—2007–2013) and are a solid ground for the newly coming one, "Horizon 2020"—2014–2020).

Finally, we also would like to thank all of our academic and institutional partners involved in the so-called "application fields":

- Ifremer (http://wwz.ifremer.fr/institut_eng/),
- European Institute for Marine Studies (IUEM – http://www.iuem.univ-brest.fr/),
- SHOM (Service Hydrographique et Océanographique de la Marine—http://www.shom.fr/),
- CETMEF (Centre d'Etudes Techniques Maritimes et Fluviales http://www.cetmef.developpement-durable.gouv.fr/).

We would also like to thank our main industrial partners:

- THALES SA, Brest;
- CLS (http://www.cls.fr/welcome_en.html);
- IXBLUE (http://www.ixblue.com/),
- ECA (http://www.ecagroup.com/index-en.htm?lang=en) with the support of the Brittany cluster of Excellence, Pôle Mer Bretagne (http://www.pole-mer-bretagne.com/ innovate-to-prosper.php).

## Endnotes

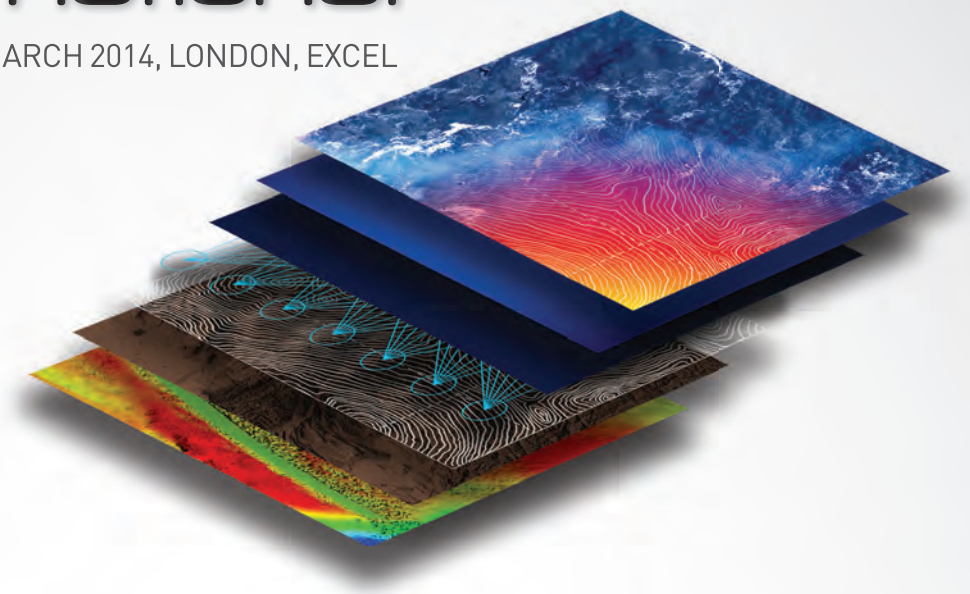
[1]Telecom Bretagne: http://www.telecom-bretagne.eu/index.php?lang=en_GB
Université de Bretagne Occidentale: http://www.univ-brest.fr/
Université de Bretagne-Sud: http://www.univ-ubs.fr/home-188100.kjsp?RH=UBS_FR&RF=UBS_EN
ENSTA Bretagne: http://www.ensta-bretagne.eu/
ENIB: http://www.enib.fr/index.php/en.html

[2]from TELECOM Bretagne, IFREMER, University Rennes 1, CNRS, University Rennes 2, Western Brittany University (Brest), INRIA, AGROCAMPUS-OUEST, University Nantes and MeteoFrance.

[3]http://www.nereus-regions.eu/

# Oi oceanology international® 2014

11–13 MARCH 2014, LONDON, EXCEL



# the global ocean forum

THE WORLD'S PREMIER EVENT FOR MARINE SCIENCE AND OCEAN TECHNOLOGY

## OCEANOLOGY INTERNATIONAL 2014 WILL FEATURE:

- 8 newly developed conference programmes covering the latest developments for key service and industry sectors
- The world's largest exhibition featuring over 520 exhibitors, 10% larger than the previous event
- A product demonstrations programme including more visiting vessels, on-water and waterside demonstrations than ever before
- Networking opportunities with your international peers across every related sector
- A new Innovation Zone featuring out-of-the-box technology ideas

## OCEANOLOGY INTERNATIONAL 2014 SHOWCASES SOLUTIONS FOR:

- Hydrographic Survey
- Geophysical Survey
- Geotechnical Survey
- Subsea Engineering Services
- Oceanographic Measurement
- Ocean Forecasting
- Metrology
- Navigation and Positioning
- GIS
- Marine Environmental Survey
- Marine Environmental Consultancy
- Coastal Engineering Consultancy

Register to attend for free at:

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Organised by: Reed Exhibitions®

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# OCEANS CONFERENCES

## Past Conference Locations

OCEANIC ENGINEERING SOCIETY

North America Europe


Asia - Pacific

CIRCLING THE GLOBE

### United States
San Francisco,CA
Los Angeles, CA
San Diego, CA
Honolulu, HA
Seattle, WA
Biloxi, MS
Boston, MA
Newport, RI
Kona, Hawaii
Providence, RI
Washington, DC
Hampton Roads.VA
Fort Lauderdale, FL

### Canada
Halifax, NS
Victoria, BC
Vancouver, BC
Quebec City, QC

### Europe
Brest, France
Bremen, Germany
Aberdeen, Scotlan
Santander, Spain
Bergen, Norway

### Asia -Pacific
Singapore
Kobe, Japan
Yeosu, Korea
Sydney, Australia

## Join Us at these International Conferences

### North America

**St. John's**
**Newfoundland**
14 -19 September 2014

**Washington**
**DC**
19-22 October 2015

**Monterey**
**California**
18-22 September 2016

**Anchorage**
**Alaska**
11-16 September 2017

### Europe

**Genoa**
**Italy**
19-21 May 2015

**Aberdeen**
**Scotland**
12-19 June 2017

### Asia - Pacific

**Taipei**
**Taiwan**
7-10 April 2014

**Shanghai**
**China**
18-21 April 2016

### Sites Under Consideration


**Want to Attend, Exhibit or Host an Ocean's Conference?**

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