OES BEACON

Newsletter of the Oceanic Engineering Society

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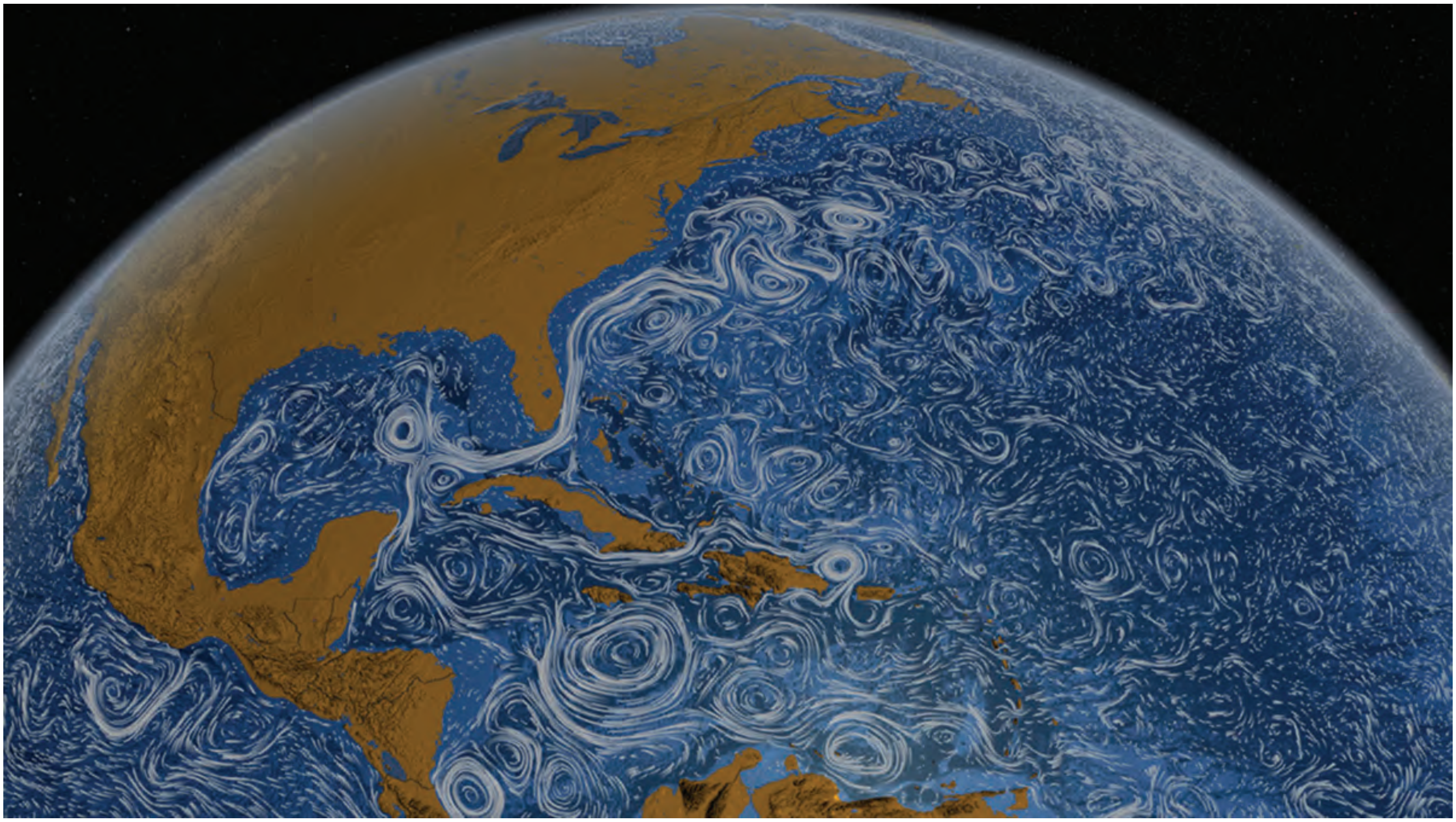

http://www.nasa.gov/topics/earth/features/perpetual-ocean.html

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Oceans '12 .... Cover

From the President

Congratulations to our newly elected ADCOM members for 2013 through 2015: James Candy, Jim Collins, Kenneth Takagi, John Potter, John Watson and Thomas Weiner. We had 10 outstanding candidates running for only 6 positions and our thanks to those candidates who were not successful this time.

It is with great sadness that we have lost our Editor-in-Chief of the IEEE Journal of Oceanic Engineering, Dr. William Carey, who passed away on July 11th. Bill was an extremely dedicated OES member and had previously served as Editor-in-Chief from 1992–1998 and again in 2011. Bill recently made arrangements for Jim Lynch to serve as the Editor-in-Chief until a new Editor can be elected at the ADCOM Meeting in October. Christian de Moustier and Robert Spindel have agreed to help Jim Lynch during this transition. The Boston University Website has an excellent summary of Bill's history and contributions including being the recipient of our Distinguished Technical Achievement Award as well as the Silver Medal from the Acoustical Society of America. He was a good friend to many of us and will be greatly missed. Our sympathy to Bill's family.

Our OCEANS Conference in Yeosu, Korea was a great success. The EXPO 12 on the OCEANS was also a sight to see and a great complement to the Conference. EXPO 12 runs until mid-August and is like a University on the OCEANS with its Pavilions and Exhibits. There are many students from countries around the world working in the Pavilions.

The Local Organizing Committee did an outstanding job organizing the Conference and the venue at the OCEANS RESORT will be difficult to beat. Our thanks to the Committee for their hard work.

Our BALTIC Symposium in Klaipeda, Lithuania in May was also very well organized and an excellent Symposium. The Symposium was conducted at the Klaipeda University which provided much support for the Symposium. We had very good participation of students who presented most of the papers and we had 39 student posters.

Our Study Day at the end of the Conference was one of the highlights with a visit to the bird sanctuary (The Ornithological Station at Vente Cape) and a trip to their pristine river delta (Nemunas Delta and Regional Park) which is a model for maintenance of river deltas. The River is allowed to flood each spring and replenish the Delta with nutrients and soil. We concluded the day with a visit to the Curonian Spit and the Parnidas Dune and Solar Clock where we were joined by the Ministers from Estonia, Latvia and Lithuania during their visit.

(continued on page 14)

In Memoriam

Mark Dwortzan, Reprinted from Boston University website

Professor William Carey (ME), 69, a leading researcher in the field of underwater acoustics, died Wednesday, July 11 at his home in Old Lyme, Connecticut after a long illness.

A professor in the Mechanical Engineering Department since 1999, Carey's research centered on the design and performance of underwater acoustic antennae known as arrays, which have been widely used in tracking enemy submarines and exploring the marine environment.

Carey's recent work on arrays focused on the development and demonstration of towed hydrophone arrays used to detect sound in shallow water coastal areas and ports. Overall, his array technology research contributed significantly to array design and calibration, at-sea array measurements and the understanding of how ocean and seabed environmental properties determine array performance.

Also a leading expert on ocean ambient noise, Carey conducted extensive studies of noise from breaking waves and the signal-to-noise ratio that towed and other arrays sense in the real ocean environment. In recent years he measured the ambient noise produced by micro-bubbles and bubble clouds resulting from sea surface activity, and helped determine that these clouds can optimally radiate and scatter low frequency sound.

In 2007 the Acoustical Society of America awarded Carey the Pioneer of Underwater Acoustics Silver Medal for his contributions to understanding ocean ambient noise and defining the limits of acoustic array performance in the ocean. At the time, only 16 other individuals had earned this distinction since the medal was introduced in 1959.

"Those who have the privilege of working more closely with Bill soon realize that there is a wealth of wisdom and experience in his flood of words, and a lot of scientific and engineering originality as well," James Lynch, a senior scientist at the Woods Hole Oceanographic Institute, said in introductory remarks for Carey's award ceremony. "That Bill's passion, experience, knowledge, and insight first gets expressed verbally is a stylistic thing—what is more important is that Bill's words are usually the prelude to some vigorous action, be it experimental, theoretical, pedagogical, advisory or editorial. Even at this senior stage of his career, Bill still actively goes to sea, works hands on with electronic and mechanical equipment, develops new mathematical theory and 'shows the students how it's done.'"

In reaction to the news of Carey's passing, Boston University Mechanical Engineering Department Chair and Professor Ronald A. Roy, who worked closely with him for over two decades, said, "A dedicated educator and consummate leader, Bill was a completely unique individual who possessed a broad spectrum of knowledge which he readily applied to a host of important scientific and national security problems related to oceanic engineering and underwater acoustics. He touched many lives over the course of a distinguished career and will be singularly missed by students, friends and colleagues."

Carey was a member of the Cosmos Club and Sigma Xi; a Fellow of the Acoustical Society of America and the Institute of Electrical and Electronics Engineers; recipient of the IEEE Oceanic Engineering Society's Distinguished Technical Achievement, Third Millennium and Distinguished Service awards; and editor emeritus of the Journal of Oceanic Engineering and an associate editor of the Journal of the Acoustical Society. Carey was also an adjunct professor of applied mathematics at the Rensselaer Polytechnic Institute and an adjunct scientist in applied ocean physics and engineering at the Woods Hole Oceanographic Institution.

He was born in Boston in 1943 but spent most of his youth in Germany. He attended Catholic University of America, where he received a bachelor's degree in mechanical engineering in 1965, a master's degree in physics in 1968 and a doctorate in 1974. After his doctoral work, he worked at the Argonne National Laboratory from 1974 to 1979. Over the next three decades, he worked for a number of different laboratories and agencies, including the Naval Research Laboratory, Naval Underwater Systems Center and the Defense Advanced Research Projects Agency, doing both ocean acoustics research and managerial work. He joined the BU faculty after a two-year stint at MIT's Department of Ocean Engineering.

Editor's Note: Bill served as Editor-in-Chief of the IEEE Journal of Oceanic Engineering (2011–2012), having served previously in that capacity (1992–1998). Bill also served as an elected member to the Administrative Committe for OES.

Welcome New and Reinstated Members

Martin Abdo	Bulgaria	Muna Alkaabi	United Arab Emirates
Nasir Ahsan	Australia	Maryam Rashad Alshehhi	United Arab Emirates
Go Akiyoshi	Japan	Yohan Ramos Antelo	Brazil
Jonathan Alexander	USA	Vandecasteele Arnaud	France

Jay Arnot	USA	John W. Hicks	USA
D. Balaji	India	Dan Bee Hong	Korea (South)
Sharbari Banerjee	India	Sean Graham Howell	USA
Robert Bares	United Kingdom	Shengwei Huang	Taiwan
Stuart Barrow	Australia	Weimin Huang	Canada
Frank A. Beal	USA	Mathieu Huchard	France
Ben Biffard	Turkey	Cory W. Huyssoon	USA
Anne Blavette	Ireland	Costin Ifrim	USA
Julien Bonnel	France	Andrew Igberaese	Nigeria
Richard Bowers	USA	Mahmud O. Ikharo	Nigeria
Arne Bredemeier	Norway	Tomoki Ikoma	Japan
Pjohannes (Jan) Buermans	Canada	Michael Iwuh	United Kingdom
Van Phuoc Bui	Korea (South)	Purnima Jalihal	India
Pablo Cacho	USA	Jonathan Jamesou	USA
Marcos Calahorrano	USA	Basanta Kumar Jena	India
Raymond H. Carlson	USA	Jianhua Jiang	Netherlands
Mike Cartusciello	USA	Leng Jianxing	China
Laurence Z. Chang	Taiwan	P.S. Kannan	India
Edward Chen	Taiwan	Thomas D. Kenny	USA
Jiewang Chen	China	Chee Houe Khong	Singapore
Jiahuan Cheng	China	Jinwhan Kim	Korea (South)
Abhra Roy Chowdhury	Singapore	R. Kirubagaran	India
Conor Conran	Ireland	Peeravit Koad	Thailand
Sherman Coonradt	USA	Jonathan Ryan Kovac	USA
Frank J. Daigre	USA	Christina Krejer	USA
Greg Darlington	USA	Jon La Follett	USA
Larry K. Davis	USA	Jian-Wu Lai	Taiwan
Ramon Deseo	Philippines	Peter Lakatos	Hungary
G. Dhinesh	India	Andrew K. Lammas	Australia
Trevor M. C. V. Do Carmo Dobbin	Brazil	Bryan Lawless	USA
Ken Du Vall	USA	Sanghean Lee	Korea (South)
Marian Duta	Romania	Taehwan Lee	Korea (South)
Ira Dyer	USA	Katrina Legursky	USA
Erdal Epcacan	Turkey	Xin Li	Chian
Atsuhito Ennyu	Japan	Sungyeop Lim	Korea (South)
Svein Erik Evju	Norway	Ying-Tsong Lin	USA
Ronan Fablet	France	Peng Liu	Japan
Gabriele Ferri	Italy	Joaquin Marzan Lopez	Philippines
Bin Fu	China	Ole Jacob Lorentzen	Norway
Spyridon Gianniotis	Greece	Shannon L. Lucas	USA
A.A. Gnanaraj	India	Sain Gee K. Man	United Kingdom
Andrew E. Goldstein	USA	Devin S. Matlock	USA
Geraint Goodfellow	United Kingdom	Takumi Matsuda	Japan
Jeremy Grant	USA	Ikuo Matsuo	USA
Jonathan Grimsdale	France	Francesco Maurelli	United Kingdom
Philip Grossweiler	USA	Lance R. McBride	USA
Linyi Gu	China	R. Menaka Menaka	India
Eggert E. Gudmundsson	USA	Laurie Ellen Meyer	USA
Ugur D Gul	Turkey	William A. Mildon	USA
Qili Guo	China	Kamran Mohseni	USA
Ravi Gurusamy	India	Motohiko Murai	Japan
John R. Hamilton	USA	P. Murugesh	India
Kevin Richard Hardy	USA	Rajesh R. Nadakuditi	USA
Peter Joseph Hardy	Australia	Hamidreza Nasiri	Iran
N. Veeran Haribalu	India	Phuc Van Nguyen	Korea (South)
Brian K. Haus	USA	James B. Nichols	USA
Jer Hayes	Ireland	Xing Yang Nie	China
Chengbing He	China	Yuri Antonio Nogueira	Angola

Premrudee Noonsang	Thailand	Hong Song	China
William T. O'Grady	USA	Kaichen Song	China
Naoki Okada	Japan	Ong Song	China
Pedro R. De La Torre Olazabal	Saudi Arabia	Ken Sooknanan	Ireland
Eduardo I. Ortiz	USA	B. Srinivasarao	India
Mehmet Ercin Ozgeneci	Turkey	D. Sudha	India
Matthew J. Palanza	USA	Xulia G. Suero	USA
Atanas Vastlev Palazov	Bulgaria	V. Suseentharan	India
Cheri Panasik	USA	Tomoki Takahoshi	Japan
Jeonghong Park	Korea (South)	Katutoshi Takeda	Japan
Moon-Jin Park	Korea (South)	Andrew George Taylor	Netherlands
Biren Pattanaik	India	K. Thilagavathi	India
Massimo Pellegrino	Italy	Keith Tice	Switzerland
Craig Allen Peterson	USA	Federico Traverso	Italy
S.V.S. Phanikumar	India	Joel Trubuil	France
Christodoulos A. Protopapas	Cyprus	Chinedu Ukazim	Nigeria
Wang De Qing	China	Murat Uysal	Turkey
Isabelle Quidu	France	Emmanuez O. Usah	Nigeria
N. R. Ramesh	India	Nikolas Valantassis-Kanellos	Greece
S. Ramesh	India	Robert Van Den Berg	Austria
D. Rajasekhar	India	Manoj Vasudevan	India
Vijaya Ravichandran	India	Jan Vegt	Netherlands
Shalaleh Rismani	Canada	R. Venkatesan	India
Lina Maria Rueda	USA	Pauline Vincent	France
K.V. Rupchand	India	Carmen Voicu	Romania
Kazuki Sakata	Japan	Fu-Tai Wang	Taiwan
M. Sankar	India	Ning Wang	China
R. Saravanan	India	Clarence M. Weaver	USA
D. Sathianarayanan	India	Randolf Erich Wenhold	South Africa
David J. Schmidt	USA	Shaun Paul Williams	New Zealand
Betsy Seiffert	USA	Peter Winsor	USA
M. Selvakumar	India	Li-Chung Wu	Taiwan
Ali Serpenguzel	Turkey	Can-Jun Yang	China
Jianguang Shi	China	Dana R. Yoerger	USA
Scott R. Sideleau	USA	Bolun Yuan	China
Allen R. Sirota	USA	Xiequing Yue	China
Nikolay Krasimirov Slavov	Bulgaria	Zheng Zeng	Australia
Jamal Yousuf Slsawalhi	USA	Jiayin Zhou	China
Samuel D. Somasundaram	United Kingdom	Zheguang Zou	China
Hee C. Song	USA		

Newly Promoted Senior Members

Senior Member is the highest grade for which IEEE members can apply. To be eligible for application, candidates must:

- be engineers, scientists, educators, technical executives, or originators in IEEE-designated fields;
- have experience reflecting professional maturity;
- have been in professional practice for at least ten years;
- show significant performance over a period of at least five of their years in professional practice.

Prospective members who would like to apply directly for Senior member grade should join IEEE and then submit the Senior member Application Form as an IEEE member number is required on the senior member application. There is no additional fee to apply for senior member grade. Visit www.ieee.org for more information.

The following members were promoted to the status of Senior Member in June. Congratulations!

Davide Anguita
Jeff Krolik
Kamran Mohseni
Harumi Sugimatsu

100th Anniversary of Titanic's Sinking

Joseph R. Vadus, Life Fellow, OES Past Vice President

This commentary paper provides the notes used first in interviews** by IEEE and then later interviews arranged by IEEE for others (Computerworld Magazine, Canadian TV, and Brazil Web Portal, Portogente). Since I was involved in the US—France Cooperative Program in Oceanography, as the US Leader for Marine Technology, Jerry Carroll, President, OES recommended me for the interviews by IEEE. The notes are presented in approximate chronological order first stating the situation in 1912 followed by technological improvements that could have averted the situation.

April 14, 1912, P.M.: The *Titanic's* lookouts spotted the iceberg 500 yds away. They tried to turn the ship away, but It was too late for such a large ship. Had they collided head-on, the ship may have survived. Instead, the ship sideswiped the iceberg and sheared the rivets holding the hull plates. The rivets were defective and failed because of sulphur content and were not able to withstand the shear forces at freezing temperature. The failed rivets parted the seams of the hull plates and exposed the water tight sections causing heavy flooding of each section along the way like pealing a banana and then forcing her bow down.

Today, modern ships have sonar that would have easily detected the iceberg because three quarters of a huge iceberg can be underwater. Most ships have surface surveillance radar that could have easily detected the iceberg at far greater ranges. Today's sonar and radar could have detected the iceberg tens of miles away, affording time to move the ship out of harm's way. Metallurgical analyses of the rivets revealed their deficiencies. Construction standards would not permit use of such rivets today.

April 14, 1912: *Titanic* received notification of icebergs in the area but they were not able to quickly affect the course of the ship. Communications were not sophisticated and radio operators were not on duty 24/7. There were no communications to provide distress signals without a radio operator on station. There was no alarm to alert a radio operator.

Today, ship and shore communications are more powerful and reliable and can receive and transmit alarms for ship warnings. Today's satellite communications systems provide reliable, long range communications. We now require round-the-clock, manned radio operation and the means for automatic distress signaling. Today there is an International Iceberg Watch System to distribute warnings of icebergs, location and drift.

April 15, 1912: Passengers were ill informed and not prepared for the pending disaster. There were insufficient life boats to accommodate the number of passengers. Those that made it on life boats had inadequate rescue or signaling aids, such as flares and radios.

Today, on board training and safety features are mandated including the number and capacity of life boats for each ship. Life boats now have rescue kits containing first aid, signaling devices and radios. In fact, personal mobile communications could be helpful.

April 15, 1912: *Titanic* breaks up as it sinks to the bottom. Once there, at 4,000 meters depth, her exact position is unknown, and there are no markers to aid location and possible salvage. There were no pressure tight compartments to withstand a water depth pressure of approximately 6,000 lbs per square inch, e.g., the weight of a truck resting on one penny.

Today ships, like aircraft, can be equipped with "black boxes" that provide a ship's operating parameters just before an accident; as well as automatic acoustic signaling to provide location. There are deep ocean acoustic transponders that can continually signal for long duration or else can be acoustically interrogated from the surface. This can provide needed information for retrieval and salvage.

Post April 15, 1912: There were no means to locate or retrieve *Titanic* or her constituent parts. Only rough navigation coordinates were available and nothing was accomplished for 73 years.

1985 and beyond: A joint mission under the US-France Program for Cooperation in Oceanography initiated a project to evaluate deep ocean survey systems at 6,000 meters. Joseph Vadus, NOAA and IEEE Fellow, was U.S. Leader for Marine Technology and Jean Jarry of IFREMER was France's leader administering several projects, one of which was this deep ocean survey project led by Bob Ballard of WHOI and Jean-Louis Michel of IFREMER. Both were at sea and credited with finding *Titanic* after many days of searching with the WHOI ship *R/V Knorr* and French ship *R/V Le Suroit*. The *Knorr* used the deep towed Argo ROV system equipped with video cameras and side looking sonar and their ANGUS (Acoustically Navigated Geological Underwater Survey) system for high resolution photography; and the *Le Suroit* used their Systeme Acoustique Remorque (SAR system) to provide acoustic information from two sonars, and a magnetometer. After many programmed traverses, the

Principals involved in the Titanic *discovery (l to r), Jean-Louis Michel, P.H. Nargeolet, George Tulloch, Captain de Frigate Dominique Girard, Joe Vadus, Anatoly Sagalevitch, Bill Garzke (Photo by Gloria Vadus)*

R/V Knorr, using the Argo system, finally discovered objects of *Titanic* on September 1, 1985.

In succeeding years, there were many *Titanic* visits using WHOI's manned submersible *Alvin* and Remotely Operated Vehicles (ROV's) equipped with advanced lighting, cameras and sonar. These visits were mainly for inspection, survey and mapping *Titanic* and her debris field. There were many visits by manned submersibles: IFREMER's *Nautile* and Russia's P.P. Shirshov Institute's *Mir-1* & *Mir-2*. There were many scientific and technological studies such as material analyses to assess construction failures, corrosion, microbial activity and deep ocean environmental survivability.

In 1994, the principals involved in the *Titanic* discovery and/or evaluation participated in a *Titanic* technical review session, "*Titanic*: Past, Present and Future" held at the IEEE/OES OCEANS 94 conference in Brest, France. The merits of the technology used in the visits to *Titanic* were presented. Each speaker gave a paper and then it was opened for questions. Over 100 attended and there was standing room only. These were the speakers and principals involved with the *Titanic*:

1) Jean-Louis Michel of IFREMER was on board the WHOI Ship Knorr with Bob Ballard when they found the *Titanic* in September 1985, as noted in their Joint paper.
2) P. H. Nargeolet, Pilot of IFREMER's Submersible Nautile; He piloted the first dive on *Titanic* in 1986.
3) George Tulloch, President of RMS *Titanic* Inc.was involved later in collecting *Titanic* artifacts even though Bob Ballard and some others sought US legislation to prevent collecting.
4) Captain de Frigate Dominique Girard, French Navy retired and with IFREMER.
5) Joe Vadus, NOAA and IEEE Fellow, was US Chair on the US-France Cooperative Program in Oceanography. Finding *Titanic* was one of six projects that year, and it was called "Evaluation of Deep Sea Survey Equipment." J. L. Michel and Bob Ballard were the project leaders for that project. It was planned for the Azores but Ballard, being a history buff, preferred testing about 400 miles off New Foundland (the probable location of *Titanic*). With OES President Joe Czika's encouragement, J. Vadus organized and Co- Chaired the session with D. Girard.
6) Anatoly Sagalevitch, Principal Pilot for Russian submersibles Mir-1 & Mir-2. He piloted many visits around *Titanic.*
7) Bill Garzke, Architect at Gibbs & Cox, Inc. conducted studies and analyses of the structural failure of *Titanic*. He identified the problems with the hull's plate rivets that were sheared away by sideswiping the iceberg. The rivets material composition was faulty and shear strength was greatly reduced by the freezing water temperature.

"*Titanic* Expedition 2010" conducted by WHOI using specially equipped ROV's and Autonomous Undersea Vehicles (AUV's) with sonars and 3D cameras enabled high resolution investigations. Advanced imaging data in combination with other imaging sources led to the ultimate data collection and resulting archeological map presented in the April 2012 issue of National Geographic Magazine, marking the 100th Anniversary of *Titanic's* sinking. Participating organizations included WHOI, NOAA, National Park Service and RMS *Titanic* Inc, (RMST) and others.

All of the equipment, instrumentation and standards used over the last 25 years in *Titanic* search, survey, analyses and for education have roots in many of the committees and engineers of the Institute of Electrical and Electronics Engineers (IEEE), too numerous to mention. There are many studies, publications and videos produced by many organizations too numerous to mention.

Brazil Interview: Questions by Rosangela Ribeiro, Brazil; and Answers below

Q1–Considering the technologies available nowadays, why do ships still sink?

A1–Despite excellent technology, the main reason for ship accidents at sea (and sinking) is human error. Approximately 50 % of ship accidents are due to human error.

Q2–What are the factors which led to the sinking of the RMS *Titanic* and how it could have been avoided?

A2–One of the main reasons was lack of operating procedures in a dangerous area. *Titanic's* lookouts saw the iceberg 500 yards away, too late to turn the huge 46,000 ton ship out of harm's way. Prior to that the ship's radio operators used the radio for other priorities such as personal communications, stock reports, etc. There were no emergency procedures for ship operators. Operators were off duty at times and no alarms could be transmitted or received. Better precautions should have been taken in this dangerous zone. Reducing ship's speed and using searchlights could have helped.

Q3–What's the role played by human errors in today's technological landscape?

A3–Despite advances in technology, human errors will always prevail. There are efforts to minimize human error by providing redundant controls and independent alarms to alert operators. However, it may not be possible to claim that human error is not possible just like they claimed that *Titanic* was unsinkable.

**** Interviewers were**

- Elizabeth Levit, Finn Partners, representing IEEE Publicity
- Sharon Gaudin, Senior Writer, Computerworld; Telephone Interview
- Owen Donnelly, IEEE Public Visibility team and Lucas Ferreira, IEEE Brazil team
- Rosangela Ribeiro, Editor of the web portal Portogente and website of the São Paulo State Engineer's Union
- Juliya Sotska, Canadian TV News; Sarika Sehgal, Newscaster—Live Interview

Chapter News

Seattle

The Seattle Section OES generally holds joint meetings with the Puget Sound MTS and Seattle Hydrographic Society. This joint meeting arrangement has been in place since the section's inception over 25 years ago. These meetings are currently held at the Ocean Sciences Building, U. of Washington, Seattle Campus, generally on the 3rd Thursday of the month, except for summers. Some separate meetings have been held, and joint meetings with the NW Acoustical Society as well, as a number of members are in both societies. The Chair is Skip Denny, Vice Chair is Tom Ott, and Secretary/Treasurer is John Hager. In the spring of 2012, several meetings were held:

February: the speaker was Richard Tarbill of the Ocean Adventure Racing NW (OAR) with a talk on "Adventure Learning and Research" as they take their 4-man rowing boat and equip it with an ocean sensor suite and refocus from cross-ocean racing to gathering oceanographic data while adventuring to stimulate youth. This spring they circumnavigated British Columbia's Vancouver Island and fed the data back to the NANOOS system for display. They discussed the technology used to gather and transmit the data.

March: the speaker was Pacific Northwest Lab's Dr. Andrea Copping on the topic "Environmental Effects of Ocean Energy Development: Opportunities and Challenges". PNNL has been at the forefront of examining effects of EMF on fish and an active discussion resulted about relative EMF field strengths, minimum fields to see observable effects on fish and public policy and permitting policies.

April: USCG Sector Puget Sound Joint Harbor Operations Center Tour. A tour of both the Vessel Traffic System (VTS) and Search and Rescue (SAR) facilities for all of Puget Sound. Our Guide, a duty Ltjg., filled us in on the technology used, the mission and the operational constraints for these 2 side-by-side facilities.

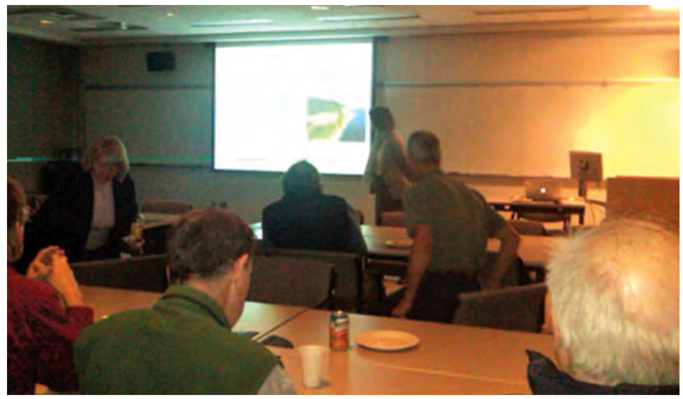
May: An Overview of the MATE ROV Challenge, conducted a week earlier. The Seattle Section OES is a co-sponsor of the regional event and several members were participating as judges and divers. At the meeting, the guests were the UW team that formed only 4-months before, built a vehicle and qualified for the international competition in Florida next in June. Seattle will host the international competition in 2013, and the tasking theme will be on the Ocean Observatories Initiative (OOI) Regional Scaled Nodes (RSN) program that is instrumenting the Juan de Fuca plate for both water column and seafloor. RSN uses ROVs extensively for their operations.

June: an annual social event is scheduled on board Ross Lab's M/V Golden Dolphin. OES/MTS take the summer off, as that is field work season for most of us. Meetings will resume in October.

Victoria

Dr. James S. Collins

The Victoria IEEE OES Chapter held two technical meetings in 2011 up to November.



The first meeting was based on the 5th Annual IEEEEXtreme Competition and lasted twenty four continuous hours. The participants were present for most of that time. This event was run jointly with the University of Victoria IEEE Student branch and the Univ. of Victoria Computer Science Department. Although the event was organized on a world wide basis by the IEEE Computer Society, Jim Collins, local OES Chapter Chair felt it would be relevant for the Chapter to get experience running worldwide competitions over the internet in preparation for conducting AUV races at remote locations tied together by the internet. A total of 1515 teams of up to three members each participated worldwide.

The Univ. Of Victoria teams and their standings were:

Rank	%tile	Team name
44	97.1	IslandVikingCoders
166	89.0	CodeMonkeyCrusaders
213	85.9	MonkeyIslandTemplars
251	83.4	GracefulCoders

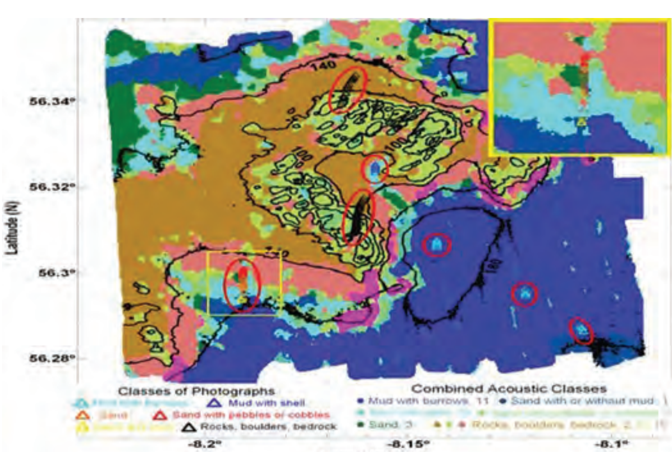
The proctors were local IEEE Members and University of Victoria faculty, Jim Collins, Jianping Pan, Sudhakar Ganti, and Kui Wu.

The Competition was open to IEEE Student Members and Graduate Student Members. The event generated six new student memberships which were subsidized by kind offers from

Broadspectrum Consulting and Kelly Manning. For more information on the competition results see www.ieee.org/xtreme.

The second meeting was held on Tuesday, November 8rd. when Jon Preston, Senior Scientist with Quester Tangent in Victoria, presented a seminar titled, "Mapping seabed sediments acoustically." Jon is a Senior member of the OES and formerly a Defense Scientist with the Defense Establishment Pacific in Victoria. He is frequently a tutorial instructor at OCEANS Conferences and also is an Adjunct Professor at the School of Earth and Ocean Sciences at the University of Victoria. This seminar gave highlights of his tutorials and information on some recent projects.

Jon showed how any fisherman with a scrolling echo sounder can see that seabed echoes contain more information than just travel times. Hard rough seabeds reflect strongly, for example, and muddy bottoms have long echoes due to backscatter from within the mud, with the resulting longer path lengths. Observations like these have been used for years to seek fish and to avoid areas that might rip nets. Quester Tangent Corporation (QTC) classification software suites are, in essence, expert systems that classify seabeds from acoustic echoes. They map seabed acoustic character from echo time series of single-beam sounders and images from multibeam and sidescan sonars. Two techniques are popular in both commercial and academic circles: inversion and phenomenological. Strengths and limitations of both were presented. A sample of the type of seabed map produced is shown below.



India

Dr. M.A. Atmanand, Director,
National Institute of Ocean Technology

I am happy to inform that NIOT team under me has won the National Geo Science Award for excellence of the Ministry of Mines, Govt of India in the category of Oil and Natural Gas Exploration, for Remotely Operable Vehicle.

The web link is: http://mines.nic.in/index.aspx?level=1&lid=112&lang=1

(After opening the link, click Awardees 2010)

Sl. No.	Name	Field
1	Dr. M. A. Atmanand	Oil & Natural Gas Exploration
2	Dr. G.A. Ramadass	Oil & Natural Gas Exploration
3	Dr. Sethuraman Ramesh	Oil & Natural Gas Exploration
4	Shri Joseph Manecius Selvakumar	Oil & Natural Gas Exploration
5	Shri Annamalai Subramanian	Oil & Natural Gas Exploration
6	Dr. Dharmaraj Sathianarayanan	Oil & Natural Gas Exploration
7	Shri Raju Ramesh	Oil & Natural Gas Exploration
8	Shri Gopalkrishnan Harikrishnan	Oil & Natural Gas Exploration

****

The Executive committee comprising the following Office Bearers and members started functioning with effect from 5th January 2012.

Office Bearers

Chairman: Dr. M. A. Atmanand, Director, NIOT Chennai
Vice-Chairman: Prof. R. Bahl, IIT Delhi
Secretary: Shri. Shibu Jacob, NIOT Chennai
Treasurer: Dr. G. A. Ramdass, NIOT Chennai

Members

1) Dr. P. R. S. Pillai, CUSAT (Past Chairman)
2) Dr. Arun Kumar, IIT Delhi
3) Dr. Srinivas Chamarthi, Kurukshetra University.

On behalf of the Executive Committee of OES India Chapter for the year 2010–2011, I wish to place on record our heartfelt gratitude and sincere thanks to all the members of OES India Chapter for all the support and cooperation rendered for the effective organization and conduct of the chapter activities.

I am certain that the new Executive Committee under the stewardship of Dr. Atmanand, Director, NIOT Chennai can take the OES India Chapter to Much Greater heights.

On behalf of the Past Executive Committee and also on my behalf, I take this opportunity to wish the best in all the professional endeavors of the OES India Chapter.

Prof.(Dr) P R Saseendran Pillai
Department of Electronics
Cochin University of Science & Technology

Singapore

Chia Chin Swee, Chair OES Singapore

The OES Singapore Chapter has organized the second annual technical workshop and exhibition for all our members on Oct 21st

Participants, presenters and exhibitors at the OES Singapore-TMSI workshop 2011.

at the Tropical Marine Science Institute (TMSI), National University of Singapore. The objective is to promote knowledge sharing and interactions among the local OES members, research institutes and industries on topics related to Oceanic Engineering, as well as to hold the Annual OES Singapore General Body Meeting.

A total of 8 talks were presented by speakers from SALT, Konsberg, CENSAM, Acoustics Society of Singapore, Acoustics Research Lab and Singapore Polytechnics. Particularly, the OES Singapore also presented our proposed plan for a local AUV competition to be held in 2013. Five local companies had also exhibited their products during this workshop. A general body meeting for OES Singapore Chapter was held after the workshop, followed by a BBQ dinner for all the participants.

This event was co-host by TMSI, with the sponsorships from the following companies, namely: Sea and Land Technologies Pte Ltd, Thales Singapore Pte Ltd, ST Electronics (Info-Comm), and Konsberg.Maritime Pte Ltd. We are also thankful to the organizing committee for this event (Rubaina, Venu, Teong Beng, GaoRui, Bernard How, Mandar, Ma Ning and Fikret).

Activities Organized by IEEE OES Singapore Chapter

Reported by Chapter Chairman: Dr Ning Ma

26 June 2012

The summarization of the activities we organized in this year is following. The upcoming event is Industry Workshop Cum with a Technical Seminar, a General Meeting, and a Social event in Oct 2012. We are under preparation.

1) Two Executive Committee meetings in Jan and Mar for kick-off the work in 2012 and discussion of the possible events to be organized, and especially the AUV competition preparation.
2) Three technical seminars were organized in Jan, March and May respectively and the detailed information is listed below.
   a) "Acoustic Signal Processing", presented by Prof. Oliver Hinton from Newcastle University, UK, 19 Jan 2012, at NUS Singapore
   b) "Pervasive Underwater Sensing for Maritime Security", presented by Mr Chia Chin Swee, DSO National Laboratories, Singapore, 30 March 2012, at NUS Singapore
   c) "Finite Element Modeling in Ocean Acoustics", presented by Marcia Isakson from Applied Research Laboratories, The University of Texas at Austin, USA, 18 May 2012 at NUS Singapore

3) One social event was organized in 31vMarch at West Bowl to promote networking. 12 members with 4 family members participated the bowling event. The photos below are taken during the event.
4) Preparation for AUV competition. An organization committee has been formed, call for participate has been sent out to local universities and institutes, and a bank account has been opened. Certain sponsorship has been allocated. The preparation work is still going on and the event will be held in March 2013.

Shanghai

Carol Cai

On the 12th May, a Workshop on Ocean Science and Information Technology was held in the Faculty Club of Shanghai Jiao Tong University, Shanghai. This workshop is a joint event held

by IEEE OES Shanghai Section Chapter and IEEE Xi'an Section SP Chapter. 46 Professors, engineers and students joined this workshop including 27 IEEE members. Prof. Tamaki Ura, IEEE fellow, Prof. Huang Jianguo, Chair of IEEE Xi'an Section & IEEE Xi'an Signal Processing Chapter, Prof. Xu Wen, Vice Chair of IEEE Shanghai Section OES Chapter, Prof. Chen Ying, Chair of Department of Ocean Science and Engineering, Zhejiang University and Prof. Lianlian, Chair of IEEE Shanghai Section OES Chapter gave the wonderful speeches listed in the below agenda.

Topic	Speaker
Opening Welcome	Prof. Lian Lian, Shanghai Jiao Tong University
Platform for Deep Sea Observation-Application of Autonomous Underwater Vehicles	Prof. Tamaki Ura, IIS. The University of Tokyo
The Development of Underwater Acoustic Communications	Prof. Huang Jianguo, Northwestern Polytechnical Universyity
Recent Progresses on Applications of Time-Reversal Acoustics	Prof. Xu Wen, Zhejiang University
Z_2ERO—ZJU-ZRS Island Experimental Research Observatory	Prof. Chen Ying, Zhejiang University
Recent Researches on Deep Sea Technology & Equipment Development	Prof. Lian Lian, Shanghai Jiao Tong University

Canadian Atlantic Chapter

Dr. Ferial El-Hawary, P.Eng., F.IEEE, F.EIC, F.MTS
IEEE/OES Canadian Atlantic Chapter—Chair

2011 was quite busy with two major events, we are happy that we have managed to engage Engineering Students in a project that is relevant to the technical field of interest of the IEEE/OES Society. Here are our activities during the year 2011.

Joint Event with MATE. The Marine Advanced Technology Education (MATE) Center coordinated an International Student Underwater Robotics remotely operated vehicle (ROV) competition and a network of 20 regional ROV contests that took place across U.S. and in Canada, Hong Kong, Scotland, and Japan. Student teams from upper elementary, middle schools, high schools, home schools, community colleges, universities, and community organizations, such as the Boys and Girls Club and 4-H, participate. The competitions consists of three different "classes" that vary depending on the sophistication of the ROVs and the mission requirements.

This year the Nova Scotia Regional ROV Competition took place at the Halifax Centennial Pool, Halifax, Nova Scotia on Saturday, May 14, between 10:00 am–5:00 pm.

Teams from Auburn Drive High School, Dartmouth High School, Dalhousie University's Faculty of Engineering Students and the Nova Scotia Community College took part in the event. The public was welcomed to view the underwater competition. This event was well attended and Many thanks to Peter Pearl (IEEE/OES member) who was the competition coordinator

Joint Event with RM/IM Chapter. This event was in the conjunction with the IEEE Canadian Atlantic Section Annual General Meeting and Dinner. This was well attended. Mr. David Hopkin of DRDC Atlantic gave a talk on "The Application of AUVs in Support of the Canadian Submission to the United Nations Convention on the Law of the Sea (UNCLOS)". The event was held at the University Club, Dalhousie University on Friday, December 2, 2011.

It is my pleasure to report that since April, 2012 the IEEE/Oceanic Engineering Society Canadian Atlantic Chapter has hosted two successful major events attended by members of the Lambda Theta Students Honours Society Chapter of Eta Kappa Nu at Dalhousie University. The Chapter is the first in Canada (Region 7) and the third outside (Regions 1-6) the USA. In attendance also were members of the Oceanic Engineering Community in the Halifax Regional Municipality such as Rolls

Royce Navy Canada, MacDonal Detwiler Associates (MDA) and Gray-Bar Canada.

The topic of the first event held on April 18, 2012 at Marriott Halifax Harbour-front Hotel was "Marine Renewable Energy-Building an Industry". The invited speaker, Mr. James Taylor, President of Quadrule Services Inc., who has led many of the efforts of NS Power in transforming their power generation away from carbon based fuel sources and exploring renewable options including tidal energy as well as carbon capture and storage, to lead to a more balanced portfolio. Partially as a result of those efforts, while energy demand increased, NS Power was able to reduce green gas emissions by 13 per cent.

Tidal/Marine Renewable Energy offers Canada a unique leadership opportunity, and James chaired development of the Technology Road-map for Marine Renewable Energy for Canada due to be released shortly.

The presentation emphasized history and lessons learned from the first deployment in the Bay of Fundy. He also outlined Canada's Technology Road Map for Marine Renewable Energy and its implementation and the opportunities for industrial development in Atlantic Canada.

The topic of the second event held at Marriott Halifax Harbour-front Hotel on Friday, June 15, 2012 was "Shipboard Electrical Engineering Design Challenges and Recommendations" with Mr. Moni Islam as distinguished speaker of the IEEE Standards Association, and President, M&R Global, and a Marine Electrical Consultant. The Lunch Round Table Discussion led by our guest speaker discussed the current state of development of energy-efficient electric propulsion system and its power quality issues. Members of local industry discussed potential solutions and mitigation directions. The Dinner Presentation addressed the fundamental challenges of modern ship electrical system design and how to coordinate design aspects with the requirements of speed, reliability, economy and energy efficiency.

The speaker has 38 years of diverse experience in ship electrical system design, implementation, commissioning and testing is a major contributor to IEEE Standards on Ship Electrical Systems. He has given some recommendations to Mitigate Design Challenges, Role of IEEE-45 Standards Working Group, and also recommended more Industry side Participation in the standards process.

Please note that: All the Speakers Slides Presentations are available at the Website: http://cas.ieee.ca/

On behalf of 2012 the IEEE/Oceanic Engineering Society Canadian Atlantic Chapter's memberships I would like to express my sincere thanks to the speakers who devoted their time to share with us their experience, to the members who attended and added more success to these events. Moreover, many thanks to the IEEE/Oceanic Engineering Society and the IEEE Standards Association for their financial support.

New South Wales

Dr. Brian Ferguson

Our first technical meeting this year, scheduled for Thursday 23rd August 2012, will be in the Engineers Australia Auditorium in the Sydney suburb of Chatswood. We normally discuss administrative matters after the technical meeting over dinner in a nearby restaurant. An abstract for this meetings talk follows.

Abstract—The underwater vehicle spectrum has the autonomous undersea glider at one extreme (simplicity) and the submarine at the other (complexity). This presentation considers the principles and practice of passive acoustic sensing of the underwater environment by an undersea glider on one hand and a submarine on the other. Fleets of gliders are currently being used by oceanographers to sample the properties of the oceans on spatial scales that range from ocean basins, through mesoscale eddies, to microscale turbulent dissipation. A glider's small sensor payload and limited power budget constrains any passive sonar capability onboard a glider to having just one sensor (hydrophone). The slow speed of advance of the glider and its quiet operating mode mean that both the platform noise and the flow induced noise at the hydrophone output are negligible. The hydrophone measures the ambient underwater noise, which complements the glider's in situ measurements of the seawater conductivity and temperature depth profiles that form input data sets to underwater sound propagation models. Using real data, it is shown that a single hydrophone can also be used for tactical surveillance of the maritime domain and for self-protection of the glider against ship strike. A more elaborate approach is required for submarines because, when submerged, they acquire practically all of their wide-area surveillance and situational awareness information by sampling and processing the outputs of multiple hydrophones. Submarines bristle with underwater acoustic sensors, which are configured as arrays, both hull-mounted and towed. Arrays of hydrophones are used to detect weak acoustic signals, to resolve closely-spaced sources, to estimate the bearing and other properties of signal sources and to identify the spatially correlated components of self-noise. Again using real data, the benefits of improved sonar system performance that accrue through the use of optimal array signal processing methods are highlighted. These benefits include a maximum signal-to-noise ratio at the array output, superdirective array gain, automatic null steering for suppression of strong interference, minimisation of spatial leakage (sidelobes), and towed array shape estimation during a submarine manoeuvre. Optimal array processing algorithms are also adaptive in that they dynamically vary the complex shading weights of the spatial filter to maintain optimal array performance despite the components and characteristics of the underwater noise field continually changing during the submarine's mission. These benefits come at the expense of an increased computational load for the array processor and little tolerance of sensor phase

For our second meeting on Wed 14th November 2012, the Sydney OES members have been invited to present at the Engineers Australia Auditorium in Newcastle (3 hour drive north from Sydney CBD) by the Newcastle Electrical Branch of Engineers Australia. This is in response to the Newcastle Branch conducting an online survey of its members to gauge interest in a number of topics for their technical program.

IEEE AUV 2012 Conference

Dr. Maaten Furlong

Every two years the Oceanic Engineering Society (IEEE-OES) sponsors a collaborative conference to bring together those working in the field of autonomous vehicles for ocean applications. In 2012 this diverse group from around the world will meet at the National Oceanography Centre in Southampton, England—the first time an IEEE-OES AUV conference has been to the UK.

The theme for this conference is Persistent Presence. It is a sign of the increasing maturity of autonomous vehicles that users are now demanding longer mission durations as well as higher levels of autonomy and sensor capability to make most effective use of the technology. Persistent Presence brings challenges in many areas, including energy storage or extraction, propulsion systems, payloads, command, control and autonomy, reliability and provision for redundancy in mission and concept design. Papers on these and other topics related to Persistent Presence are welcome.

The main conference will take place on 25 & 26 September 2012 and tutorials will take place on 27 September 2012. To submit an abstract, please visit www.auv2012.org to register, the deadline for submission has been extended to the 8th of June 2012.

From the President *(continued from page 3)*

The OCEANIC ENGINEERING SOCIETY—IEEE AUV 2012 (Autonomous Underwater Vehicles Conference) will be in Southampton, UK 24–27 September 2012. There will be many good papers presented on the latest technology on AUVs. The AUV Conference is always a great success. Our fall OCEANS Conference -OCEANS' 12 MTS/IEEE Hampton Roads—October 15–18 should be another in the long tradition of excellent OCEANS Conferences. The Local Organizing Committee is working hard to provide the attendees with a good technical program and many opportunities to network with ocean scientists and engineers. Our last major conference of the year will be our 2012 ATC (Arctic Technology Conference) in Houston, 3–5 December. We will also be participating in the 2012 Mast Conference in Malmo, Sweden 11–13 September.

With "Open Access" making changes to the publishing business for technical journals there will be some major changes made by IEEE. Please pay careful attention to the latest news releases from the IEEE.

Jerry Carroll,
OES President

Visit www.auv2012.org

Oceanic Engineering Society - IEEE AUV 2012

Autonomous Underwater Vehicles 2012
24 - 27 September 2012

HOME PROGRAMME GALLERY COMMITTEE CONTACT

AUV 2012 INFORMATION

- Login | Sign up
- Abstract submission & Tutorial proposal (login needed)
- Paper submission (login needed)
- Registration
- Tutorials
- Venue information
- Accommodation
- Things to do
- Links
- Award nomination

IMPORTANT DATES

Abstract submissions

Submit abstract here... from Monday 30 January 2012

Submission of abstracts deadline

Friday 25 May 2012

Notification of acceptance by

Friday 15 June 2012

Submission of full papers by

Friday 10 August 2012

NEWS

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Information for Sponsors and Patron's packages
Please contact us here.

Welcome to AUV 2012

24 - 27 September 2012 - Southampton, UK

Every two years the Oceanic Engineering Society (IEEE-OES) sponsors a collaborative conference to bring together those working in the field of autonomous vehicles for ocean applications. In 2012 this diverse group from around the world will meet in Southampton, England - the first time an IEEE-OES AUV conference has been to the UK.

The theme for this conference is *Persistent Presence*. It is a sign of the increasing maturity of autonomous vehicles that users are now demanding longer mission durations as well as higher levels of autonomy and sensor capability to make most effective use of the technology. Persistent Presence brings challenges in many areas, including energy storage or extraction, propulsion systems, payloads, command, control and autonomy, reliability and provision for redundancy in mission and concept design. Papers on these and other topics related to Persistent Presence are welcome.

AUV 2012 also offers a number of social events for connecting up with old friends, building new links, exchanging ideas and collaborating on future efforts. Industry, Military and the Research Community are all represented along with some key components from state of the art manufacturers. An outline programme is given below.

Special thanks to our patrons and sponsors:

IEEE · OES · SUT Society for Underwater Technology · National Oceanography Centre Natural Environment Research Council · KONGSBERG · HYDROID A KONGSBERG COMPANY · ocean business 13 · RS AQUA · TELEDYNE RD INSTRUMENTS A Teledyne Technologies Company · EdgeTech · seebyte

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Not a member? You can get a discount on this and other IEEE conferences by joining. It's easy to do, helps the community, connects you with peers and offers a long list of additional benefits.
Go to: Membership to find out more.

Outline Programme

Monday 24 September
Icebreaker Welcome Drinks Reception - *White Star Tavern, Oxford Street* - Early Evening

Tuesday 25 September
Conference Day 1 - *National Oceanography Centre, Southampton*
Gala Dinner - Venue TBC

Wednesday 26 September
Conference Day 2 - *National Oceanography Centre, Southampton*

Thursday 27 September
Tutorials - *National Oceanography Centre, Southampton*

OCEANS'11 MTS/IEEE Kona Conference

The OCEANS'11 MTS/IEEE Kona conference was held September 19–22, 2011 at the Hilton Wailoloa Village in Kona, Hawaii. The following photos from that event capture some of the highlights.

Cadets from the Massachussets Maritime Academy assisted with several events at the conference. Pictured with OES President Jerry Carroll (l to r) are: Peter Gels, Michelle Pare, Julie Shebroe, Corey Stewart. Photo: Matthew Gelis

After the conference the cadets sent a thank you letter which is reprinted below:

To President Jerry Carroll and the OES,

Thank you so much again for your kindness and generosity, which has allowed us to attend the Oceans '11 MTS/OES Conference in Kona, Hawaii. We are all so thankful for this wonderful learning opportunity that we have been provided with, as it has opened our eyes to new and exciting innovative technology that we would have never known to exist had it not been for our attendance at the conference. Each of us has taken a new interest in ocean engineering and the machinery that it relates to. We all hope that sometime in the future we will be able to attend another Oceans Conference, whether it be as a speaker, a poster presenter, a booth representative, or a committee member. This experience is one that will not be forgotten, thanks to you and your support.

Prior to the conference an Educator's Workshop was held in Hilo, Hawaii. Five Islands were represented—Oahu, Maui, Molokai, Kauai, and Hawaii. The big island was well represented with teachers from all areas of Kona to Hilo.80% of participants were "first time" users of the technology. The Pacific American Foundation partnered to pay for teachers to fly in for the session. Of the 28 participating educators—12 were from high schools, 3 from intermediate schools and 5 were from the elementary level. The balance were Keck Educators, an Adult School teacher, and 4H coordinators.

Raytheon Company donated an HDTV to the Big Island School.

West Hawaii Explorations Academy middle school and high school students toured the Oceans '11 MTS/IEEE Kona Trade Show.

Oceans 2012 Yeosu

Photos by Stan Chamberlain and Ferial El-Hawary

The MTS/IEEE OCEANS 2012 Yeosu Conference and Exhibition was held May 21–24 at the Ocean Resort in Yeosu, Republic of Korea. Jointly sponsored by IEEE/OES, the Marine Technology Society, and the Korean Association of Ocean Science and Technology Societies, the theme of the conference was *The Living Ocean and Coast—Diversity of Resources and Sustainable Activities.*

Jung-geuk Kang, President of the Korea Ocean Research and Development Institute addresses the plenary session.

The Ocean Resort provided a scenic venue for the conference.

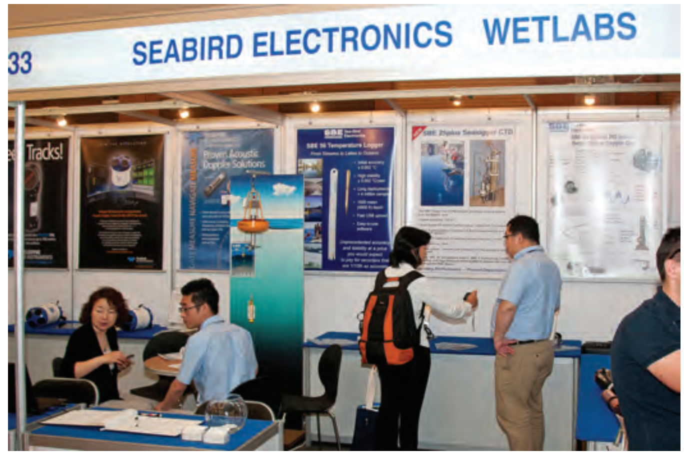
Plenary session speakers.

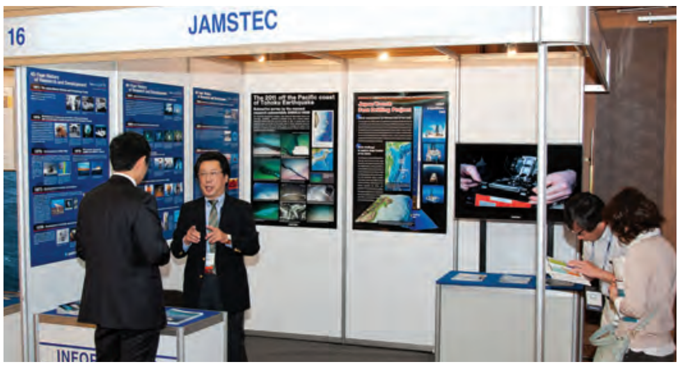
Rice paddies near the conference.

The welcome reception is a golden opportunity to see old friends and make new ones.

Twenty three student posters were on display.

Technical sessions and workshops enabled the free exchange of the latest developments in a wide variety of topics.





Numerous exhibition booths displayed products and services from a several companies and organizations.

Philippe Courmontagne was persuaded to show that scientists and engineers can have an artistic side as well.

Entertainment at the Gala Dinner.

The Gala Dinner is always a special occasion where new and old friends and colleagues come together for a great meal.

Student Poster Competition

Norman D. Miller, OES Student Activities Coordinator

The 30th Student Poster Program of the OCEANS Conferences was held at OCEANS'12 MTS/IEEE Yeosu at the Ocean Resort, Yeosu, Republic of Korea, May 21–24, 2012. Once again outstanding posters describe the work that the students were presenting. Their work was appreciated by all who attended the Conference and the student participants appreciated the opportunity to display and describe their research work. The program was organized and directed by Ria Park. 23 student posters were accepted from the 80 abstracts that were received. The students were from schools in Europe, Asia, the USA and Canada. Once again the program was supported by funding from the US Navy Office of Naval Research Global which enabled the students to attend the conference. The posters were judged by a team organized by Dr. Christophe Sintes, Telecom-Bretagne, France. The student award winners were announced at the Wednesday evening Gala. Dr. Sintes opened the awards ceremony and introduced Dr. Sandy Williams, OES Vice President of Technical Activities, who presented each student with a Certificate of Participation in the OCEANS'12 MTS/IEEE YEOSU. The winning student posters were then announced and Mr. Jerry Carroll, President of OES presented the awards to the students. 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".

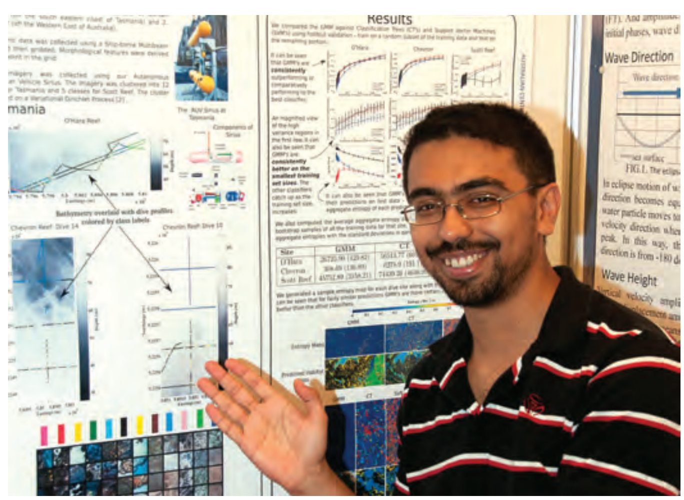
The students receiving awards were then announced and each came forward to receive their plaque and award. The winning students were:

First Place	Nasir Ahsan, University of Sydney, Australia
Second Place	Qunyan Ren, Environmental Hydroacoustics Lab, Brussels, Belgium and Frederico Traverso, University of Genoa, Italy
Third Place	Yoann Ladroit, Telecom Bretagne, Brest, France, Sharbari Banerjee, Indian Institute of Technology, Delhi, India, and Anne Blavette, University College of Cork, Ireland

The winning students all received a round of applause for their accomplishments and participation in the Student Poster Program of OCEANS'12 MTS/IEEE YEOSU!

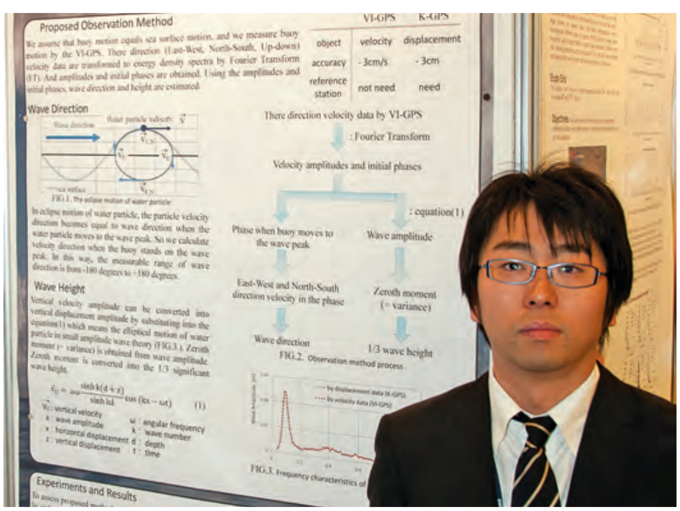
The students, their schools, poster titles and abstracts are listed below. The winning paper is reprinted

Nasir Ahsan, University of Sydney, Australia, *Robust Broad-Scale Benthic Habitat Mapping when Training Data is Scare*



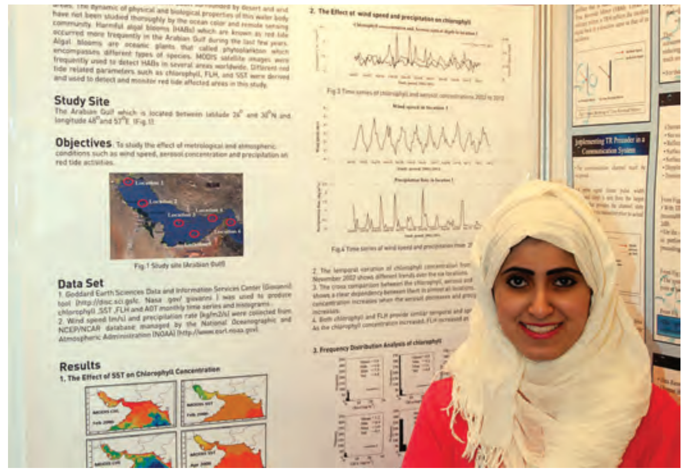
Abstract—Understanding the distribution of habitat classes at broad scales is of interest in marine park conservation and planning. Typically sites of interest can extend up to many hundreds of square kilometers. However, collecting ground truth data (optical imagery, towed video, grab samples, and etc.) over such broad scales is impractical, and only a small fraction of the sites can be sampled depending on budget constraints. Benthic habitat mapping involves learning the correlations between habitat classes derived from limited ground truth sampling of the seabed and its corresponding morphology and extrapolating these correlations to the entire site. One important issue with such approaches is that the correlations are learned on limited data, therefore, motivating the need to investigate robust techniques for learning the correlations and extrapolating them. In this paper we have motivated the use of the generative classifier Gaussian Mixture Models (GMM's) for the task of benthic habitat mapping instead of discriminative models such as Classification Trees (CT's—popular in the benthic habitat mapping literature) and Support Vector Machines (SVM's—generally popular in a variety of fields) based on the idea that generative classifiers take into more information about the underlying data distribution than discriminative classifiers, yielding more robust extrapolations. Using holdout validation we have shown that GMM's consistently perform comparably, or outperform, the best classifier for all training set sizes (small and large), and that this is not the case with CT's and SVM's. We also show that GMM's are more certain about their predictions over the broad-scale than the other classifiers.

Go Akiyoshi, Kobe University, Japan, *Wave Information by Precise Velocity measurement using GPS Buoys*



Abstract—In this paper observation method for wave direction and height is proposed. The precise velocity measured by velocity information GPS (VI-GPS) on our buoy is introduced in our method. Because VI-GPS can measure precise velocity without a reference station on land, one usual GPS receiver is only needed. Two basic experiments were carried out to assess the method. Compared with the result of kinematic GPS (K-GPS), the average value measured by VI-GPS in our experiments was almost the same, although the standard deviation of wave direction was larger. Two significant wave heights estimated by VI-GPS and K-GPS had almost same value.

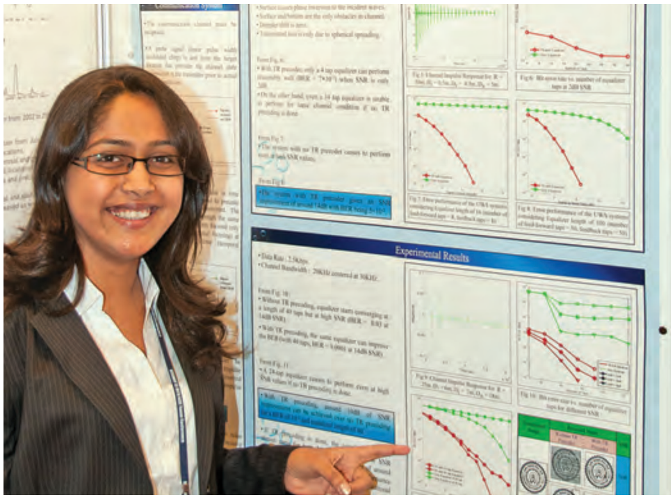
Maryam Al Shehi, Mandar Institute of Science and Technology, *Temporal-Spatial Analysis of Chlorophyll Concentration Associated with Dust and Wind Characteristics in the Arabian Gulf*



Abstract—Arabian Gulf is an enclosed shallow basin surrounded by desert and arid areas. The dynamic of physical and biological properties of this water body have not been studied thoroughly by the ocean color and remote sensing community. Harmful algal blooms (HABs) which are known as red tide occurred more frequently in the Arabian Gulf during the last few years. Algal blooms are oceanic plants that called phytoplankton which encompasses different types of species. MODIS satellite images were frequently used to detect HABs in several areas worldwide. Different red tide related parameters such as chlorophyll, FLH, and SST were derived and used to detect and monitor red tide affected areas in this study. The effect of metrological and atmospheric conditions such as wind speed, aerosol concentration and precipitation on red tide activities has been assessed. It was found that dust loading, temperature, wind and nutrients availability have a direct affect on chlorophyll concentrations.

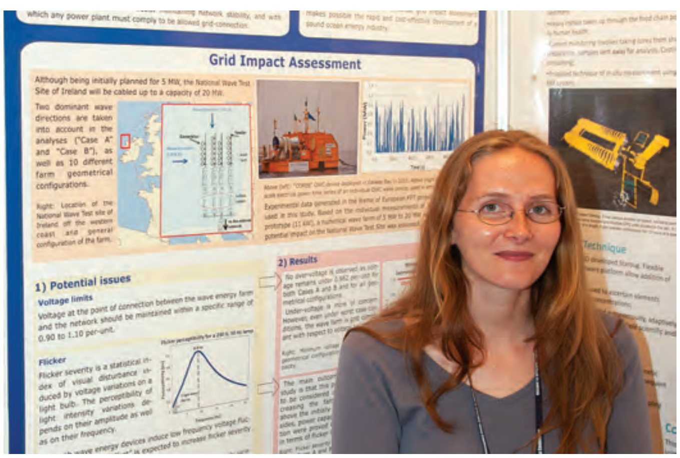
Sharbari Banerjee, Indian Institute of Technology, *Time Reversal Precoder: An Efficient Tool for more Reliable Underwater Acoustic Communication*

Abstract—Underwater acoustic communication has always been a challenging area of research where intersymbol interference (ISI) due to the complex multipath structure of the channel is one of the major issues in establishing a reliable communication link. In order to combat this ISI, the adaptive equalizer requires a large number of taps (equalizer length) and hence increases not only the computational complexity but also the delay in the system. Time Reversal (TR) precoder is another approach to mitigate ISI by means of its inherent property of spatio-temporal focusing of the transmitted energy at target location. It is also easier to implement as it does not incur much computational burden, unlike an equalizer. In this paper, we present a study on the performance of a UWA communication



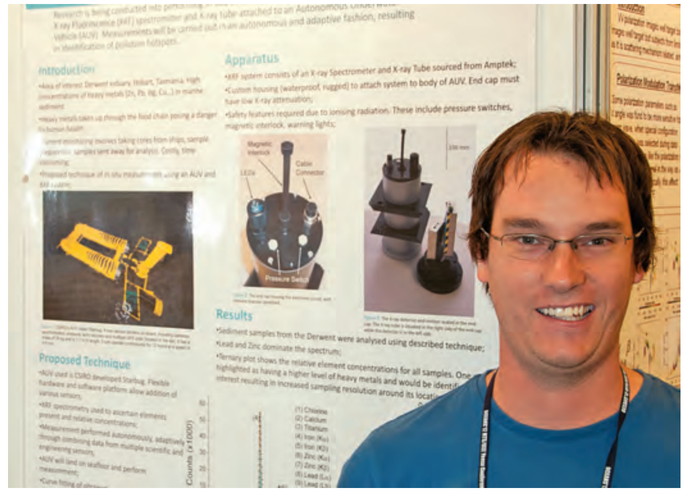
system using a TR precoder along with an equalizer. Experimental and simulation studies show that using a TR precoder not only reduces the required length of the equalizer but also performs reasonably well under severe channel conditions even at low signal to noise ratio (SNR).

Anne Blavette, University College, Cork, Ireland, *Impact of a Wave Farm on its Local Grid: Voltage Limits, Flicker Level and Power Fluctuations*



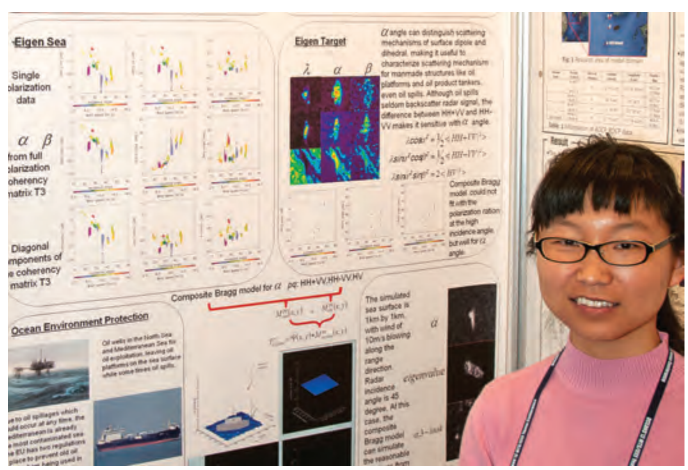
Abstract—Significant electrical power fluctuations in the range of seconds may be generated by most oscillating wave energy converters without significant amounts of energy storage capacity. Because of these fluctuations, a wave farm may have a negative impact on the power quality of the local grid to which it is connected. Hence, the impact of these devices on both distribution and transmission networks needs to be well understood, before large scale wave farms can be allowed to connect to the grid. This paper details a case study on the impact of a wave farm on the distribution grid around the national wave test site of Ireland with respect to voltage and power fluctuations, as well as regarding flicker levels. The electrical power output of the oscillating water column (OWC) wave energy converters was derived from experimental time series produced in the context of the FP7 project "CORES". The results presented in this paper are based on a typical time series. Simulations were performed using DIgSILENT simulation tool "PowerFactory".

Jeremy Breen, University of Tasmania, *Analysis of Heavy Metals in Marine Sediment using a Portable X-ray Fluorescence Spectrometer onboard an Autonomous Underwater Vehicle*



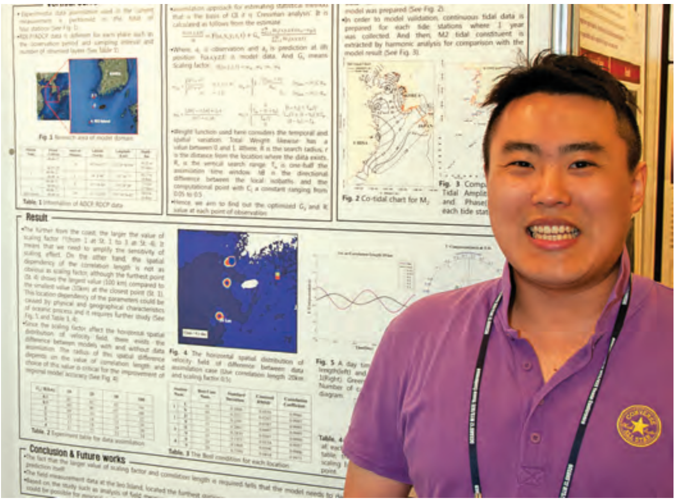
Abstract—Research is being conducted into performing chemical analysis of marine sediments in situ using an Autonomous Underwater Vehicle (AUV) equipped with an X-ray Fluorescence (XRF) spectrometer and X-ray tube. This is for the purpose of identifying regions of high heavy metal concentrations. A housing has been designed to safely attach the XRF system to the AUV. Work has been done on analysing sediment samples taken from the Derwent Estuary, Hobart, Tasmania using the analysis techniques that will be used on-board the AUV during a mission.

Bo Wang, University of China, *Sea surface backscatter simulation based on eigenvector decomposition*



Abstract—A simulation of the radar backscatter from the complex sea surface has been established based on the eigenvector invariant property under rotations about the line of sight. The complex sea surface may have stationary or anchoring man-made targets as well as may be contaminated by surface covering layers such as oil spill. To better understand the scattering mechanism on the radar imagery from sea surface, we view the latter as a surface abnormal modulation (Mab) using a physical scattering method based on the target decomposition (TD) theorem.

BonHo Gu, Oregon State University, USA, *Application of Optimal Interpolation to Vertical Current Data in Ieo Island of Korea using Unstructured Grid Ocean Numerical Model (FVCOM)*



Abstract— the data assimilation in the field of oceanography is an estimation problem for producing model parameters or initial states for ocean predictions. Optimal interpolation (OI) is a least square method to estimate the initial conditions by calculating the weight where the error covariance between model values and observations becomes minimized. OI is a statistical data assimilation method and thus is influenced by the number of observation data. Although theoretical framework of OI application in ocean modeling is now relatively well established, OI is still quite useful methodology in ocean modeling, because OI can be applied to any local region of the model domain, requiring relatively less computational cost compared to vibration and ensemble-based methods. In this study, we assimilate the vertically distributed ocean current data at Ieo Island and South-western part of Korea via OI technique into the Finite Volume Coastal Ocean Model (FVCOM), which is the unstructured grid ocean numerical model.

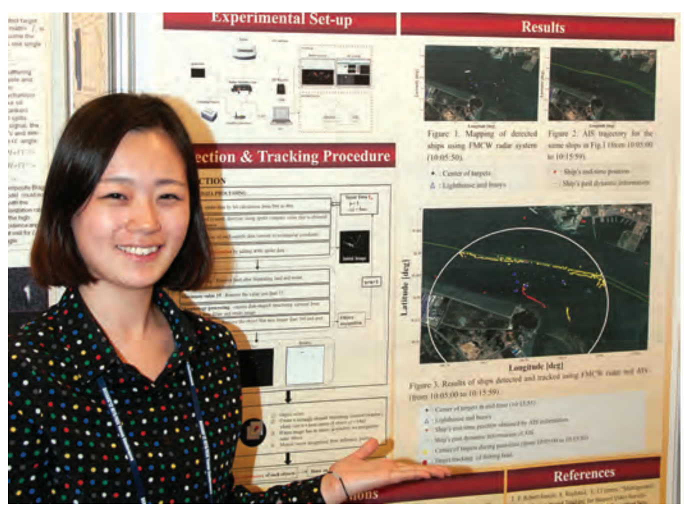
FVCOM is first setup for tidal simulation in the region of Korea peninsula (See Fig. 1). The complex and irregular geographic characteristics of the coastline of Korea were complemented with unstructured grid, and the 30 second grid water depth (KorBathy30s) of the seas near Korea provided by Korea Ocean Research & Development Institute (KORDI), and NAO99 was used for tidal boundary conditions. The verification of tide model was conducted based on the surface measurement data at sea level observation station operated by National Oceanographic Research Institute (NORI).

Before applying the data assimilation to the model domain, the various kinds of numerical experiment were conducted to calculate the weight for the model and the observation data calculated previously in the observation station. The scaling factor and correlation radius based on the numerical experiment were used to calculate the weight of observation and model data in the domain. Based on the estimated weight, OI was used based on the unstructured grid ocean numerical model at the Ieo Island to suggest the best state of ocean prediction and the empirical correlation. The observation data used in data assimilation was the vertically distributed ocean current data at the Ieo Island and 3 stations near the South-western sea of Korea (See Table 1). The observation period is from 2006 to 2009, and consecutive observation period ranges from 33 days to 45 days.

For the application of the vertical current data to the prepared ocean numerical model, all the observation period and intervals need to be synchronized for assimilation. For this purpose, all vertical current data at each station was harmonically analyzed, and the extracted harmonic constituents were used to reproduce the time series data, and then converted to data assimilation input data. For computer resources, the TACHYON 2nd system of supercomputing center of KISTI was used to optimize the process of the data assimilation. The TACHYON 2nd system is parallel computing system which has Intel Xeon X5570 2.93GHz(8 core) and 24GB memory each nodes (total 3,176 nodes). For a single model experiment, about 360~380 CPUs were used and take about 2 days (48 hours).

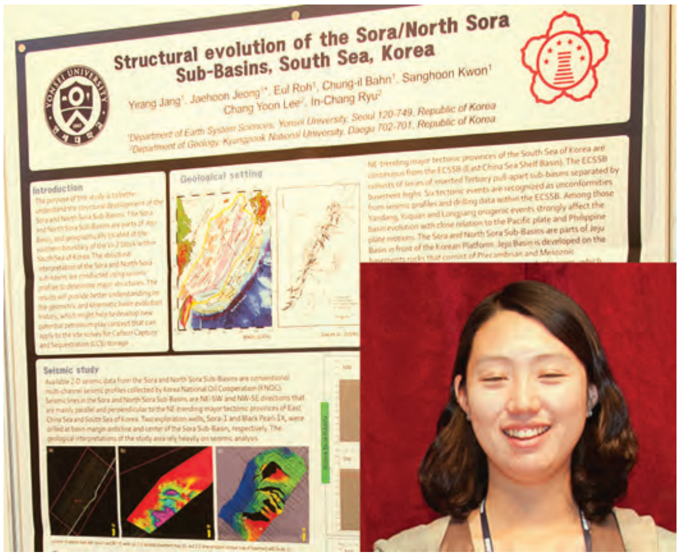
Overall, the OI data assimilation scheme is applied to assimilate vertical current data to the unstructured grid ocean numerical model considering the geographical characteristics of coastline of Korea and Ieo Island, and the accuracy of ocean numerical model and the practicality of the data assimilation in the oceanography over South sea of Korea. Furthermore, it is expected to give insight of the foundation for research of selection of ocean observation locations and construction of ocean prediction system in the future.

Dan Bee Hong, KORDI, *Algorithm Design for Detection and Tracking of Multiple Targets Using FMCW Radar*



Abstract—According to the increasing maritime trades and development of marine transportation, ship's navigation information must be provided not only to prevent an accident but also to ensure safe navigation. To get it, in general, radar and AIS are now in use, but do not integrate fully to each other. In this study, we introduce preliminary results of field experiment to merge both data in real-time. FMCW (Frequency Modulated Continuous Wave) radar and AIS system were used for monitoring ships in Pyeongtaek port, located on the west coast of Korea. The radar, developed by SIMRAD provides preprocessed data which can be handled by user through SDK program. First, an image generation procedure was performed from spoke data, and time series of the imagery was processed to detect and track ships. Consequently, we succeeded in simultaneously displaying ships from both FMCW radar and AIS. In the future, a matching work will be made to integrate the two data.

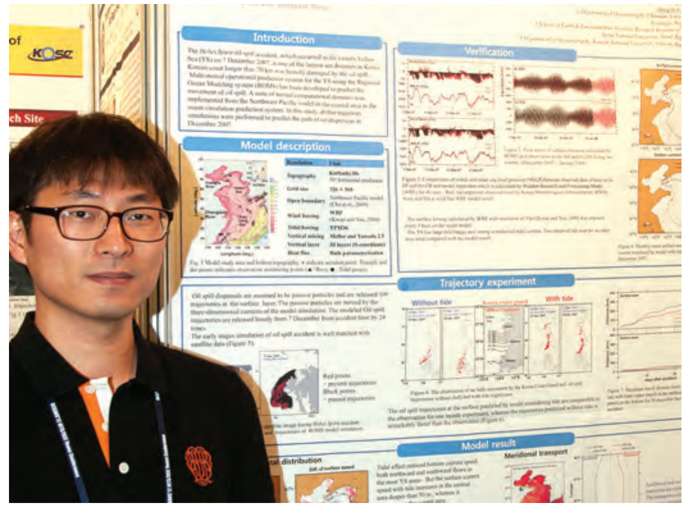
Yirang Jang, Kyungpook National University, *Structural evolution of the Sora/North Sora Sub-Basins, South Sea, Korea*



Abstract—The structural interpretation of the Sora and North Sora sub-basins are conducted using up-to ca. 75 cross-sections to determine major structures. The purpose of this study is to better understand the structural development of the Sora and North Sora Sub-Basins. Seismic lines conducted at 1990, 1997, 2006 supported by KNOC (Korea National Oil Cooperation) and well data are re-interpreted in terms of fault geometries and key horizons considering basin-type and tectonic evolution. The results show that both Sora and North Sora Sub-Basins experience similar geological evolution since Cenozoic. However, the NE-trending regional structures beneath the Late Cretaceous unconformity are different as results of faulted depression controlled by Yandang movement. Trap geometries are formed before end of the late Mid-Miocene contractional deformation. Reactivated rift-related structures are preserved in North Sora Basin. However, syn-rift growth pattern is not observed within the Sora Basin, indicating that it might be a depression at the end of Cretaceous. These results will provide better understanding on the geometric and kinematic basin evolution history, which might help to develop new potential petroleum play concept that can apply to the site survey for Carbon Capture and Sequestration (CCS) storage.

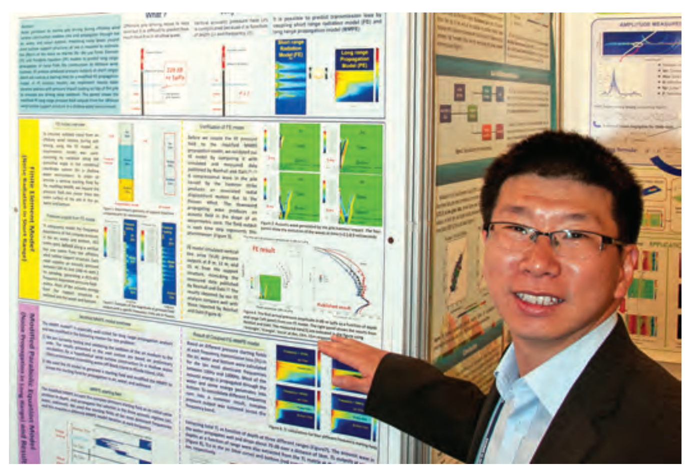
Chang sin Kim, Seoul National University, *Effects of tide in oil spill prediction during Hebei Spirit accident in Korea*

Abstract—Multi-nested operational prediction system for the Yellow Sea (YS) has been developed to predict the movement of oil spill. Drifter trajectory simulations were performed



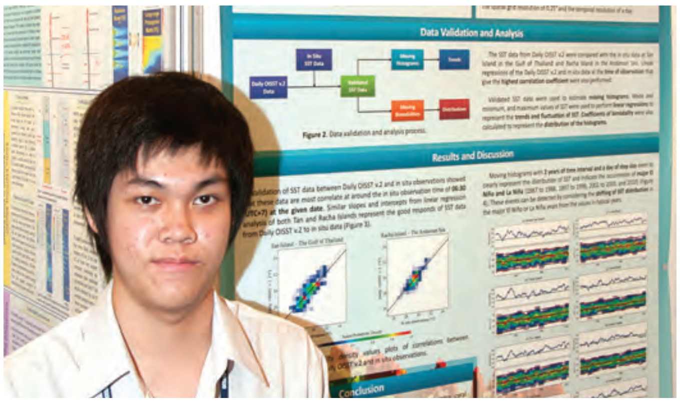
to predict the path of the oil spill during the Hebei Spirit accident. The oil spill trajectories at the surface predicted by model with tidal forcing were comparable to the observation for one month experiment, whereas the speed of drifter predicted from the simulation without tidal forcing was remarkably faster than the observation. The bottom current flowing northward from the simulation without tidal forcing was also faster than that with tidal forcing in the interior of the YS. Increased bottom friction by strong tidal current induces increase of vertical mixing and decrease of vertical shear between the surface and bottom currents. Without tidal mixing the relatively strong bottom northward current, which could act as a compensation flow, may enhance the southward surface current. Strong tide might reduce upwind flow along the deep central trough in the YS.

Huikwan Kim, University of Rhode Island, USA, *Long range propagation modeling of offshore wind turbine noise using Finite Element and Parabolic Equation models*



Abstract—Noise generated by marine pile driving during offshore wind turbine construction radiates into and propagates through the air, water, and ocean bottom. Predicting noise levels around wind turbine support structures at sea is required to estimate the effects of the noise on marine life. We use Finite Element (FE) and Parabolic Equation (PE) models to predict long range propagation of noise from the construction of offshore wind turbines. FE analysis produced pressure outputs at short ranges which are used as a starting field for a modified PE propagation model. In FE analysis models, we implement the axisymmetric elements and implicit and steady state dynamic analysis with pressure impact loading on top of the pile to simulate pile driving noise radiation. This paper shows the modified PE long range pressure field outputs from the offshore wind turbine support structure in a shallow water environment around Block Island, Rhode Island.

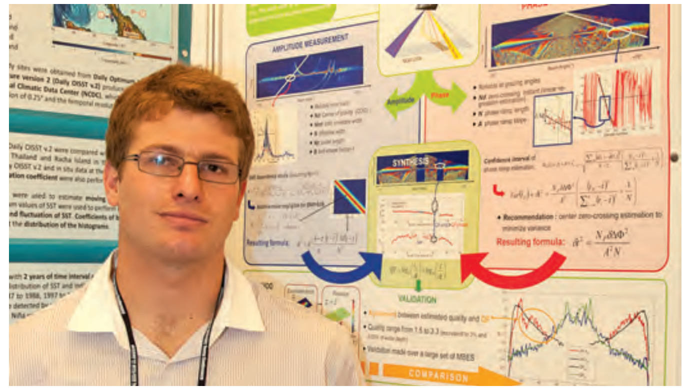
Peeravit Koad, Walailak University, *Sea Surface temperature trends in the Gulf of Thailand and the Andaman Sea*



Abstract—This study represents an attempt to estimate sea surface temperature (SST) trends of ten islands along the coastlines of the Gulf of Thailand and the Andaman Sea. Satellite-based SST data from September 1981 to December 2011 were obtained from Daily Optimum Interpolation Sea Surface Temperature version 2 (Daily OISST v.2) produced at NOAANCDC, where they were used to analyze moving histograms, coefficients of bimodality and linear regression analysis. We found that SST of all study sites had significantly increased over the past 30 years, and coefficients of bimodality showed that distribution of SST would be bimodal distribution rather than unimodal distribution. Results also showed that mass coral bleaching events in the Gulf of Thailand and the Andaman Sea were likely to occur when there were sudden increases in SST over a short period or a small increase over a long period due to major El Niño or La Niña events roughly every 10 years.

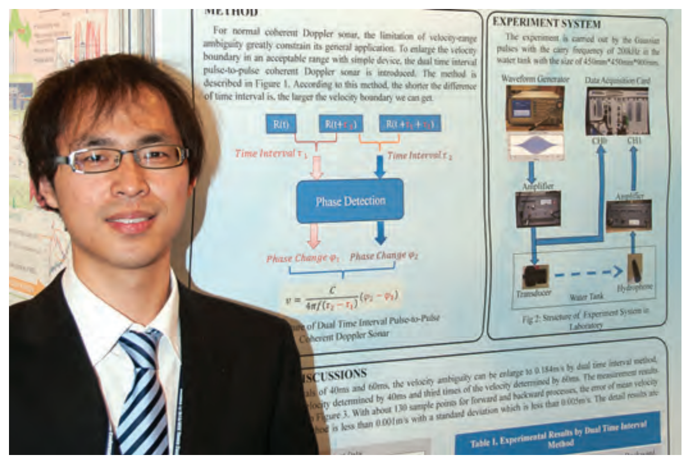
Yoann Ladroit, Telecom-Bretange, France, *Definition and application of a Quality Estimator for multibeam echosounders*

Abstract—For modern multibeam echosounders, the use of a robust and reliable quality estimator associated with each sounding is an absolute necessity. Indeed, due to the large volume of data acquired, a lot of time is lost, both during the survey and the post-processing. This is a costly problem for hydrographers. The definition of a quality estimator based on the characteristics of the beamformed signal gives an answer to this problem. It has been successfully implemented by several sonar manufacturers and its relevance in measuring the quality of each sounding has been demonstrated.



The defined Quality Factor can also be used directly in the sonar measurement process, such as in detection algorithm, in order to improve the performance of the systems. This makes it possible to enhance of existing systems at very little cost with success.

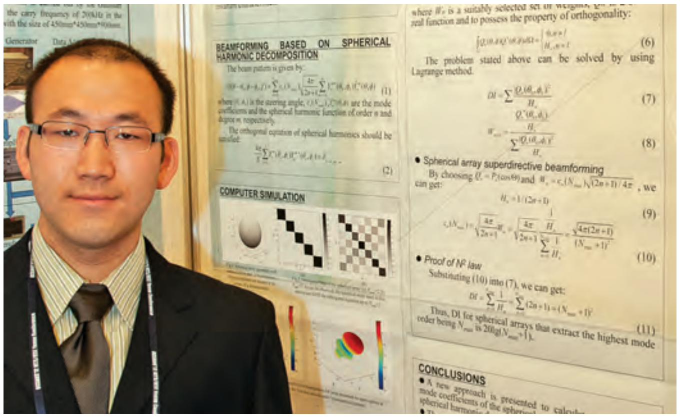
Peng Liu, Kobe University, Japan, *Velocity Measurement by Dual Time Interval Pulse-to-Pulse Coherent Doppler Sonar*



Abstract—With high accuracy and resolution Pulse-to-Pulse coherent Doppler sonar is wildly used in both laboratory and field application. However, the occurrence of range and velocity ambiguities brings serious limitations on the more general application of the technique. One method to deal with speed ambiguities is to import a dual pulse repetition interval which can provide acceptable speed ambiguities and requires uncomplicated equipment. The experiments are carried out under the frequency of 200KHz with 40ms and 60ms pulse intervals in a water tank. The results show that this method is efficient and produces high quality velocity data to track the velocity of an object in a limited range in water.

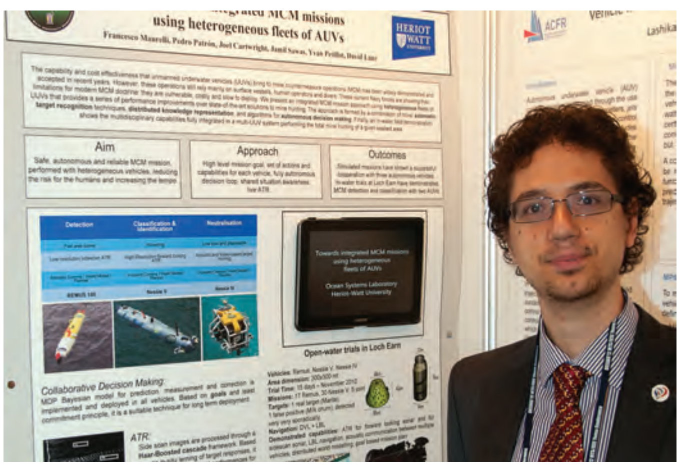
Yukang Liu, University of Kentucky, *USA, Spherical Array Superdirective Beamforming based on Spherical Harmonic Decomposition of the Soundfield*

Abstract—This paper provides a new analytical method to calculate superdirective mode coefficients of the spherical array beamforming based on spherical harmonic decomposition of the soundfield. Furthermore, *N*2 law of the spherical



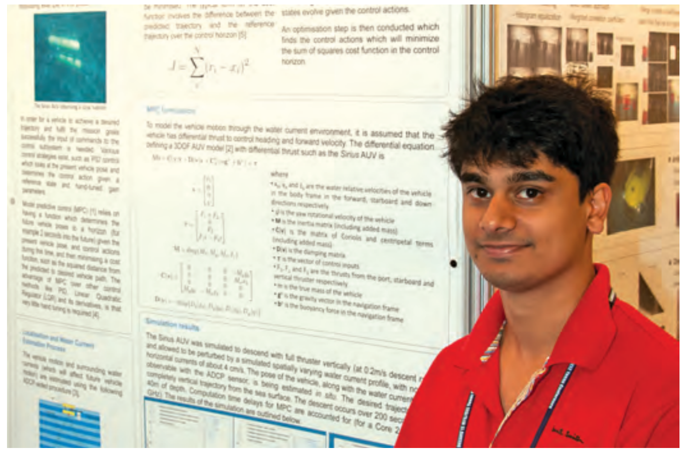
receiving arrays is proven: given the highest mode extracted *Nmax*, the Maximum Directivity Factor (DF) is (*Nmax*+1)2. Computer simulation is conducted for the spherical array with 20 hydrophones located at the vertex of a dodecahedron, which can be optionally mounted on open sphere or rigid sphere. The resulting directivity index (DI) for *Nmax*=1 and 2 corresponds to the theoretical DI at low frequencies. The operating frequency range is from 100Hz to about 5kHz. The proposed method to calculate the superdirective mode coefficients is also applicable for arrays of any shape and any form of expansion, indicating its wide usage in superdirectivity beamforming.

Francesco Maurelli, Heriot Watt University, UK, *Integrated MCM missions using heterogeneous fleets of AUVs*



Abstract—The capability and cost effectiveness that unmanned underwater vehicles (UUVs) bring to underwater survey, target detection and identification operations has been widely demonstrated and accepted in recent years. However, these operations still rely mainly on pre-planned missions and require a high level of expert human interaction both at the planning and data analysis stages. In this paper, we present an integrated mission approach using heterogeneous fleets of UUVs that provides a series of performance improvements over state-of-the-art solutions. The approach is formed by a combination of novel automatic target recognition techniques, distributed knowledge representation, and algorithms for autonomous in mission decision making. This results in an increase tempo of operation as well as an improvement in the pertinence of the gathered data whilst reducing the need for expert human input. The benefits of the approach are demonstrated in real in-water trials where vehicles have different capabilities and collaborate to perform a mine hunting clearance process for a user-defined area of the seabed.

Lashika Medagonda, University of Sydney, Australia, *Model Predictive Control of an Autonomous Underwater Vehicle in an in situ Estimated Water Current Profile*

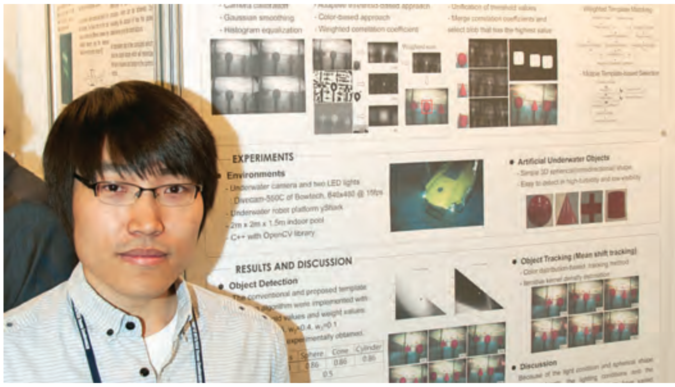


Abstract—Autonomous underwater vehicle control actuation is attained through the use of various methods, including propellors, jets and control surfaces. In order for a vehicle to achieve a desired trajectory and fulfil the mission goals successfully, the input of commands to the control subsystem is needed. Model predictive control (MPC) [2] relies on having a function which determines the future vehicle poses to a horizon given the present vehicle pose, and control actions during this time, and then minimising a cost function, such as the squared distance from the predicted to desired vehicle path. The advantage of MPC over other control methods like PID, Linear Quadratic Regulator (LQR) and its derivatives, is that very little hand tuning is required [10]. The method outlined in [9] allows simultaenous estimates of the vehicle pose and the water current profile in the direction of the Acoustic Doppler Current Profiler (ADCP) beams, including small scale gradients in situ. The position, velocity, attitude and water current estimates from this localisation filter could be used to arrive at control commands in real-time to achieve the desired vehicle trajectory given the predicted water current acting on the vehicle and the vehicle pose for future states.

Results in this paper show that even with large delays due to the MPC optimisation stage to arrive at control actions, the controller can accurately track the desired trajectory in the mean estimates from the localisation. The trajectory following accuracy is shown to be limited by the localisation error.

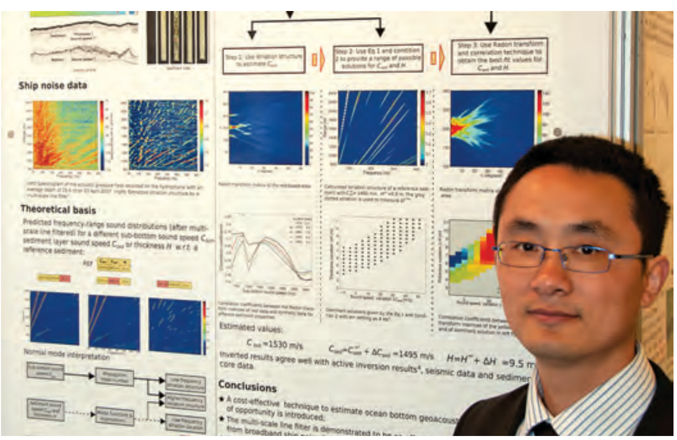
Donghoon Kim, KAIST, *Object Detection and Tracking for Autonomous Underwater Robots Using Weighted Template Matching*

Abstract—Underwater environment has a noisy medium and limited light source, so underwater vision has disadvantages of the limited detection range and the poor visibility. However it



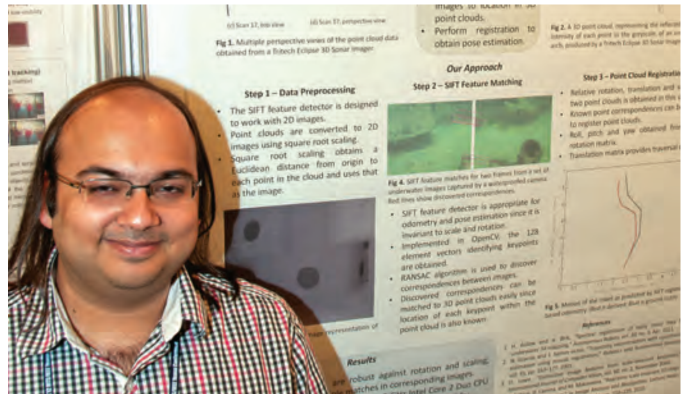
is still attractive in close range detections, especially for navigation. Thus, in this paper, vision-based object detection (template matching) and tracking (mean shift tracking) techniques for underwater robots using artificial objects have been studied. Also, we propose a novel weighted correlation coefficient using the feature-based and color-based approaches to enhance the performance of template matching in various illumination conditions. The average color information is incorporated into template matching using original and texturized images to robustly calculate correlation coefficients. And the objects are recognized using multiple template-based selection approach. Finally, the experiments in a test pool have been conducted to demonstrate the performance of the proposed techniques using an underwater robot platform yShark made by KORDI.

Qunyan Ren, Environmental Hydroacoustical Lab, *Ocean bottom geoacoustic characterization using surface ship noise opportunity*



Abstract—The broadband noise field of a ship of opportunity often exhibits environment dependent striation structure in the frequency-range plane. For the soft-layered sediment environment studied in this paper, the striation structure is critically determined by sub-bottom sound speed (Cbot), sediment thickness (H) and sediment sound speed (Csed). Numerical simulations demonstrate that striations in different frequency bands have different sensitivities to the three critical parameters. The sensitivity differences are used here to progressively estimate the Cbot, H and Csed. We first use low-frequency striation structure to estimate the Cbot, then obtain a preliminary estimation of the H and Csed with a set of low-frequency striations, and finally find the best-fit solutions from previous estimates using high frequency striation structure. We processed passive ship run data collected in Mediterranean Sea in 2007. The good agreement between our results with active inversion methods demonstrates the accuracy of the method for ocean bottom geoacoustic characterization.

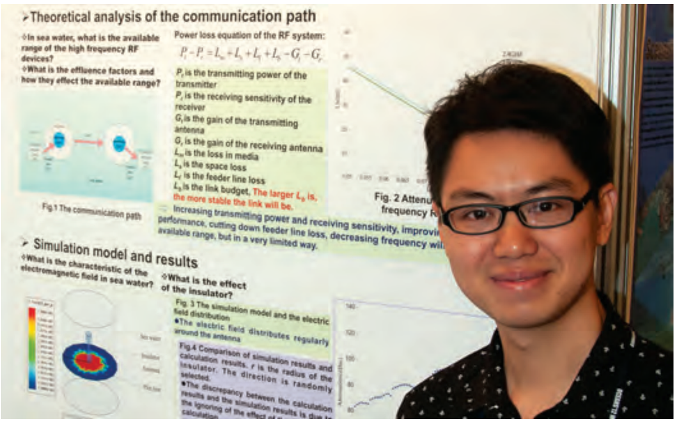
Anuj Seghal, Jacob University, Bremen, *Pose Estimation and Trajectory Derivation from Underwater Imagery*



Abstract—Obtaining underwater imagery is normally a costly affair since expensive equipment such as multi-beam sonar scanners need to be utilized. Even though such scanners provide imagery in form of 3D point clouds, the tasks of locating accurate and dependable correspondences between point clouds and registration can be quite slow. Registered 3D point clouds can provide pose estimation and trajectory information vital to the navigation of a robot, however, the slow speed of point cloud registration normally means that maps are generated offline for later use. Furthermore, any algorithm must be robust against artifacts in 3D range data as sensor motion, reflection and refraction are commonplace. In our work we describe the use of the SIFT feature detector on scaled images based on point clouds captured by sonar in order to register them in real-time. This online registration approach is used to derive navigational information vital to underwater vehicles. The algorithm utilizes the known point correspondence registration algorithm in order to achieve real-time registration of point clouds, thereby generating 3D maps in real-time and providing 3D pose estimation and trajectory information.

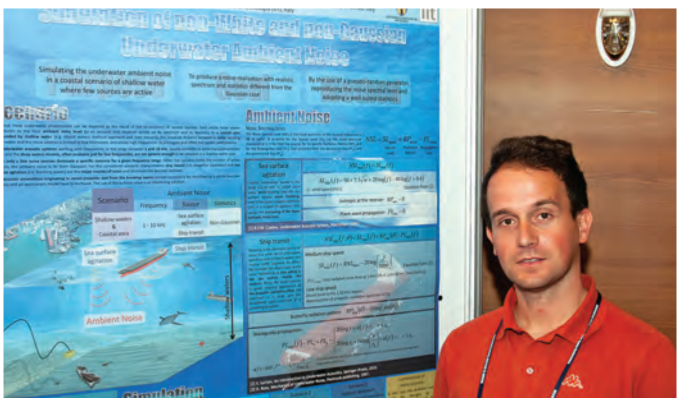
Jianguang Shi, Zhejiang University, *High frequency RF based non-contact underwater communication*

Abstract—Although electromagnetic wave, especially high frequency electromagnetic wave suffers great attenuation in sea water, it has advantages of high reliability and high speed in short distance and non-contact communication situations, such as AUV (Autonomous Underwater Vehicle) docking systems and wet-mate connectors. This paper discusses the propagation characteristic of high frequency RF in sea water. Computational and experimental results of an underwater high frequency RF system are presented. The findings offer intuitive insights for the design of a non-contact communication system which transfers data in high speed and high reliability in sea water.



Specifically, this paper begins with theoretical calculation of the propagation path. Then, the communication system is modeled in the finite analysis software ANSOFT HFSS to study the characteristic of the electromagnetic field and to evaluate the influence of insulation. The simulation model has been experimentally validated by comparing the computed available range against the measured data based on the water tank test.

Frederico Traverso, University of Genoa, Italy, S*imulation of non-white and non-Gaussian underwater ambient noise*



Abstract—Noise in the ocean is the result of many contributions. Sources emitting sound in open sea as well as in a coastal area can be placed both in the sea surface and underwater. Excluding the self-noise, the noise impinging a sonar system is called ambient noise and usually is split in two groups: anthropic and natural. In this paper we focus in modeling noise produced by ship transit, which falls in the anthropic category, and noise due to sea surface agitation, that is classified as a natural source. In particular we aspire to simulate the acoustic noise radiated by the machinery of a vessel once the rotational speed of the propeller induces the cavitation effect. Further, we take account of the wind speed action in the sea state and its contribution to the actual underwater ambient noise. An algorithm based on a non-Gaussian approach allows to generate sequence of samples representative of a noise realization having specified kurtosis level and to reproduce the desired source spectrum. The results of the simulation suggest that the surface ship transit can be thought as a major factor in limiting the performance of a underwater acoustic communications systems operating in a coastal shallow waters scenario.

Winning Student Paper

Robust Broad-Scale Benthic Habitat Mapping when Training Data is Scarce

Nasir Ahsan, Stefan B. Williams, and Oscar Pizarro
Australian Center for Field Robotics
University of Sydney, Sydney, NSW 2006, Australia
Email: {a.nasir,stefanw,o.pizarro}@acfr.usyd.edu.au

***Abstract*— Understanding the distribution of habitat classes at broad-scales is of interest in marine park conservation and planning. Typically sites of interest can extend up to many hundreds of square kilometers. However, collecting ground truth data (optical imagery, towed video, grab samples, and etc.) over such broad scales is impractical, and only a small fraction of the sites can be sampled depending on budget constraints. Benthic habitat mapping involves learning the correlations between habitat classes derived from limited ground truth sampling of the seabed and its corresponding morphology and extrapolating these correlations to the entire site. One important issue with such approaches is that the correlations are learned on limited data, therefore, motivating the need to investigate robust techniques for learning the correlations and extrapolating them. In this paper we have motivated the use of the generative classifier Gaussian Mixture Models (GMM's) for the task of benthic habitat mapping instead of discriminative models such as Classification Trees (CT's - popular in the benthic habitat mapping literature) and Support Vector Machines (SVM's - generally popular in a variety of fields) based on the idea that generative classifiers take into more information about the underlying data distribution than discriminative classifiers, yielding more robust extrapolations. Using holdout validation we have shown that GMM's *consistently* perform comparably, or outperform, the best classifier for all training set sizes (small and large), and that this is *not* the case with CT's and SVM's. We also show that GMM's are more certain about their predictions over the broad-scale than the other classifiers.**

I. Introduction

Benthic imaging Autonomous Underwater Vehicles (AUVs) can collect geo-referenced, high quality optical imagery ideal for habitat characterization [1], [2], [3]. This imagery provides fine-scale, high-resolution detail sufficient to determine habitat type and the biological assemblages present in the area photographed. However, marine habitats of interest may extend over many hundreds of square kilometers, and it is infeasible to collect and analyze full coverage imagery data or video footage over entire sites of this size.

Since seabed bathymetry, with the advent of multibeam sonar, can be gathered readily in a cost-effective manner over large areas, and benthic habitats are strongly correlated with the underlying bathymetry and associated seabed morphology [4], [5], [6], [7], [8], it is possible to develop predictive models of habitat type as a function of seabed terrain. In practice, this is accomplished by extrapolating correlations present between sparse ground-truth optical imagery and features derived from the associated seabed terrain [6], [9], [10], [11]. These procedures produce high-resolution habitat maps over regions that are orders of magnitude larger than would be practical using optical imagery alone. Therefore, accurately learning the correlations and extrapolating them to broad scales, from limited sampled data, motivates the need for robust and reliable modeling techniques.

In this work we investigate a class of parametric generative probabilistic models known as Gaussian Mixture Models (GMM's) as an alternative to the popular discriminative Classification Trees (CT's) and Support Vectors Machines (SVM's), for learning the correlations between seabed bathymetry and habitat classes from scarce sampled data. We compare the accuracy of GMM's against Classification Trees using hold-out validation experiments and show that GMM's *consistently* perform comparably, or outperform, CT's and SVM's when sampled data is limited making them less sensitive to the amount of sampled data. We also show that this is *not* the case with CT's and SVM's. Furthermore, we show that GMM's are more certain than CT's and SVM's in their extrapolations over the broader scales. We present our results on data collected from three different regions: the O'Hara Reef and Chevron regions both in the Tasman Peninsula off South Eastern Australia and Scott Reef off Western Australia.

The rest of the paper is organized as follows: Section II presents an overview of benthic habitat mapping and techniques generally used to construct these maps. Here, we also introduce a class of models, for learning the correlations, known as generative models, that are robust to scarce training data, and highlight some of the work done in the ecological literature that employs generative classifiers. Section III presents our formulation of the GMM for benthic habitat classification. Section IV first describes the experimental setup and the data used to learn the correlations and generate the habitat maps and then presents results that highlight the effectiveness of GMM's over CT's and SVM's when training is scarce. Section V presents a discussion of our results. We conclude the paper in Section VI.

II. Background

In this section we first present an overview of benthic habitat mapping. We then present a review of existing techniques for learning and extrapolating the correlations between habitat classes and their underlying seabed bathymetry. Finally, we introduce the concept of generative classifiers.

A. Overview of Benthic Habitat Mapping

There are two basic methods by which acoustic data can be used for the purposes of benthic habitat mapping. One approach (the top-down approach) is to classify the seabed terrain features[1] derived from the acoustic data into distinct clusters, after which samples are collected to validate the character of the habitats. An example of such an approach is the use of sidescan sonagraphs to map tilefish habitats [13]. Here the authors cluster seabed terrain features into clusters based on similarity of the features and then obtain ground truth for each of those clusters by sampling the seabed. The main problem with such an approach is that the differences apparent in the acoustic data may not be indicative of relevant differences in habitat.

The second method (the bottom-up approach) requires collecting ground truth data independent of the acoustic data, classifying this into distinct habitat classes and then modelling the relationship between the acoustic data and the classes at sampled locations. A

[1]These include depth derived features such as slope, surface curvatures, surface roughness indices, etc. For more details we refer the reader to [12].

particular instance of this approach combined broad scale multibeam bathymetry and backscatter data with fine scale optical imagery and seafloor sediment samples to identify a number of benthic habitats [4]. Different sediment types; thick sand, sand over gravel lag, gravel lag and gravel lag with thin sand, were identified using multibeam bathymetry and backscatter imagery and were confirmed by sea floor sample grabs and sidescan sonagrams. A cluster analysis of the relative frequencies of occurrence of megabenthos revealed their affinities for different sea floor sediment types. Six habitats were defined based on the sediment type and habitat complexity derived from multibeam data, benthic assemblages inferred from photographs, and relative water current strength. A cluster analysis was then used to determine the affinity of species to sediment types, from which habitats were inferred at unsampled regions, i.e., where no ground truth was taken. A second example of this approach learned a decision tree model to relate seabed terrain features and habitat labels determined from optical imagery [14]. Five seabed terrain features were employed; reflectivity, rugosity, bathymetric position index, surface complexity, and slope. The benthic classes were obtained by classifying towed video data. Additional examples of this approach appear in [6], [15] and [5] which use bathymetric features computed at multiple scales, and more sophisticated decision tree models, respectively.

In this work we have focused on the robustness aspect of the second basic approach, in which the ground truth is first classified into distinct habitat types and these are then related to the seabed terrain features. This approach does not assume that the clusters of seabed terrain features directly correspond to benthic habitat classes, but instead allows us to learn the relationship between the benthic features and the habitats they support.

B. Existing Modeling Techniques for the Bottom-Up Approach to Benthic Habitat Mapping

A wide range of models have been used to model the correlations between seabed bathymetry and benthic habitat classes to produce benthic habitat maps. Probabilistic habitat mapping was employed in the form of ordinary indicator kriging by [6] and maximum likelihood classifiers by [5]. Probabilistic models naturally incorporate uncertainty into the maps facilitating dive planning, for instance [16] used Gaussian Processes to learn habitat maps for autonomously generating sampling trajectories. Additional approaches include Discriminant Analysis [17] and Canonical Correspondence Analysis [18], however, these make restrictive assumptions on the distribution of the data and the independence of features [19]. Recently, classification trees (CT's) have gained popularity in benthic habitat classification [15], [5], [14]. Two key characteristics of CT's are that they are non-parametric in nature (i.e., they do not make assumptions about the distribution of the data) and are easy to interpret, giving better insight into how the bathymetry and habitat classes may be related. For a general overview on predictive models in ecology we refer the reader to [19].

C. Generative Models and Environmental Modeling

All the models mentioned in the previous subsection were examples of discriminative classifiers, which are a class of models that directly model the conditional distribution of the habitat classes C given the seabed bathymetry X, i.e., $P(C \mid X)$. Though discriminative models are well suited for classification tasks and are less intense in terms of computational complexity of learning, it has been shown they are outperformed, in classification, by another class of models known as generative models when training data is scarce [20]. Generative models explicitly model the distribution of inputs $P(X)$ along with the likelihood of the data given the class $p(X \mid C)$ allowing us to derive the joint distribution $P(X, C)$. Such models give us more information about how the data is distributed. It was concluded by [20] that generative models do indeed have higher asymptotic error than discriminative classifiers when sufficient training data is present, but also approach their asymptotic error much faster with much less training data as compared to discriminative models. It should be noted that generative models are parametric in nature, and therefore, make restrictive assumptions about the distribution of the data, which is not the case with discriminative models. However, as mentioned earlier, they perform better than discriminative models with limited training data. It is the purpose of this paper to investigate their robustness for the task of benthic habitat classification with limited training data.

Generative models have been applied in the area of species distribution modeling [21], [22], [23], [24], [25], [26], where presence/absence maps are required for species. For such tasks Maximum Entropy modeling (MaxEnt) appears to be the popular choice for generative models. One example of MaxEnt applied to environmental modeling mapped the distribution of a low land species of sloth and a small montane murid rodent as a function of a set of environmental variables like climatic variables (e.g., temperature and precipitation), topographic variables (e.g., elevation and aspect), and land cover variables (e.g. percent canopy cover) [21]. The authors motivated the use of generative models by acknowledging their robustness when training data is scarce. MaxEnt was also employed for habitat mapping of fish species [23], where the authors motivated the use of MaxEnt by showing that it outperformed discriminative Boosted Regression trees. Another approach employed MaxEnt for mapping the spatial distribution of cold-water Stony Corals [22], where authors showed that MaxEnt consistently outperformed Environmental Nice Factor Analysis (ENFA) even though both models performed well. One of the major drawbacks of using MaxEnt for broad-scale habitat mapping is that it is not clear how much regularization is needed which can lead to poor generalization [27].

Other generative models such as Naive Bayes [28] have also been employed for modelling the spatial distribution of Red Deer as a function of accumulated frost and altitude in the Grampian regions of north east Scotland. Although Naive Bayes is a generative model, it makes strong independence assumptions about the data. Gaussian Mixture Models (GMM's - explained in the following section) were employed by [29] to predict the distribution of the Western Hemlock as a function of climatic variables, and were compared against Regression Trees. The results indicated superior performance of GMM's and concluded that regression trees poorly fit the data. Finally, GMM's have also been employed as models for predicting vegetation occurrence as a function of environmental variables such as soil types, groundwater regimes, and a history of atmospheric deposition of nitrogen [30]. As mentioned earlier, for a general overview on predictive models in ecology we refer the reader to [19]. To the best of our knowledge we have not encountered any literature which employs Gaussian Mixture Models for benthic habitat mapping.

III. Gaussian Mixture Models for Classification

Gaussian Mixture Models (GMM's) are a well known class of generative models, which are parametric in nature and model the distribution of data as a set of clusters, where each cluster is a multivariate Gaussian [31]. Although these models make assumptions about the underlying distribution of the data, they can still approximate almost any continuous density with arbitrary accuracy [32], hence motivating their use over other models previously used in the benthic habitat mapping literature, that make restrictive assumptions about the data such as Canonical Correspondence Analysis and Naive Bayes [19]. In order to model the correlations between habitat classes and their underlying bathymetry we propose to learn a GMM for each habitat class, and show how they can be combined to give a predictive habitat model.

We first introduce some preliminary notation that will be used throughout the paper. Let $P = \{p_1 = \langle x_1, y_1 \rangle, \cdots, p_n = \langle x_n, y_n \rangle\}$ be the set of all evenly spaced out points that compose a bathymetric grid. Let $X_i = \{x_{i1}, \cdots, x_{id}\}$ be a d-dimensional feature vector associated with point $p_i \in G$, where each element $x_{ij} \in X_i$ corresponds to a feature value associated with p_i. Suppose, using an AUV we have sampled some subset $P^L \subset P$ of m observations and have received a habitat class label c_i associated with each point $p_i \in P^L$. Then we define training data to be the set $D^L = \{\langle X_1, c_1 \rangle, \cdots, \langle X_m, c_m \rangle\}$, i.e., a collection of feature vectors and the corresponding habitat class label for all sampled points. Let the remaining unlabeled points be denoted as P^U.

Now we define our Gaussian Mixture Model for a single class c. Let $\boldsymbol{X_c} \subset D^L$ be the set of all feature vectors that have a class label c. Then the GMM for class c is a set of clusters given by the distribution $p(X_c)$

$$p(X_c) = \sum_{k=1}^{K_c} \pi_k \mathscr{N}(X_c \mid \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k) \tag{1}$$

where K_c is the total number of clusters for class c (determined using the BIC score criterion), $\langle \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k \rangle$ represent the mean and covariance matrices for cluster k, $\mathscr{N}(X_c \mid \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k)$ represents the cluster conditional density $p(X_c \mid k)$, π_k is the proportion of observations in the data (X_c) belonging to cluster k, and K_c is the total number of clusters in the GMM. The model $\mathscr{M}_c$ is learned on the data X_c using the Expectation-Maximization (EM) Algorithm [33], [31], [34]. We decide on K_c by learning a range of models with different values for K_c and choose the model which minimizes the Bayesian Information Criterion (BIC) score [32].

We now combine all the GMM's (one $\mathscr{M}_c$ for each class) into a single Bayesian classifier. The posterior distribution of classes given an observation is described by the Bayes Theorem as

$$P(C = c \mid X_i) = \frac{p(X_i \mid c) P(c)}{\sum_{c=1}^{C} p(X_i \mid c) P(c)} \tag{2}$$

$p(X_i \mid C)$ is the likelihood of the data given a class, and $P(C)$ is the prior distribution over the classes. The likelihood of an observation $X_i \in D$ given the class is simply the mixture density from Equation 1.

$$p(X_i \mid C = c) = \sum_{k=1}^{K_c} \pi_k \mathscr{N}(X_i \mid \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k) \tag{3}$$

The prior probability distribution over the classes

$$P(C) = \langle \beta_1, \cdots, \beta_C \rangle$$

is simply the proportion of observations in D^L from each class. We can now rewrite Equation 2 as follows.

$$P(C \mid X_i) = \frac{\beta_c \sum_{k=1}^{K_c} \pi_k \mathscr{N}(X_i \mid \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k)}{\sum_{c=1}^{C} \beta_c \sum_{k=1}^{K_c} \pi_k \mathscr{N}(X_i \mid \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k)} \tag{4}$$

Equation 4 can now be used to extrapolate class labels to P^U, where the most probable class label is assigned to an $X_i \in P^U$.

Fig. 1. The vehicle on-board the R/V Challenger prior to deployment. The dolerite cliffs of the peninsula can be seen in the background.

IV. Data and Results

In this section we give an overview of the data and the data acquisition process. This is followed by a description of the experimental setup and results.

A. Data

Since habitat mapping requires learning correlations between seabed morphology and habitat classes, each observation in our data was a feature vector of morphological characteristics (such as surface complexity (rugosity), slope, and etc.), and a class label. The acquisition and description of feature vectors and class labels are described in the following subsections.

1) Bathymetry: Bathymetric data was obtained using a ship-borne multibeam sonar over three different sites: (1) the O'Hara Reef and (2) the Chevron region, off the south eastern coast of Tasmania Australia, and (3) the Scott Reef which was off the Western Coast of Australia, shown in Figures 4(a), 5(a,b), and 6(a), respectively. The data for the O'Hara and Chevron sites was converted to DEM grids with each point at a spacing of 2 m (by courtesy of Geoscience Australia), resulting in bathymetric grids of 693112 and 48553 observations for the O'Hara and Chevron sites. The data for the Scott reef site was converted to a DEM grid with each point at a spacing of 4 m (also by courtesy of Geoscience Australia) resulting in a grid of 575240 observations. The bathymetric features derived from the grids were slope, aspect, profile curvature, plan curvature, and rugosity [12], [35], and were computed at a variety of spatial scales as benthic habitats can span a continuum of spatial scales.

2) Imagery: Geo-referenced seafloor imagery was collected at each of these sites by our AUV *Sirius* (Figure 1) from a height of 2m at 0.5m intervals over approximately two 2 km transects for the O'Hara site, 2 grids for the Chevron site, and one 5 km long transect for the Scott Reef site, illustrated in Figures 4(a), 5(a,b), and 6(a), respectively. The AUV is equipped with a high resolution stereo camera pair and strobes, a multibeam sonar, depth and conductivity/temperature sensors, Doppler Velocity Log (DVL) including a compass with integrated roll and pitch sensors, Ultra Short Baseline Acoustic Positioning System (USBL) and forward looking obstacle avoidance sonar [36]. The imagery was classified using a generative non-parametric Bayesian classifier - the Variational Dirichlet Process (VDP) model [37] into 12 classes (Figure 4(b)) for the Tasmania dives[2] and 5 for the Scott Reef dive (Figure 6(b)).

The class labels for sampled positions using the AUV and the feature vectors for these positions derived from the shipborne multibeam bathymetry formed the datasets we used for our experiments. We combined data from both transects in the O'Hara region, into one dataset because the dives were in close spatial proximity. For the same reasons we also combined the data from both grids in the Chevron region. This resulted in a total of 3 datasets (O'Hara, Chevron, and Scott Reef composed of 15812, 5659, and 2972 observations, respectively) that we used to carry out our experiments, including the long transect at Scott Reef.

B. Experimental Setup

In essence, our experiments were based on learning a classifier on randomly chosen subsets of all the data and testing on the remaining data. The key idea was to illustrate the behavior of the classifier performance as the training set size grows.

In the machine learning literature randomly choosing a subset of the data to learn a model and the remaining to test the model is known as *holdout validation* and was used to compare generative and discriminative classifiers by [20]. We repeated holdout validation 100 times (each time using a different random subset of all the data) for a fixed training set size and recorded the average accuracy, where the accuracy was simply the proportion of correctly classified instances. We repeated this procedure for growing sizes of training sets.

We compared GMM's to Classification Trees [38] (CT's) and Support Vector Machines [39] (SVM's), both being non-parametric in nature, i.e., they do not make assumptions about the underlying data distribution, and are well known discriminative classifiers. As mentioned earlier Classification Trees have recently gained popularity in the benthic habitat mapping literature [15], [5]. Although, we have not encountered any literature in the benthic habitat mapping field that employs SVM's, they are acknowledged to be very competitive discriminative classifiers in the machine learning literature [40], [41], and therefore, making them important classifiers to compare against.

Classification trees are prone to overfitting because the learning algorithm is unstable [42]. In order to alleviate this problem we limited the number of observations per split and leaf to be 5 and used the *Gini* criteria for splitting [43]. Furthermore, we also pruned a learned decision tree based on resubstitution error computed using a 10-fold cross validation. Other techniques to reduce overfitting such as *bagging* (alternatively known as *bootstrap aggregation*) have been recommended in the literature [42]. Bagging can be applied to any classifier including GMM's. However, in this paper we only consider single learners and leave the ensemble based comparison as future work. We used the standard Matlab implementation of Classification Trees, which also allows probabilistic outputs.

SVM's require setting two important parameters: the soft margin parameter C and a kernel parameter γ. We selected a combination of C and γ by carrying out a grid search with exponentially growing sequences of C and γ, and computing the cross validation error for each combination. The combination with the least error was chosen. Using this technique, parameter values were automatically determined individually for every training set used in our experiments. We used the LIBSVM implementation of [44] which also allows probabilistic outputs.

[2] All the imagery from the Tasmania dives, i.e., O'Hara 7, 20, Chevron 10, and 14, were collectively classified resulting in a total of 12 labels for both regions.

Finally, we used uniform priors for computing the posterior in Equation 4, i.e., $\beta_c = \frac{1}{C}$, where C is the total number of classes for the labelled data. We will further elaborate on this point in Section V.

C. Results

The results of the holdout validation experiments are displayed in Figure 2. We initially incremented the training set sizes by a small value resulting in *high variance* regions in Figures 2(a, b, c). We provided a magnified view of these high variance regions in the second row, i.e., Figures 2(d, e, f). The first row of Figure 2 illustrates that the GMM performs comparably, or outperforms, the best classifier for all training dataset sizes. The second row in Figure 2 illustrates that for the smallest training datasets the GMM outperforms the other classifiers on all datasets.

It can be observed that the CT suffers on small training set sizes, however catches up in performance as the the training set sizes increase. On the contrary, it can be observed that the SVM performs relatively well to the CT, and comparably to the GMM, for small training set sizes, however it is outperformed by the other classifiers for larger training set sizes on all the datasets. This observation can be explained by the fact that CT's suffer from overfitting, and this problem becomes more severe in absence of sufficient training data that would be a good representative of the test data. Hence, the SVM is more suitable than the CT for smaller training sets, whereas the GMM performs comparably, or better, for all training set sizes on all of the datasets.

We also compared the overall uncertainty of predictions for each of the classifiers as is illustrated in Figure 3. We used entropy of the predicted posterior class distribution for a given observation x (feature vector)

$$H(x) = \sum_{c=1}^{C} P(c \mid x) \log P(c \mid x). \tag{5}$$

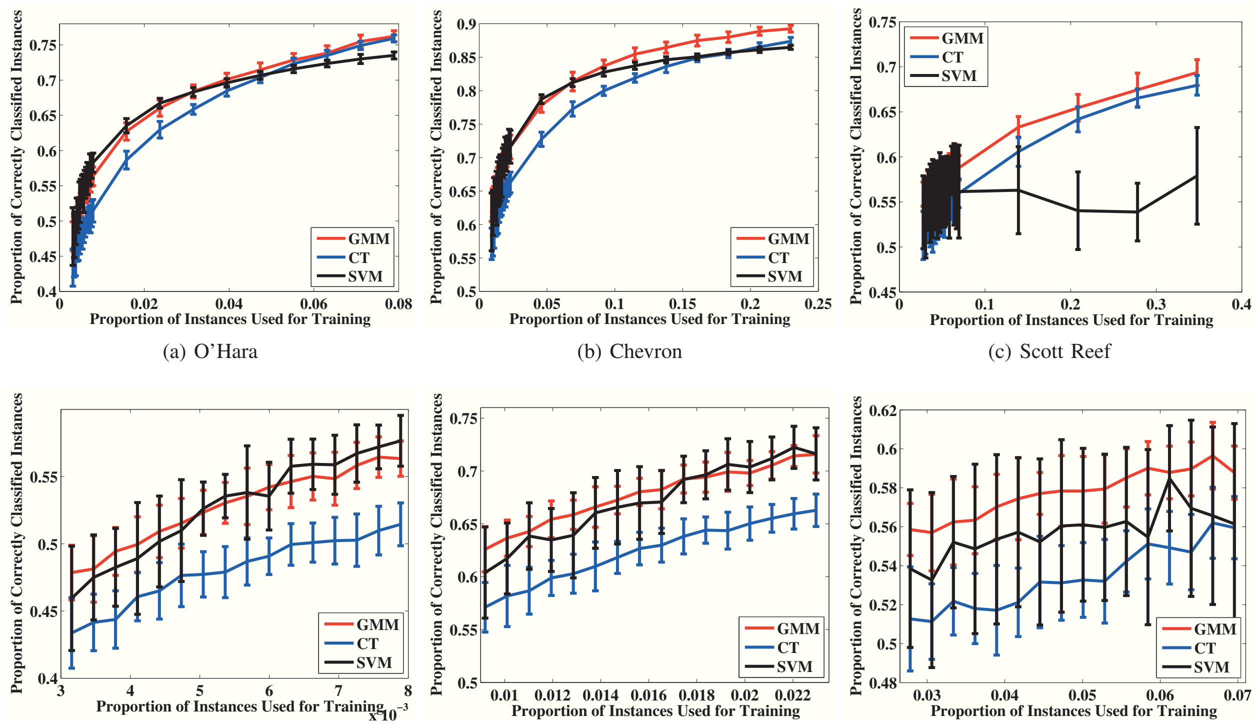
where $\{1, \cdots, C\}$ is the set of all classes. Given the entropy for each prediction we compute an overall uncertainty measure for each classifier

$$U(classifier) = \sum_{X_i \in P^U} H(X_i), \tag{6}$$

i.e., the sum of the individual entropies for each observation in the entire training set. The entropies were computed alongside the accuracies when running the holdout validation experiments.

From Figure 3 it can be seen that for all datasets the GMM is more certain about its predictions in contrast to the SVM and the CT, particularly for small training set sizes. Furthermore, it is an order of magnitude more certain on the Chevron dataset, for smaller training set sizes. As the training set size increases it can be observed that the CT catches up in its certainty, however, at a faster rate than the SVM (this phenomenon will be explained shortly). The relatively greater certainty of the GMM on unseen data is explained by the fact that the GMM is a generative model and takes into account the distribution of the bathymetric features as well, enabling it to model the joint distribution of the class and the features. This is not the case with discriminative classifiers such as the SVM and the CT, which only model the conditional distribution of the classes given the features, which carries lesser information than the joint distribution.

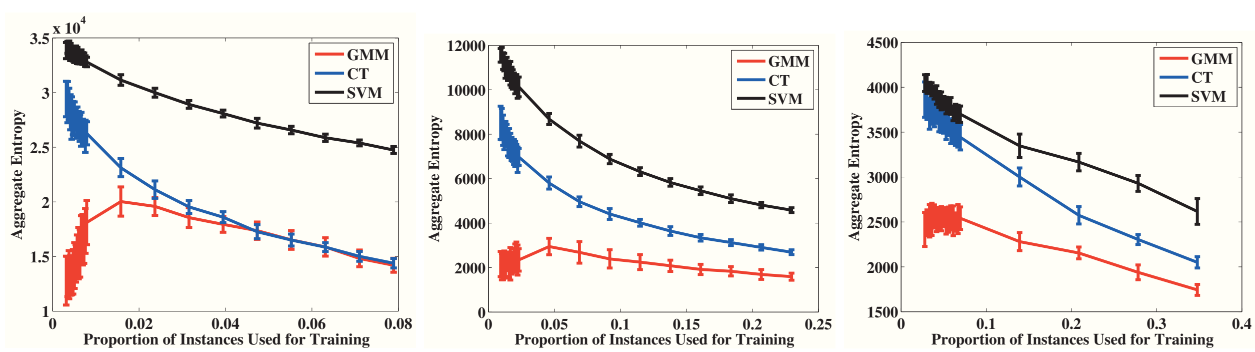
We were also interested in comparing model confidence when extrapolating a classifier's predictions to the entire survey site, as that is the ultimate goal of broad-scale benthic habitat mapping. As mentioned earlier, bathymetric data for the entire site was made available using a ship-borne multibeam sonar, yielding a bathymetric



(a) O'Hara (b) Chevron (c) Scott Reef

(d) O'Hara (e) Chevron (f) Scott Reef

Fig. 2. (First Row) Holdout validation accuracy as the training set size increase. The accuracy is the number of correctly classified instances averaged over a 100 runs for a given proportion of training instances in the entire data set. (Second Row) A magnified view of the *high variance* regions inside the plots in the first row, to highlight the behavior of holdout validation accuracy for very small training datasets.



(a) O'Hara (b) Chevron (c) Scott Reef

Fig. 3. The average aggregate entropy (U - overall uncertainty) of the classifiers predictions on the test data as training dataset size increases. The average was obtained over 100 random training sets for each training set size.

grid. This made it possible for us to compute bathymetric features for each point in the grid. The classifiers were learned over the entire training data for a site and their predictions were extrapolated to each point in the bathymetric grid. In order to make point estimates of the mean and standard deviation of $U(classifier)$, we generated 100 bootstrap samples of each training dataset and computed the mean and standard deviations [45]. Table I illustrates the model uncertainties $U(classifier)$ for each site. It should be noted that the proportion of training data used for each site was less than 10% of the corresponding test data (recall that training set sizes for O'Hara, Chevron, and Scott Reef sites were 15812, 5659, and 2972, respectively, whereas the test data sizes for each of the sites were 693112, 48553, and 575240, respectively).

It can be seen that GMM's are more confident in their predictions than the discriminative classifiers. As mentioned earlier, this can be explained by the fact that GMM's model the joint distribution, hence carry more information about the data in contrast to discriminative classifiers which simply model the boundaries between the classes, i.e., $P(C \mid X)$. Sample entropy maps are displayed in Figures 4(c-e), 5(d-i), and 6(c-e). Corresponding habitat maps are displayed in Figures 4(f-h), 5(j-o), and 6(f-h).

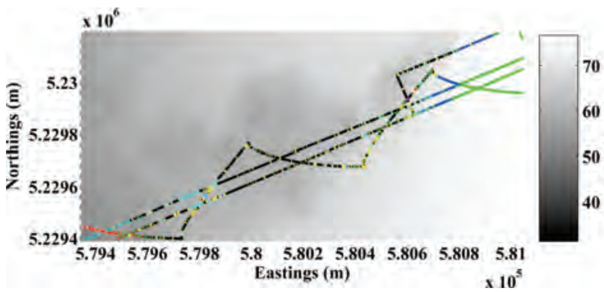
It can be observed that SVM's consistently exhibited the poorest confidence in their predictions even though they performed well in our holdout validation experiments. This suggests that although the classification may be correct many observations still lie close to the support vectors or within the margins between them.

It should be noted that the GMM based habitat maps also contain regions which do not belong to existing classes but some unobserved

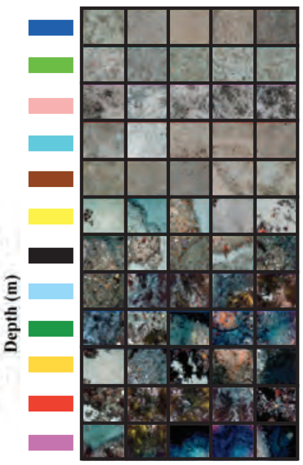
Site	GMM	CT	SVM
O'Hara	26725.90 (429.82)	56513.77 (669.40)	101440.46 (512.65)
Chevron	308.69 (136.89)	6278.9 (191.11)	14215.35 (512.65)
Scott Reef	45752.89 (3158.21)	74439.26 (4646.99)	202529.00 (2609.22)

TABLE I

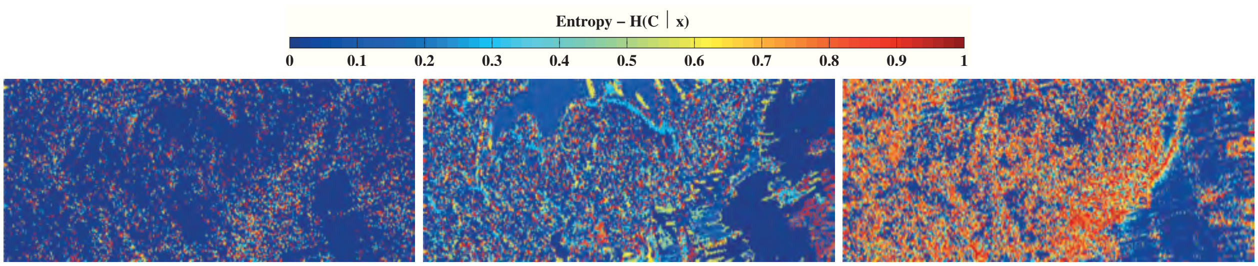
THE AVERAGE AGGREGATE ENTROPIES (STANDARD DEVIATION IN PARENTHESES) FOR PREDICTIONS OVER THE ENTIRE SURVEY REGION MADE BY GMM'S, CT'S, AND SVM'S LEARNED OVER ALL LABELED DATA. CORRESPONDING SAMPLE ENTROPY MAPS ARE DISPLAYED IN FIGURES 4(C-E), 5(D-I), AND 6(C-E). CORRESPONDING HABITAT MAPS ARE DISPLAYED IN FIGURES 4(F-H), 5(J-O), AND 6(F-H).



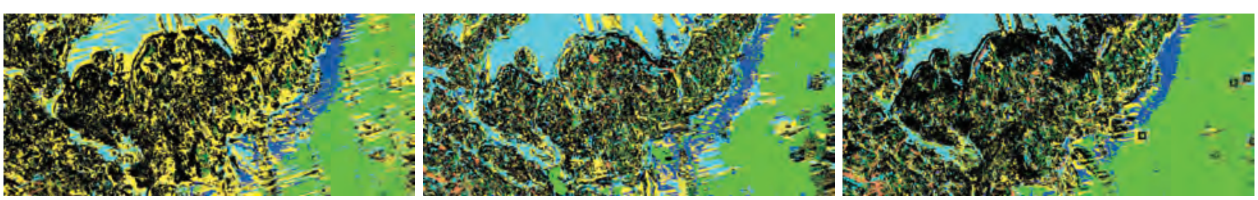
(a) O'Hara bathymetry overlaid with dive profiles



(b) VDP labels for Tasmania



(c) O'Hara (GMM) (d) O'Hara (CT) (e) O'Hara (SVM)



(f) O'Hara (GMM) (g) O'Hara (CT) (h) O'Hara (SVM)

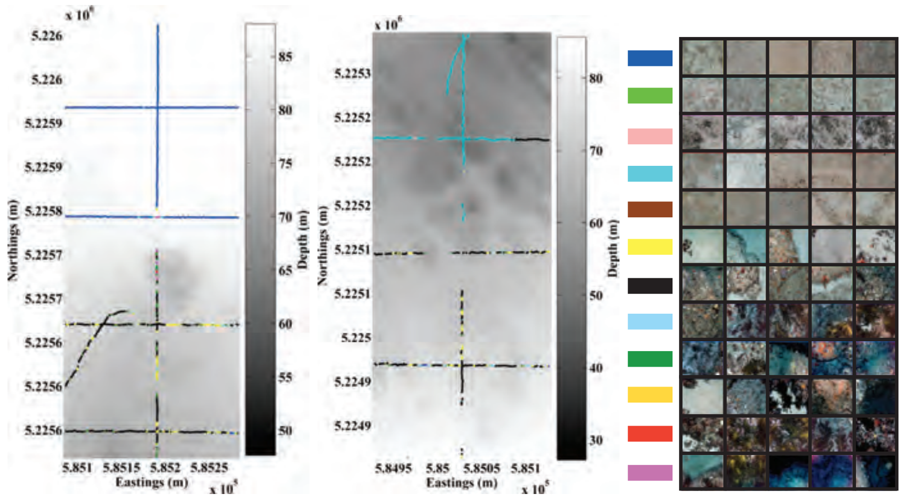
Fig. 4. (a) Seabed bathymetry (depth map in meters) overlaid with dive profiles in region of the O'Hara site. The dives are colored by the class labels identified by the VDP algorithm (b). (c, d, and e) Sample entropy maps of GMM, CT, and SVM predictions over entire sites based on classifiers learned over all available training data. (f, g, and h) Habitat maps based on GMM, CT, and SVM predictions over entire sites.

(new) classes. This feature of generative models further motivates its use over discriminative classifiers in habitat mapping, and can be particularly beneficial in future dive planning, though that is not the subject of this paper.

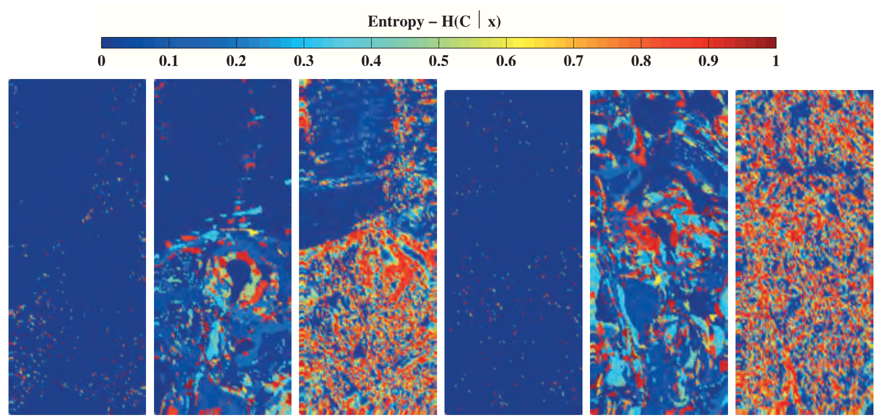
In summary, the GMM *consistently* performs similar to, or outperforms, the best classifier for all training set sizes. This is *not* the case with the SVM and the CT. Furthermore, the GMM is also more certain in its predictions than the other classifiers for all training set sizes. Finally, the GMM is consistently observed to be more certain in its predictions over each survey site and has the capability to indicate whether unlabeled instances belong to an existing class or some unobserved (new) class.

V. DISCUSSION

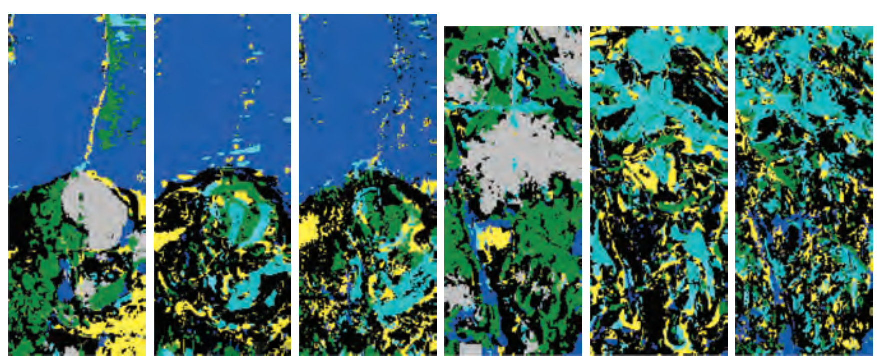
One issue in GMM based classification that arises in yhe absence of sufficient training data is the determination of the class probability priors in Equation 4. One obvious way to determine priors is through the available labeled data. However, if this data is scarce, then our priors may clearly be misleading. In order to alleviate this problem we used non-informative priors (i.e., uniform priors) for $P(C)$.



(a) Chevron 10 bathymetry overlaid with dive profile (b) Chevron 14 bathymetry overlaid with dive profile (c) VDP labels for Tasmania



(d) Chevron 10 (GMM) (e) Chevron 10 (CT) (f) Chevron 10 (SVM) (g) Chevron 14 (GMM) (h) Chevron 14 (CT) (i) Chevron 14 (SVM)

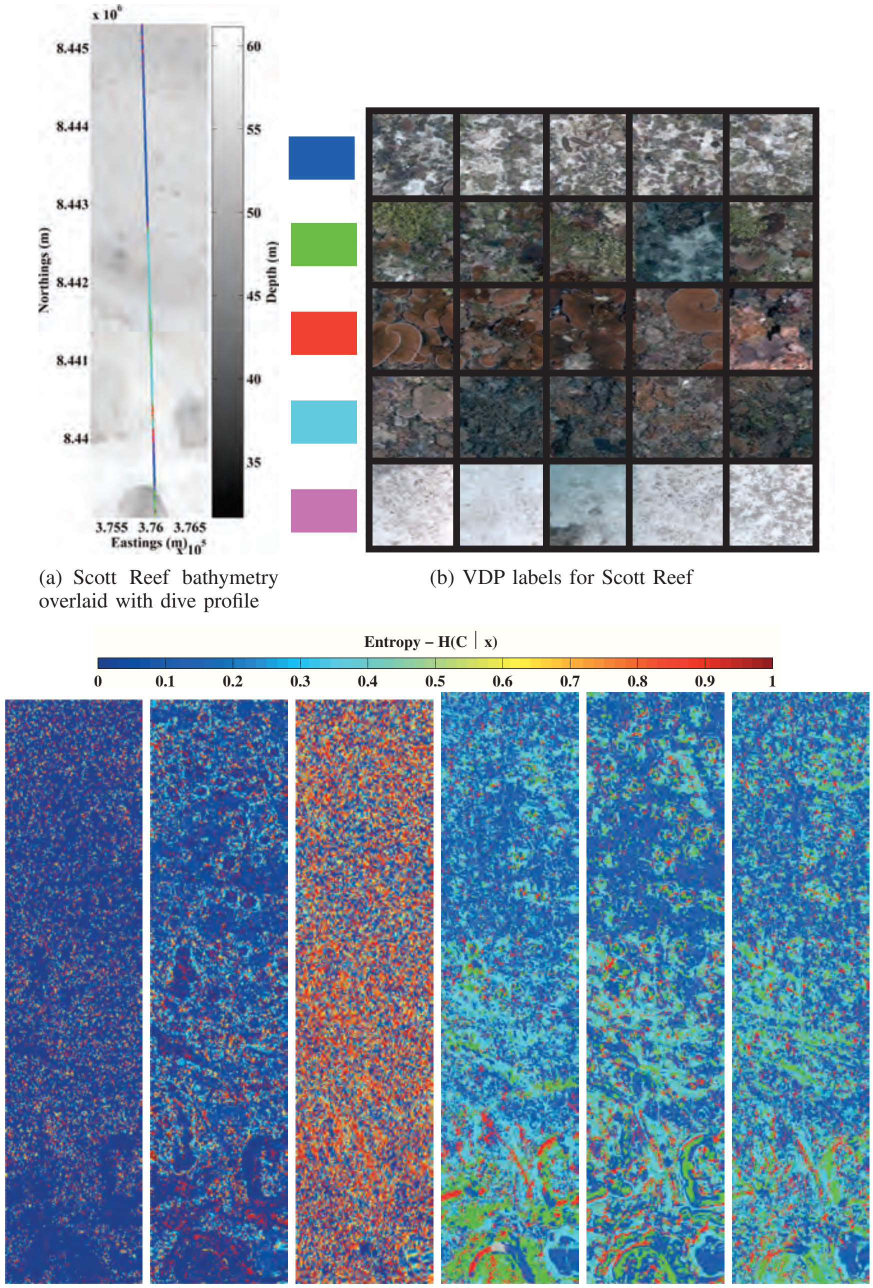


(j) Chevron 10 (GMM) (k) Chevron 10 (CT) (l) Chevron 10 (SVM) (m) Chevron 14 (GMM) (n) Chevron 14 (CT) (o) Chevron 14 (SVM)

Fig. 5. (a) Seabed bathymetry (depth maps in meters) overlaid with dive profile in two regions of the Chevron site. The dives are colored by the class labels identified by the VDP algorithm (b). (c, d, and e) Sample entropy maps of GMM, CT, and SVM predictions over entire sites based on classifiers learned over all available training data. (f, g, and h) Habitat maps based on GMM, CT, and SVM predictions over entire sites.

Though we have not presented results on priors determined from training data, a significant degradation of GMM performance was observed when we made an attempt to do so. This clearly indicates the important of using informative priors. In future, we intend to investigate methods based on expert knowledge that would allow us to formulate informative priors. We anticipate that with better priors we may be able to boost the performance of the GMM, particularly for smaller training set sizes. Some work on formulating informative priors from expert knowledge in ecological modeling has been done by [46].

Gaussian Mixture Models are learned using the EM-algorithm, which makes point estimates of the most probable parameter values,



(a) Scott Reef bathymetry overlaid with dive profile

(b) VDP labels for Scott Reef

(c) Scott Reef (GMM)

(d) Scott Reef (CT)

(e) Scott Reef (SVM)

(f) Scott Reef (GMM)

(g) Scott Reef (CT)

(h) Scott Reef (SVM)

Fig. 6. (a) Seabed bathymetry (depth map in meters) overlaid with the dive profile in Scott Reef. The dives are colored by the class labels identified by the VDP algorithm (b). (c, d, and e) Sample entropy maps of GMM, CT, and SVM predictions over entire sites based on classifiers learned over all available training data. (f, g, and h) Habitat maps based on GMM, CT, and SVM predictions over entire sites.

i.e., the means and covariances of the mixture components. Another algorithm known as the Variational Bayes [47], [48], [49] can compute distribution over the parameters giving more information that can be used to reduce overfitting of the GMM on training data leading to better generalization on unseen data. Since benthic habitat mapping involves extrapolation to much broader scales we consider it worthwhile to investigate the Variational Bayes algorithm for learning GMM's.

One of the requirements for learning a GMM is to specify the number of components the GMM should take. We overcame this problem by computing the BIC score for a class of models (with with a different number of components) and chose the model that minimized the BIC criterion. However, there exist models such as Dirichlet Process Mixture Models that can estimate the number of components in a more principled manner [50], and have been recommended for model selection [51]. Given that Dirichlet Process Mixture Models can be learned through variational techniques (leading to better generalization) and that the number of components is determined in a more principled Bayesian manner, we consider it worthwhile to investigate the usefulness of such models for benthic habitat mapping.

Another important issue is that the CT's have high variance due to the nature of the learning algorithm. It has been recommended that *bagging* CT's can reduce the model variance [42]. Bagging can be described as the process of taking n bootstrap samples of the training data and learning n corresponding classification trees. The final model is then taken as an average of all the classification trees. Given that bagging can be applied to other classifiers we would also like to investigate the effect of bagging classification trees against an ensemble of Gaussian Mixture Models.

VI. Conclusion

In conclusion, we have shown that Gaussian Mixture Models can be effectively used for benthic habitat classification, particularly when training data is limited, making them less sensitive to the amount of training data in contrast to CT's and SVM's. Furthermore, we have shown that they *consistently* perform comparably to, or outperform, the best discriminative classifier (SVM's or CT's) for a variety of training set sizes ranging from small to large, which is not the case with the other two classifiers. We have also shown that GMM's are more certain in their predictions when learned on small training sets in contrast to other classifiers which only catch up for relatively larger training sets. Finally, we note that GMM's also have the capability of indicating whether an unobserved instance belongs to an existing class or some new unobserved class. This feature particularly motivates the use of GMM's, over discriminative classifiers, when habitat maps are used in future dive planning.

We anticipate that the uncertainty maps generated could be used to direct optical surveys toward areas of high entropy [52]. Since our data processing pipeline is fully automated these maps can be automatically updated after each round of sampling. Furthermore, since GMM's are more robust in the presence of little training data, future work will compare how data collected from trajectories based on uncertainty maps from GMM's compares to that collected by using SVM's or classification trees.

Acknowledgment

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References

[1] S. Williams, O. Pizarro, J. Webster, R. Beaman, I. Mahon, M. Johnson-Roberson, and T. Bridge, "auv-assisted surveying of drowned reefs on the shelf edge of the great barrier reef, australia," *Journal of Field Robotics*, vol. 27, no. 5, pp. 675–697, 2010.

[2] R. Armstrong, H. Singh, J. Torres, R. Nemeth, A. Can, C. Roman, R. Eustice, L. Riggs, and G. Garciamoliner, "Characterizing the deep insular shelf coral reef habitat of the Hind Bank marine conservation district (US Virgin Islands) using the Seabed autonomous underwater vehicle," *Continental Shelf Research*, vol. 26, no. 2, pp. 194–205, Feb 2006.

[3] R. Henthorn, D. Caress, H. Thomas, R. McEwen, W. Kirkwood, C. Paull, and R. Keaten, "High-Resolution Multibeam and Subbottom Surveys of Submarine Canyons, Deep-Sea Fan Channels, and Gas Seeps Using the MBARI Mapping AUV," in *OCEANS 2006*, sept. 2006, pp. 1 –6.

[4] V. Kostylev, B. Todd, G. Fader, R. Courtney, G. Cameron, and R. Pickrill, "Benthic habitat mapping on the Scotian Shelf based on multibeam bathymetry, surficial geology and sea floor photographs," *Marine Ecology-Progress Series*, vol. 219, pp. 121–137, 2001.

[5] D. Ierodiaconou, J. Monk, A. Rattray, L. Laurenson, and V. Versace, "Comparison of automated classification techniques for predicting benthic biological communities using hydroacoustics and video observations," *Continental Shelf Research*, vol. In Press, Corrected Proof, pp. –, 2010. [Online]. Available: http://www.sciencedirect.com/science/article/B6VBJ-4Y8G5YF-3/2/b42880aab7587b9a60b173ff153409d0

[6] K. Holmes, K. V. Niel, G. Kendrick, and B. Radford, "Probabilistic large-area mapping of seagrass species distributions," *Aquatic Conservation: Marine and Freshwater Ecosystems*, vol. 17, no. 4, pp. 385–407, 2007.

[7] P. Dartnell and J. Gardner, "Predicting seafloor facies from multibeam bathymetry and backscatter data," *Photogrammetric Engineering and Remote Sensing*, vol. 70, no. 9, pp. 1081–1091, 2004.

[8] A. Kenny, I. Cato, M. Desprez, G. Fader, R. Schuttenhelm, and J. Side, "An overview of seabed-mapping technologies in the context of marine habitat classification," *ICES Journal of Marine Science*, vol. 60, no. 2, pp. 411–418, 2003.

[9] M. Haywood, C. Pitcher, N. Ellis, T. Wassenberg, G. Smith, K. Forcey, I. McLeod, A. Carter, C. Strickland, and R. Coles, "Mapping and characterisation of the inter-reefal benthic assemblages of the torres strait," *Continental Shelf Research*, vol. 28, no. 16, pp. 2304 – 2316, 2008, marine resources, biophysical processes, and environmental management of a tropical shelf seaway; Torres Strait, Australia. [Online]. Available: http://www.sciencedirect.com/science/article/B6VBJ-4S85DR7-3/2/b7b86950be7ac626df8243fca57f1bb4

[10] B. Radford, O. Pizarro, J. Colquhoun, C. Moore, S. Williams, M. Jakuba, T. Cooper, A. Heyward, M. Sexton, and S. Burq, "Predictive habitat mapping of deep water coral reefs using data from Multibeam and AUV machine auto-classified data and an Ecological Modelling approach," in *Proc. of Euro International Society for Reef Studies: Reefs in a Changing Environment conference*, 2010.

[11] V. Lucieer et al, ""object based segmentation of multibeam backscatter data: methods for spatial analysis of shallow coastal seabeds, south eastern tasmania, australia"," in *Geohab 2010*, May 2010.

[12] M. F. J. Wilson, B. O'Conell, C. Brown, J. Guinan, and A. Grehan, "Multiscale terrain analysis of multibeam bathymetry data for habitat mapping on the continental slope," *Marine Geodesy*, vol. 30, no. 1, pp. 3–35, 2007.

[13] K. W. Able, D. C. Twichell, C. B. Grimes, and R. S. Jones, "Sidescan sonar as a tool for detection of demersal fish habitats," *Fishery Bulletin*, vol. 85, no. 4, pp. 725–736, 1987.

[14] C. N. Rooper and M. Zimmermann, "A bottom-up methodology for integrating underwater video and acoustic mapping for seafloor substrate classification," *Continental Shelf Research*, vol. 27, no. 7, pp. 947 – 957, 2007. [Online]. Available: http://www.sciencedirect.com/science/article/B6VBJ-4MR86N8-3/2/77220b3f45e494e0ce1a5dd764c854cd

[15] K. Holmes, K. Van Niel, B. Radford, G. Kendrick, and S. Grove, "Modelling distribution of marine benthos from hydroacoustics and underwater video," *Continental Shelf Research*, vol. 28, no. 14, pp. 1800–1810, 2008.

[16] P. Rigby, O. Pizarro, and S. B. Williams, "Toward adaptive benthic habitat mapping using gaussian process classification," *Journal of Field Robotics*, vol. 27, no. 6, pp. 741–758, 2010. [Online]. Available: http://dx.doi.org/10.1002/rob.20372

[17] K. Lowell, "Utilizing discriminant function analysis with a geographical information system to model ecological succession spatially," *International Journal of Geographical Information Systems*, vol. 5, no. 2, pp. 175–191, 1991.

[18] C. J. F. Braak and P. F. M. Verdonschot, "Canonical correspondence analysis and related multivariate methods in aquatic ecology," *Aquatic Sciences - Research Across Boundaries*, vol. 57, no. 3, pp. 255–289, 1995.

[19] A. Guisan and N. E. Zimmermann, "Predictive habitat distribution models in ecology," *Ecological Modelling*, vol. 135, no. 2-3, pp. 147 – 186, 2000. [Online]. Available: http://www.sciencedirect.com/science/article/B6VBS-41YG767-4/2/08e50360467a21c812a2cbc658d91871

[20] A. Jordan, "On discriminative vs. generative classifiers: A comparison of logistic regression and naive bayes," *Advances in neural information processing systems*, vol. 14, p. 841, 2002.

[21] S. Phillips, R. Anderson, and R. Schapire, "Maximum entropy modeling of species geographic distributions," *Ecological modelling*, vol. 190, no. 3, pp. 231–259, 2006.

[22] D. P. Tittensor, A. R. Baco, P. E. Brewin, M. R. Clark, M. Consalvey, J. Hall-Spencer, A. A. Rowden, T. Schlacher, K. I. Stocks, and A. D. Rogers, "Predicting global habitat suitability for stony corals on seamounts," *Journal of Biogeography*, vol. 36, no. 6, pp. 1111–1128, 2009. [Online]. Available: http://dx.doi.org/10.1111/j.1365-2699.2008.02062.x

[23] S. Pittman and K. Brown, "Multi-scale approach for predicting fish species distributions across coral reef seascapes," *PloS one*, vol. 6, no. 5, p. e20583, 2011.

[24] C. JEFFREY, R. CLARK, and S. HILE, "Spatial patterns in benthic composition of nearshore seascapes and implications for scarid populations and fisheries in la parguera, sw puerto rico," *Proceedings of the 62nd Gulf and Caribbean Fisheries Institute*, pp. 2–6, 2010.

[25] Z. Huang, B. Brooke, and J. Li, "Performance of predictive models in marine benthic environments based on predictions of sponge distribution on the australian continental shelf," *Ecological Informatics*, 2011.

[26] K. Howell, R. Holt, I. Endrino, and H. Stewart, "When the species is also a habitat: Comparing the predictively modelled distributions of lophelia pertusa and the reef habitat it forms," *Biological Conservation*, 2011.

[27] S. Phillips, M. Dudík, and R. Schapire, "A maximum entropy approach to species distribution modeling," in *Proceedings of the twenty-first international conference on Machine learning*. ACM, 2004, p. 83.

[28] R. Aspinall, "An inductive modelling procedure based on bayes' theorem for analysis of pattern in spatial data," *International Journal of Geographical Information Systems*, vol. 6, no. 2, pp. 105–121, 1992.

[29] D. G. Gavin and F. S. Hu, "Bioclimatic modelling using gaussian mixture distributions and multiscale segmentation," *Global Ecology and Biogeography*, vol. 14, no. 5, pp. 491–501, 2005. [Online]. Available: http://dx.doi.org/10.1111/j.1466-822x.2005.00171.x

[30] J.-P. M. Witte, R. B. Wjcik, P. J. Torfs, M. W. de Haan, and S. Hennekens, "Bayesian classification of vegetation types with gaussian mixture density fitting to indicator values," *Journal of Vegetation Science*, vol. 18, no. 4, pp. 605–612, 2007. [Online]. Available: http://dx.doi.org/10.1111/j.1654-1103.2007.tb02574.x

[31] G. McLachlan and D. Peel, *Finite mixture models*. Wiley-Interscience, 2000.

[32] C. Bishop, *Pattern recognition and machine learning*. Springer New York, 2006, vol. 4.

[33] A. Dempster, N. Laird, and D. Rubin, "Maximum likelihood from incomplete data via the EM algorithm," *Journal of the Royal Statistical Society. Series B (Methodological)*, vol. 39, no. 1, pp. 1–38, 1977.

[34] G. McLachlan and T. Krishnan, *The EM algorithm and extensions*. LibreDigital, 2008.

[35] J. Jeness, http://www.jennessent.com/arcview/grid_tools.htm, 2002.

[36] S. Williams, O. Pizarro, I. Mahon, and M. Johnson-Roberson, "Simultaneous localisation and mapping and dense stereoscopic seafloor reconstruction using an AUV," *Experimental Robotics: The 11th Intern. Sympo.*, vol. 54, pp. 407–416, 2009.

[37] D. Steinberg, S. Williams, O. Pizarro, and M. Jakuba, "Towards autonomous habitat classification using Gaussian Mixture Models," in *Intelligent Robots and Systems (IROS), 2010 IEEE/RSJ International Conference on*. IEEE, pp. 4424–4431.

[38] J. R. Quinlan, *C4.5: Programs for Machine Learning (Morgan Kaufmann Series in Machine Learning)*, 1st ed. Morgan Kaufmann, January 1993. [Online]. Available: http://www.amazon.com/exec/obidos/redirect?tag=citeulike07-20&path=ASIN/1558602380

[39] A. Smola and B. Schölkopf, *Learning with kernels*. Citeseer, 1998.

[40] N. Cristianini and J. Shawe-Taylor, *An introduction to support Vector Machines: and other kernel-based learning methods*. Cambridge Univ Pr, 2000.

[41] I. Steinwart and A. Christmann, *Support vector machines*. Springer Verlag, 2008.

[42] J. Friedman, T. Hastie, and R. Tibshirani, *The elements of statistical learning*. Springer Series in Statistics, 2001, vol. 1.

[43] W. Buntine and T. Niblett, "A further comparison of splitting rules for decision-tree induction," *Machine Learning*, vol. 8, no. 1, pp. 75–85, 1992.

[44] C.-C. Chang and C.-J. Lin, "LIBSVM: A library for support vector machines," *ACM Transactions on Intelligent Systems and Technology*, vol. 2, pp. 27:1–27:27, 2011, software available at http://www.csie.ntu.edu.tw/~cjlin/libsvm.

[45] M. Saar-Tsechansky and F. Provost, "Active sampling for class probability estimation and ranking," *Machine Learning*, vol. 54, no. 2, pp. 153–178, 2004.

[46] S. Choy, R. O'Leary, and K. Mengersen, "Elicitation by design in ecology: using expert opinion to inform priors for bayesian statistical models," *Ecology*, vol. 90, no. 1, pp. 265–277, 2009.

[47] H. Attias, "Inferring parameters and structure of latent variable models by variational bayes," in *Proceedings of the fifteenth conference on uncertainty in artificial intelligence*. Morgan Kaufmann Publishers Inc., 1999, pp. 21–30.

[48] H. a. Attias, "A variational bayesian framework for graphical models," *Advances in neural information processing systems*, vol. 12, no. 1-2, pp. 209–215, 2000.

[49] S. Waterhouse, D. MacKay, and T. Robinson, "Bayesian methods for mixtures of experts," *Advances in neural information processing systems*, pp. 351–357, 1996.

[50] Y. Teh, M. Jordan, M. Beal, and D. Blei, "Hierarchical dirichlet processes," *Journal of the American Statistical Association*, vol. 101, no. 476, pp. 1566–1581, 2006.

[51] R. M. Neal, "Markov chain sampling methods for dirichlet process mixture models," *Journal of Computational and Graphical Statistics*, vol. 9, no. 2, pp. pp. 249–265, 2000. [Online]. Available: http://www.jstor.org/stable/1390653

[52] N. Ahsan, S. Williams, M. Jakuba, O. Pizarro, and B. Radford, "Predictive habitat models from AUV-based multibeam and optical imagery," in *OCEANS 2010*. IEEE, pp. 1–10.

Adcom Election Results

Jim Barbera, OES Junior Past President

A ballot for the annual election of the OES Administrative Committee was issued on 17 May 2012 for the term to begin in 2013 and end in 2015. A total of 274 ballots were returned to IEEE Headquarters for the three year term. The ballots have been counted and the following candidates have been elected:

James V. Candy
James S. Collins
John Potter
Ken Takagi
John Watson
Thomas F. Wiener

The results reflect our international flavor in that there are several countries represented.We welcome the newly elected members to the Adcom and extend our thanks to all the candidtes for their willingness to serve the society and for taking the time and effort to place themselves in contention.

JAMES V. CANDY (S'73-M'76-M'93-SM'94-F'99) is the Chief Scientist for Engineering, a Distinguished Member of the Technical Staff and founder/former Director of the Center for Advanced Signal & Image Sciences (CASIS) at the Lawrence Livermore National Laboratory. Dr. Candy received a commission in the USAF in 1967 and was a Systems Engineer/Test Director from 1967 to 1971 (Captain/Vietnam Era Veteran). He has been a Researcher at the Lawrence Livermore National Laboratory since 1976 holding various positions including that of Project Engineer for Signal Processing and Thrust/Focus Area Leader for Signal and Control Engineering. Educationally, he received his B.S.E.E. degree from the University of Cincinnati and his M.S.E. and Ph.D. degrees in Electrical Engineering from the University of Florida. He is a registered professional Control System Engineer in the state of California. He has been an Adjunct Professor at San Francisco State University, University of Santa Clara, and UC Berkeley, Extension teaching graduate courses in signal and image processing. He is an Adjunct Full-Professor at the University of California, Santa Barbara. Dr. Candy is a Fellow of the IEEE "for contributions to model-based ocean acoustic signal processing" and a Fellow of the Acoustical Society of America (ASA) "for contributions to model-based acoustic signal processing." He was elected as a Life Member (Fellow) at the University of Cambridge (Clare Hall College). He is a member of Eta Kappa Nu and Phi Kappa Phi honorary societies. He was elected as a Distinguished Alumnus by the University of Cincinnati "for meritorious achievement, recognized stature and conspicuous success in the imaginative blending of engineering education with highly productive endeavors in industry, professional activities, and public service." Dr. Candy received the IEEE Distinguished Technical Achievement Award for the "development of model-based signal processing in ocean acoustics." Dr. Candy was selected as an IEEE Distinguished Lecturer for oceanic signal processing as well as presenting an IEEE tutorial on advanced signal processing available through their video website courses. He was nominated for the prestigious Edward Teller Fellowship at Lawrence Livermore National Laboratory. Dr. Candy has recently been awarded the Interdisciplinary Helmholtz-Rayleigh Silver Medal in Signal Processing/Underwater Acoustics by the Acoustical Society of America "for contributions to the advancement of science, engineering, or human welfare through research accomplishments." He received the R&D100 award for his innovative invention in radiation threat detection. He has published over 225 journal articles, book chapters, and technical reports as well as written four texts in signal processing, "Signal Processing: the Model-Based Approach," (McGraw-Hill, 1986) and "Signal Processing: the Modern Approach," (McGraw-Hill, 1988), "Model-Based Signal Processing," (Wiley/IEEE Press, 2006) and "Bayesian Signal Processing: Classical, Modern and Particle Filtering" (Wiley/IEEE Press, 2009). He was the General Chairman of the inaugural 2006 IEEE Nonlinear Statistical Signal Processing Workshop held at the Corpus Christi College, University of Cambridge. He has presented a variety of short courses and tutorials sponsored by the IEEE and ASA in Applied Signal Processing, Spectral Estimation, Advanced Digital Signal Processing, Applied Model-Based Signal Processing, Applied Acoustical Signal Processing, Model-Based Ocean Acoustic Signal Processing and most recently Bayesian Signal Processing for IEEE Oceanic Engineering Society/ASA. He has also presented short courses in Applied Model-Based Signal Processing for the SPIE Optical Society. He is the IEEE Chair of the Technical Committee on "Sonar Signal and Image Processing" and was the Chair of the ASA Technical Committee on "Signal Processing in Acoustics" as well as currently being an Associate Editor for Signal Processing of ASA (on-line JASAEL). He has recently been nominated for the Vice Presidency of the ASA and was elected to the Administrative Committee of IEEE OES. His research interests include Bayesian learning, estimation, identification, spatial estimation, signal and image processing, array signal processing, nonlinear signal processing, tomography, sonar/radar processing and biomedical applications.

Statement: If elected to the Administrative Committee of the IEEE Oceanic Engineering Society, I would again actively focus my attention on the technical aspects of the society and endeavor to motivate more technical participation especially from those colleagues in signal processing related areas (ocean acoustics, imaging, etc.). I have seen a marked improvement of the abstracts and manuscripts submitted for OCEANS and anticipate that the effort will continue. I believe that the heart of any technical society is its members and their technical efforts that lead to high interest both inside and outside OES (e.g. papers, conferences, workshops, etc.). I would like to see a more organized and focused effort on tutorials and education, since this is typically an area that our members seek to gain technical knowledge and direction especially when entering a new technical area. More Technical Committee participation should be pursued in order to recommend potential tutorial/short course instructors that actively engage in educating our OES members in areas of high interest. Again I remained focused on these technical thrusts and through the AdCom will be able to help guide decisions and votes fostering technical leadership supporting these efforts.

JAMES S. COLLINS (M'66-S'68-M'74-SM'97-LS'08) is completing a term, 2010–2012, as an elected member of the Administrative Committee. His main activity has been to promote the use of autonomous vehicle races to popularize the areas of autonomous marine robotics and more generally oceanic engineering. Earlier as IEEE OES Vice President for Professional Activities from 2004 to 2009 Jim was responsible for Membership Development, Chapters, Newsletter, eNewsletter, Website and Student Activities. He chaired the OES Constitution and Bylaws Committee which was responsible for a complete rewrite of the OES Constitution and Bylaws approved in 2006. Collins served as OES Vice President of Technical Activities in 1994-6, Membership Development Chair for 1998-2003 and elected member of AdCom from 1994 to 1999. He was instrumental in the formation in 2008 of an India Council OES Chapter and a Joint Chapter in New South Wales, Australia. He is completing a term as OES Chapter Chair of the Victoria Section, Victoria, British Columbia, Canada and is as well as a member of the IEEE Women in Engineering affinity group.

As Chair of the IEEE Victoria Section in 1984 he organized the creation of the Victoria OES Chapter. He chaired the 1993 OCEANS Conference in Victoria which was very technically and financially successful.

In recognition of his service he was awarded the IEEE Millennium Medal in 2000 and the OES Distinguished Service Award in 2002.

Jim Collins holds a Ph.D. in Electrical Engineering from the University of Washington, Seattle. In 1979 he joined the Department of Engineering at Royal Roads Military College (RRMC), Victoria and subsequently became Engineering Department Head. He is active in the development of AUV applications and is owner and President of Collins Technologies Inc. as well as an Adjunct Professor in the Department of Electrical and Computer Engineering at the University of Victoria.

Statement: I have been involved with autonomous marine robotics (AMR's) since 1979. AMRs are doers and transporters of increasingly valuable instrument, sensor and effector based tasks. AMR's include AUVs, chemically and wave energized gliders, autonomous sailing craft, amphibians and solar powered surface AMR's. Our growing network of OES Chapters can help to nourish the peaceful development of AMR uses by providing a forum for the racing and design competition of classes of similar AMRs. Conversely this networking activity is valuable to both the participants, Chapters, and members and at the same time spurring growth of the OES worldwide.

More than two billion people live in the countries bordering the Indian Ocean. The IEEE OES conference activity has been focused solely on the Atlantic and Pacific Ocean basins with typically one OCEANS Conference in each basin annually plus a variety of smaller symposia and workshops. The Indian Ocean area is overdue for a small scale version of an OCEANS conference. I made initial contact with the India members in 2002 and encouraged and assisted them in forming their own India Chapter in 2008. Also I helped initiate successful OES technical cosponsorship with Cochin University of the Symposium on Ocean Electronics (SYMPOL) in Kochi, Kerala. With this experience in place the time is right for the India Chapter to initiate a small OCEANS style conference for the Indian Ocean area which is financially and technically cosponsored with the OES.

Internally it is time to do some OES housekeeping. We need to revisit our Constitution and Bylaws to ensure that the very substantial changes introduced in January 2006 are providing the best service to our members. A Policy and Procedure document, not yet written, is required for guiding the OES on a day-to-day basis and for ensuring that new volunteers can succeed in their new positions after a change of personnel. For example when is the last time you saw any information on the financial status and operation of the OES? Where does our revenue come from and where is it spent? I would like to have this financial data from IEEE OES more readily available in our newsletters. Also access to our membership directory used to be available and should be again on a password protected basis. Other IEEE Societies do this.

I am privileged to have served the IEEE Oceanic Engineering Society as a volunteer in many capacities. It is a pleasure to work with the other Administrative Committee members and I will continue to work with them and other members of the OES management to give you the programs you want for your continued professional and intellectual achievement.

JOHN POTTER (M'96-SM'98) earned a Joint Honours degree in Mathematics and Physics from Bristol University in the UK, followed by a PhD in Glaciology and Oceanography from the Univ. Cambridge on research in the Antarctic, where he spent four consecutive summers and for which he was awarded ht ePolar Medal by Queen Elizabeth II.

John has worked in underwater acoustics, communications and autonomous vehicles over a period of more than 25 years, starting as a scientist at the NATO Undersea Research Centre (then Saclant ASW Centre) in 1986. This was followed by 3 years at Scripps Institution of Oceanography where he built the first acoustic camera that produced real-time video images using only ambient noise. It was also during this period that John became interested in the impact of noise on marine mammals, biosonar and humpback whale song.

In 1995 John sailed with his family across the Pacific to Singapore, where he founded the Acoustic Research Laboratory (ARL) and joined the team to create the Tropical Marine Science Institute (TMSI) in the National University of Singapore.

In 2004/5 John took a 14-month sabbatical with his family, circumnavigating the Indian Ocean by sailboat on an expedition of marine research, education and environmental awareness.

John remained head of the ARL for 12 years and became an Associate Director of the TMSI. John co-chaired the OCEANS Asia 2006 conference and exhibition and was subsequently elected to the IEEE OES Administrative Committee, on which he served for three years. John is now involved in the local committee for the OCEANS Europe 2015 conference and exhibition, to be held in Genoa, Italy. In 2008 John began co-ordinating joint research projects between Singapore and NURC in the areas of distributed autonomous intelligent sensing, underwater communications networking and co-operative behaviour, taking up a full-time NURC position in 2009 to head the communications and networking project.

John is a Senior Member of the IEEE, an Associate Editor for the *IEEE Journal of Oceanic Engineering*, PADI Master Scuba Diver Trainer and an International Fellow of the Explorer's Club, among other things. In his spare time he enjoys sailing (both coastal and blue-water) racing motorcycles, flying, visiting whales, skiing, diving, hiking, karate, great food, wine, travel and reading.

It is no longer true that he neither owns nor operates a television.

Statement: The IEEE is the world's largest, and quite possibly the most successful, professional members' organization. The Oceanic Engineering Society (OES) is a small, but very active, society within IEEE and is arguably the pre-eminent professional society for marine engineers and research scientists. This prominent position is supported in no small part by the popular and widely recognized OCEANS conference and exhibition.

While the IEEE and the OES began with a focus on north America, the extension of the OES annual OCEANS conference series to 'Two Oceans', with the second meeting being held alternately in Asia and Europe has greatly expanded the scope, reach and interests of OES.

I believe that the successful development and promotion of OCEANS conferences and exhibitions is a major tool in the OES armoury to serve its members and promote ocean engineering interests. Not least is the continued support to students to participate and compete for awards, the inclusion of underwater vehicle displays and competitions for students (first introduced at Oceans 2006 in Singapore) and related activities that are clustered around these events.

As a previous co-chair of OCEANS Asia 2006 and a local organizing committee member of OCEANS Europe 2015, if elected to the OES AdCom I commit to pursuing the development of OCEANS conferences and exhibitions to bring them to an even higher and more effective level, serving more members, with stronger participation, particularly in Europe.

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

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

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

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

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

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

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

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

(2004) before taking up the Chair of Electrical Engineering in 2007. It was at Aberdeen University that my interests in subsea optics developed and my activities specifically concentrated on the application of holography in the subsea environment. Another interest with a specifically underwater flavour was the work on subsea laser welding. Other research activities include optical image processing, holographic interferometry and laser micro-spectral analysis. I have undertaken joint research with colleagues in the USA, Russia, Ukraine and Europe. I have published extensively on laser-related research including an undergraduate textbook on *Optoelectronics*.

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

Of particular relevance to the IEEE, I was Executive Chair of IEEE/OES OCEANS'07 in Aberdeen and am at present heading a bid to bring it back to Aberdeen in 2017. I served as an elected member of OES AdCom from 2007–11 and a co-opted member of ReCon from 2010, with a specific role related to European OCEANS conferences; I am also European convenor of the Subsea Optics and Vision professional group of OES.

I wish to stand for re-election to OES AdCom in order to continue promotion of OCEANS events across Europe and to the wider community. More specifically related to my own area of expertise I believe that optics in the 21st century has an increasing role to play in the subsea community. I believe that being re-elected to AdCom will enable me to promote this area more effectively within the OCEANS community.

THOMAS F. WIENER (S'55-M'62-M'78-SM'92-LS'02) is an Aerospace Engineer with over 40 years of increasing responsibility in conducting and directing high technology research and development efforts. Now the Principal of the Forté Consultancy, he was formerly a Program Manager of the U.S. Defense Advanced Research Projects Agency, serving there for a total of ten years. He served in the U.S. Navy for over 22 years, qualified in Destroyers and in Submarines. He commanded the nuclear attack submarine USS JACK. His special technical proficiencies span the fields of missile technology, inertial guidance, and automatic control, imaging and non-imaging sensors, and C3I. He has acquired substantial expertise in training and education in the Navy and in civilian life.

Sc.B. (Engineering), Brown University; Sc.D. (Instrumentation), M.I.T. His dissertation, the first substantial work on strapdown inertial guidance, was the basis for the Apollo Guidance System.

Sigma Xi, Tau Beta Pi, and Sigma Gamma Tau

AIAA (Senior Member), SPIE, USNSL, SPEBSQSA (Member)

IEEE Activities

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

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

Conferences: General Chair, IEEE SENSORS 2003

Technical Activities Board: Member (2001–2005); Chair, TAB Society Review Committee (2004–2007)

Chair (2010–2012), IEEE Committee on Earth Observation ICEO

Statement: The Oceanographic Engineering Society is my IEEE home. I've been involved in its activities for the past 17 years. I had the good fortune and honor to serve as Society President for four years. During that time we initiated the practice of presenting two OCEANS Conferences each year, we rewrote our constitution, and we forged a strong, cooperative relationship with the Marine Technology Society.

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

NOSB - 2012

Norman D. Miller, P.E., OES Student Activities Coordinator,
Photos by Will Ramos / Ocean Leadership

The fifteenth National Ocean Sciences Bowl, sponsored by the Consortium for Ocean Leadership, was held in Baltimore, Maryland at the Sheraton City Center Hotel, April 19–22, 2012.

The NOSB is a nationally recognized and highly acclaimed high school academic competition that provides a forum for talented students to test their knowledge of the marine sciences including biology, chemistry, physics, and geology. The NOSB mission is to enrich science teaching and learning across the United States through a high-profile national competition that increases high school students' knowledge of the oceans and enhances public understanding and stewardship of the oceans.The NOSB was created in 1998 in honor of the International Year of the Ocean and since its inception, the competition has grown to include 25 regional competition locations with 300 schools and over 2,000 students participating annually. Visit www.nosb.org for more information.

A group of students with Dr. Steve Ackleson, Associate Director of Research and Education at Ocean Leadership. They are participating in the career event that occurred on Thursday evening, the first night the students arrived.

Norman Miller (L) with the captains of the winning 5-8th place teams and Dr. Robert Gagosian (R).

The Sheraton was an excellent venue for the event with rooms for the competitions, an excellent auditorium (the International Ballroom), and lodging and food for all. 25 High School teams from across the country were invited and participated in the competition. The 2012 competition brought a number of "new" schools that had not been participants previously and it was nice to see the field spreading. Once again the Oceanic Engineering Society was one of the sponsors and Norman D. Miller represented the Society at the event. Friday began with field trips in and around Baltimore. The opening ceremony began Friday afternoon at the Sheraton International Ballroom. Dr. Gargosian opened the meeting and then introduced the keynote speaker, Jim Toomey, the cartoonist creator of Sherman's Lagoon. He gave a very interesting presentation and showed some of the Sherman cartoons. Following the opening ceremony a tour and dinner at the National Aquarium completed the day.

On Saturday morning all hands assembled in the International Ballroom and Dr. Gargosian reviewed the rules for the competition. The Round Robin Competitions began at 9:00 AM and continued on through the day. On Sunday morning, the teams assembled in the International Ballroom at 8:00 AM and heard a very interesting presentation by Dr. Ray Beiersdorfer, a professor from Youngstown State University. The Double Elimination competitions began at 9:00 AM in the International Ballroom and the Pratt Room. All of the competitions were completed by noon and lunch followed. The Awards Ceremony began in the International Ballroom at 2:00 PM. The Awards Ceremony began with the introduction of the 9th through 25th place teams. Several special presentations were also made. The formal award presentations followed.

Dr. Gagosian called Colonel Norman Miller for the Oceanic Engineering Society forward to present the 8th through 5th place awards. The team captains came forward as their awards were announced and received a plaque and award certificate. Photos were taken as each plaque was presented. The schools receiving the awards were:

8th place	Loveland HS, Loveland, CO
7th place	Albany HS, Albany, CA
6th place	Maui HS, Kahului, HI
5th place	Santa Monica HS, Santa Monica, CA

Dr. Gargosian then called the other presenters forward and the 4th through 1st place awards were presented as follows:

4th place	Lexington HS, Lexington, MA
3rd place	Eastside HS, Gainesville, FL
2nd place	Raleigh Charter HS, Raleigh, NC
1st place	Marshfield HS, Marshfield, WI

The final award given is the James D. Watkins Sportsmanship Award. This award is voted on by the volunteers for demonstrating the best sportsmanship throughout the weekend-long competition. The 2012 award was presented to Ledyard High School of Ledyard, Connecticut. The team was given the appropriate recognition by the assembled students. Dr. Gargosian then gave closing remarks and the 2012 NOSB was ended and another very interesting and successful NOSB was completed!

Baltic 2012 International Symposium

Algirdas Stankevicius, Conference Co-Chair

The IEEE/OES Baltic 2012 International Symposium was held May 8–11, 2012 in Klaipeda, Lithuania. The theme of the Symposium was *Ocean: Past, Present and Future. Climate Change Research, Ocean Observation & Advanced Technologies for Regional Sustainability.*

The symposium was a success and no major problems were reported. Members of the Lithuanian Parliament participated. Approximately 150 were in attendance. The figure varied each day as some left and others came in. Resistratins was 126 paid and does not include free registration for students and some of their teachers. Free registration enabled Klaipeda University students to hear technical papers without the benefits of lunches, receptions or the banquet. The papers were provided in a CD. Papers are being reviewed and processed for entry in the e-xplore system. Forty six participated in the study tour the day after the symposium.

The next Baltic Symposium will be in Tallinn, Estonia in May, 2014. Professor Juri Elken, Director, Systems Institute, Technical University of Tallinn will be Co-Chair. In 2016, the symposium will be in Riga, Latvia.

Opening ceremony.

Cultural presentation by city of Klaipeda.

James McFarlane Receives Queen Elizabeth II Diamond Jubilee Medal

Dr. James R. McFarlane, OC, CD, P.Eng., FCAE, founder and president of International Submarine Engineering Ltd. received the Queen Elizabeth II Diamond Jubilee Medal on April 11th, 2012.

Presented by The Honourable Steven Point, Lieutenant Governor of British Columbia, Dr. McFarlane received his medal at a presentation ceremony held at the HMCS Discovery in Vancouver. The Diamond Jubilee Medal was presented to Dr. McFarlane By Command of Her Majesty The Queen in commemoration of the sixtieth anniversary of Her Majesty's Accession to the Throne and in recognition of his contributions to Canada.

Dr. McFarlane started ISE in 1974 and has been involved with the design, construction, and operation of manned, tethered and untethered Remotely Operated Vehicles as well as subsystems of these vehicles including manipulators and computer control systems. Since that time, Dr. McFarlane has been a part of engineering teams that have built over 400 robotic manipulators and over 200 vehicles.

In addition to his Officer of the Order of Canada designation in 1989, Dr. McFarlane has received numerous awards including, inter alia, the BC Science Council Award for Industrial Innovation, the BC Science and Engineering Gold Medal, the IEEE Engineer of the Year Award and the MTS Lifetime Compass Distinguished Achievement Award. In October, 2011 he received the Diver Certification Board of Canada's Lifetime Achievement Award for his significant contributions to the underwater industry.

Dr. McFarlane is the author of many papers on submarines, manned submersibles, remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). He has also made keynote presentations in Europe, India, Japan, China, Korea, USA and Canada. Two notable presentations include the inauguration of the India Chapter of IEEE, Oceanic Engineering Society at the National Institute of Ocean Technology (NIOT) in 2008, and the Institute of Industrial Science, at The University of Tokyo in 2010.

McFarlane has served on many boards and committees world wide and has been a guest speaker at many different conferences around the globe. Most recently, he lectured to students and faculty at the Indian Institute of Technology Madras in Chennai, India on submarine design and engineering.

International Submarine Engineering Ltd.

ISE was formed in 1974 to design and build underwater vehicles. Based just outside Vancouver, Canada, ISE has delivered 240 vehicles and over 400 robotic manipulators to more than 20 countries around the world.

The ISE family of vehicles includes ROVs, AUVs, submersibles, semi-submersibles, and active towfish. ISE has a robotics capability, having built underwater manipulators for a variety of functions and land based robotic systems including an automated car refueling station and the Canadian Space Agency robotic manipulator training system.

IEEE International Transportation Forum Draws Participants From Five Continents

[Editor's note: The following is reprinted from a summary of the FISTS 2011 Conference that was jointly sponsored by OES and other societies of IEEE Division IX. OES Past President James Barbera served on the Steering Committee and OES President Jerry Carroll served on the Technical Program Committee for the Forum.]

VIENNA—June 29-July 1, 2011, one hundred fifty engineers, scientists, academics, and practitioners, from Europe, North America, Asia, Africa, and South America gathered in Vienna, Austria to discuss how best to achieve integrated sustainable transportation systems. The Forum, sponsored jointly by four IEEE Societies—the Aerospace and Electronic Systems Society, the Intelligent Transportation Systems Society, the Oceanic Engineering Society, and the Vehicular Technology Society—offered provocative presentations, lively discussion, and visionary futures about sustainable transportation systems that create economic opportunity and improve access to basic human needs.

AustriaTech's Reinhard Pfliegl (far left) served as local host and Europe Co-Chair for the Forum, held at the Messe Wien Exhibition & Congress Center. As General Chair, the USA's Charles Herget (center) coordinated overall Forum planning and design. Program Chair Matthew Barth (right) assembled speakers, topics, and over 100 technical papers that ensured a comprehensive view of integrated and sustainable transportation systems.

In his opening address, keynote speaker Martin Wachs (at right) from the RAND Corporation and the University of California at Berkeley, asserted that—global sustainability is probably the

greatest challenge to transportation policymakers. ‖ Wachs stated that policy makers must deal with 1) living within limits imposed by available resources and the carrying capacity of our environment, 2) addressing the interconnections among the economy, social wellbeing, and the environment, and 3) equitably distributing resources and opportunities for advancement across places and among generations. According to Wachs—mobility is perhaps the single greatest global force in the quest for equality of opportunity‖ because it offers improved access to better health care, education, economic opportunity, and social connectivity. Wachs' thoughtful perspective set the stage for discussion throughout the remainder of the Forum.

The Forum, built around policy issues, strategies, technology, and integration/logistics, included panel presentations, plenary discussions, technical papers, and an Electronic Interactive Information Marketplace (EIIM) where Forum participants could present and discuss their work with others. In addition, the Forum offered a special ITS Energy Symposium where representatives from the European Community, the USA, and Japan met to discuss ways to promote and facilitate cooperation between the EU, Japan and the US on assessment of ITS and CO2 emissions and to work toward trilateral agreement on a framework within which a common assessment methodology can be defined.

The Forum's plenary discussion format gave participants an opportunity to ask questions, offer comments and engage in dialogue with panelists and other participants.

The Dreadnaught

Author unknown

[According to Stan Hugill's Shanties from the Seven Seas *this was an early Naval ballad called La Pique or The Flash Frigate. It was a capstan shanty. The Dreadnought was known as "The Wild Boat of the Atlantic". Launched in 1853, she was a clipper of the Red Cross Line which set many transatlantic speed records. She sailed in the Atlantic and China trade until going down rouding Cape Horn in 1869. Ships that carried the mail were called "packets." Swallow Tail and Black Ball were competing lines.]*

Nelson-Burns, Lesley; The Dreadnought http://www.contemplator.com/sea/dread.html

There's a saucy wild packet, and a packet of fame;
She belongs to New York, and the Dreadnought's her name;
She is bound to the westward where the stormy winds blow;
Bound away in the Dreadnought, to the west'ard we'll go.

There time of her sailing is now drawing nigh;
Farewell, pretty May, I must bid you good-bye;
Farewell to old England and all there we hold dear,
Bound away in the Dreadnought, to the west'ard we'll steer.

Oh, the Dreadnought is pulling out of Waterlock dock,
Where the boys and girls to the pierheads do flock;
They will give us three cheers while their tears do flow,
Saying, "God bless the Dreadnought, where'er she may go!"

Oh, the Dreadnought is waiting in the Mersey so free,
Waiting for the Independence to tow her to sea,
For around that rock light where the Mersey does flow,
Bound away in the Dreamings, to the westward we'll go.

Oh, the Dreadnought's a-bowlin' down the wild Irish Sea,
Where the passengers are merry, their hearts full of glee,
While her sailors like lions walk the decks to and fro,
She's the Liverpool packet, oh, Lord, let her go!

Oh, the Dreadnought's a-sailing the Atlantic so wide,
While the dark, heavy seas roll along her black sides,
With her sails neatly spread, and the Red Cross to show,
She's the Liverpool packet, oh Lord, let her go!

Oh, the Dreadnought's becalmed on the banks of Newfoundland,
Where the water's so green and the bottom is sand;
Where the fish of the ocean swim round to and fro,
She's the Liverpool packet, oh Lord, let her go!

Oh, the Dreadnought, she's a-bowlin' past old Nantucket Head,
And the man in chains takes a cast with the lead,
The up jumps the flounder just fresh from the ground,
Crying, "Blast your eyes, Chucklehead;
and mind where you sound!"

Oh, the Dreadnought's arrived in America once more,
We'll go ashore, shipmates, on the land we adore,
See our wives and our sweethearts, be merry and free,
Drink a health to the Dreadnought, whereso'er she may be.

Here's a health to the Dreadnought, and to all her brave crew.
Here's a health to her captain and officers too.
Talk about your flash packets, Swallow Tail and Black Ball,
But the Dreadnought's the clipper to beat one and all.


Techno-Ocean 2012
~ For Safe Oceans, Towards Productive Oceans ~
November 18-20, 2012, Kobe, Japan
November 18 Aqua Robot Competition
November 19-20 Sessions & Exhibitions
Kobe International Conference Center
Organaizer
TON
Techno-Ocean Network (TON)
Co-organizer
IEEE
OES
marine technology SOCIETY
·Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
·City of Kobe
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·IEEE/OES Japan Chapter
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For more information: techno-ocean2012.com