OES BEACON

Newsletter of the Oceanic Engineering Society

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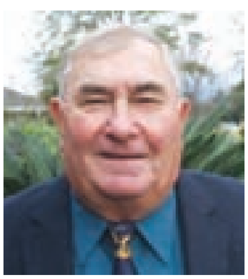
Table of Contents

President's Corner



Season's Greetings to all our OES members as we get ready for 2013. The Society continues to grow with many new members and activities. Our OCEANS Conference in Yeosu, South Korea in conjunction with EXPO 12 (The Living Ocean) was a great success and enjoyed by those in attendance. The OCEANS Conference in Hampton Roads in October was also very successful due to the hard work of the Local Organizing Committee. We have OCEANS Conferences planned in Bergen, Norway and San Diego, CA, this year that you will not want to miss as well as several Workshops and Symposiums.

I want to thank the members of our ADCOM and EXCOM that have worked with me during my term as President. We are very fortunate to have such dedicated and competent members serving on these committees. Good luck to René Garello as he becomes President in 2013. I am sure the Society will continue to be a leader in the OCEAN Community under his leadership.

Jerry Carroll
Outgoing OES President

Season's Greetings to all as well. Fortunately, when you read these Newsletters, we will be well passed the end of the world. By the way, the place where I live is named "the end of the World" or Penn Ar Bed, in Breton. But we call it "the beginning of the World".

Indeed the task set by Jerry is challenging. But I will follow the path he and the previous presidents had set and for that purpose, I will rely on the support of all of the officers, the AdCom members and, of course, the members of the Society.

As Jerry pointed out, the OCEANS conferences, flagship of our society, were very successful this year and, I have no doubt about it, will be for 2013. The OCEANS conferences are the place to meet our community which is quite large across the scientific and technical domains (http://ieeeoes.org/page.cfm/cat/84/Technical-Committees-and-Scope/).

A very important item for me as president will be to maintain a high level of activities (discussion, sharing) with our three main partners, by order of importance: IEEE, OTC and MTS. The former is our structural and administrative mother entity. We must understand their directives in order to bring the quintessential part to OES. The latter is our natural partner for the OCEANS conferences and we must work on an equality

(continued on page 5)

Welcome New and Reinstated Members

Bijou T. Abraham	USA
S. A. Adekola	Nigeria
Glenn Alcock	Australia
Chris A. Allison	USA
Michael Baker	USA
Abigail L. Barber	USA
Christopher Barber	USA
Heather Beem	USA
Daniel Blustein	USA
Jeff Bosma	Canada
Donald P. Brutzman	USA
Alex Paul Cabatbat	USA
Didier Caute	France
Jean-Luc L. Calvez	France
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Min-Kang Chao	Taiwan
Yougan Chen	China
Geoffrey Cram	USA
Jason Christopher Dahl	USA
Jesse O. David	Canada
Cheyenna Marie Deal	USA
Shandor Dektor	USA
Sarah C. Derrane	USA
Kris Allen Dindoffer	USA
Sabra Domeika	USA
Michael T. Eckhart	USA
Dana Enstad	USA
Stephen Estrin	USA
Patrick Thomas Faha	USA
Bruno Ferreira	Portugal
Alejandro Flores	Germany
Rachel A. Gaines	USA
Enric Galceran	Spain
Alan Thompson Gardner	USA
Julia Gazagnaire	USA
William E. Gilchrist	USA
Arthur C. Gleason	USA
Orlando Colon-Gonzalez	USA
Andrew Goodney	USA
Claire E. Gorman	USA
Alexandra Karina Gottschall	USA
Ole Gron	Denmark
Linyi Gu	China
Riley Garlow	USA
Jennifer Marie Greeno	USA
Charles Herbert Haas	USA
Jinxing Hao	China
Axel Hackbarth	Germany
James R. Halliday	UK
James D. Haluska	USA
Marcus Hammond	USA
Thomas Ryan Hanley	USA
Maryam Haroutunian	UK
Catherine Ann Harris	UK
David Harland Heimke	USA
Daniel H. Hoetger	USA
Ben Hollings	Australia

Liesl Ann Hotaling	USA
Sarah Houts	USA
Sam Hughes	UK
Sean C. Ivusic	USA
Nehemiah Tony Jandroep	USA
Liling Jin	China
Charles Johnson	USA
Ed Jones	Canada
Mathew Wayne Jordan	USA
Jerome Jouffroy	Denmark
James B. Joslin	USA
Christopher S Judd	USA
Zheng Kai	China
Carl Kaiser	USA
S. Karabchevsky	Israel
James G. Kelly	USA
Yukihiro Kida	Japan
Jeongchang Kim	Korea (South)
John William Klyce	USA
Adam J. Konrad	USA
Warren S. Krug	USA
Yoann Ladroit	France
David Lane	UK
Stephanie A. Lee	USA
Wei Lei	China
Monica Leslie	USA
Murray Leslie	Canada
Nicholas Liakos	USA
Stephen Licht	USA
Doobyo Lim	Korea (South)
Joseoniram De Aquino Limaverdefilho	Brazil
Nicholas M. Limparis	USA
Christi M. Linardich	USA
Xiong-Hou Liu	China
Yukang Liu	USA
Jon D. Loftis	USA
Hannan Lohrasbipeydeh	Canada
Daniel Lopes	Portugal
Robert N. Lowell	USA
Feng Lu	China
Luksa Luznik	USA
Divine Maalouf	France
Shyam Kumar Madhusudhana	Australia
Nicole Robina Marshall	Canada
Giuseppe Masetti	USA
Matthew Matt	USA
Katherine Marie McBryan	USA
Philip Andrew McGillivary	USA
Michael A. McGraw	USA
Mehrube Mehrubeoglu	USA
Hsuan W. Mikkola	Denmark
Nathan John Muller	Canada
Dainis Nams	Canada
Jack R. Newell	USA
Lisa Niedermeyer	USA
Jonathan Lawrence Odom	USA
Kyle O'Donnell	USA

Dagogo Olungwe	Nigeria
Claudiu Alexandru Oprea	Romania
Samir Ouelha	France
Paul Ozog	USA
Jose Antonio Padial	USA
Jong-Chun Park	Korea (South)
John Pennewell	USA
Jesse Pentzer	USA
William J. Perry	USA
Rachel L. Pleathner	USA
Michael T. Pollard	USA
Dustin Porak	USA
Bastien Y. Quesie	UK
Dillon Rag	USA
Mostafa Rahimpour	Canada
Deepak Venkat Ramani	USA
Pareeima Rattanasiri	UK
Kevin H. Rea	USA
Gaultier Real	France
Patrick M. Reilly	USA
Rebecca M. Roth	USA
Mehul Naresh Sangekar	Japan
Suriyan Saramul	USA
Agustin Alex Saucan	France
David Scaradozzi Scaradozzi	Italy
Sophia Schillai	Germany
David J. Shea	Canada
Akihiro Shima	Japan
Hiroki Shimizu	Japan
Seiji Shimizu	Japan
Sankar Nath Shome	India
Leo V. Steenson	UK
Keith M. Stuart	USA
Hee-Su Lee	Korea (South)
Jacqueline Szeto	Canada
Jonathan Rowe	USA
Nathan J. Smith	Canada
Anthony Michael Spicher	USA
Kim Stanley	USA
Edward Steele	UK
Jessica Marie Strand	USA
Knut Streitlien	USA
Tomoko Takahashi	Japan
Ivan Torres Tamanaja	Mexico
Sudhakar Tata	India
Glenn A. Turner	USA
James Turpen	USA
Reny Blue Tyson	USA
John Matthew Varnes	USA
William J. Von Alt Ii	USA
Sherman R. Waddell	Canada
Nicholas Charles Waters	USA
Zong-Wei Liu	China
Jonathan Wheare	Australia
Ben Wiles	USA
Carissa Wilkerson	USA
Ian C. Williams	UK
Maxwell U. Woolsey	USA
Jinsheng Yang	China
Yeon-Mo Yang	Korea (South)
Thomas Young	USA
Casey S. Zebrowski	USA
Lan Zhang	China
Michael Zuba	USA

Senior Member Promotions

Congratulations to the following IEEE OES members who have been promoted to the grade of Senior Member.

Jessie Jackson

Fernando Lopez Pena

From the President *(continued from page 3)*

basis with them. And last but not least, OTC is our major conference equivalent and we have to consider the services that OES can provide to keep it at this level.

All conferences, symposia and workshops are made for you, but they are also made by you! And they are the means for communication between you and with your peers. In his essay “What is art?”, Leo Tolstoy, in 1897, proposed “Art is communication” (Real art requires the capacity to unite people via communication. Clearness and genuineness are therefore crucial values). More communication is needed, from the Society, but also between members and we must facilitate these exchanges. This will be done through our mastering of the modern means of communication and a better way to respond to the needs and desires of you, the members.

As president, I will act in order that each member of the OES intimately believes the following: “Reach out, OES will be there!”. You, members, ARE our Society.

Once again, best wishes for this New Year.

René Garello
Incoming OES President

Chapter News

China

Carol Cai

Drew Michel, MTS President-Elect and IEEE Senior Member, visited Shanghai Jiao Tong University and Zhejiang University on 21 and 22 November, 2012. The section presented a proposal for OCEANS '16 Shanghai and held a Marine Technology Workshop. Topics presented at the workshop included:

- Applied Underwater Information and Acoustic Measurement Systems by Jun Han,
- Adaptive Optics for Inter-island Laser Propagation by Hong Song,
- Wave-Powered Air-Lifted Artificial Upwelling by Jiawang Chen, and
- ZJU-ZRS Experimental Research Observatory (Z2ERO) by Fengzhong Qu

Victoria, Canada

Ross Chapman and Jim Collins

Victoria Chapter celebrated its 25th anniversary in early 2012. To mark the event the Chapter held a dinner at its annual general meeting (AGM) on May 8th, 2012 and sponsored a scholarship competition for college and university students in the Victoria area.

The AGM started with a dinner with twelve members and guests followed by a business and technical meeting. At the business meeting Jim Collins gave a talk describing the formation and history of the Chapter which he chaired for the twenty five years except for two years chaired by Jon Preston. For the most part each year saw at least two or three technical meetings. However 1993 marked a unique achievement when the Chapter stepped forward to organize a very successful annual edition of the popular IEEE Oceans Conference sponsored solely by the OES at that time. Chapter membership has reached thirty in 2012.

Nick Hall-Patch presented the financial report for the previous year and then the new slate of officers was announced for the coming year. The new Chair is Ross Chapman, Vice Chair is Jim Collin, Secretary Treasurer is Nick Hall-Patch and Member-at- Large is Dale Shpak.

Under new business several new possible projects were discussed including the Twenty Fifth anniversary Scholarship (Ross Chapman), Chapter website development (Dale Shpak), Possibility of Oceans 2017 in Victoria (Jim Collins) and new ideas in AUV competitions and Sea Perch ROV competitions for school children (Jim Collins).

The technical portion of the meeting followed with a presentation by Tom Dakin of Ocean Networks Canada. His topic was Low Frequency Smart Hydrophones at Ocean Networks Canada. During his talk Tom introduced Ocean Networks Canada (ONC) and the hydrophone issues facing ONC. The low frequency (LF) smart hydrophone project is the first of 4 projects to address these hydrophone issues. The work done to date on the performance verification of the LF hydrophone and the impact this has had on ONC was discussed. Also discussed was the LF hydrophone calibration system developed for this project.

This year marked the 25th anniversary of the founding of the Victoria Chapter and the executive decided to create a student scholarship award to commemorate the occasion. Accordingly, an announcement of the IEEE Oceanic Engineering Society Victoria Chapter 25th Anniversary Scholarship was distributed to undergraduate and graduate students in the Victoria area in September. The award was given to Mostafa Rahimpour, a graduate student in Mechanical Engineering at the University of Victoria for his work on hydrodynamic flow around ocean platforms. The award was presented to Mostafa at the Technical Meeting in December.

Dr. Alexandra Albu from the Electrical and Computer Engineering and Computer Science departments at the University of Victoria presented a seminar on her work on management of large data sets to about 30 members, guests and students in December. The turnout during the exam period when many are otherwise occupied showed the high level of interest in the research. The seminar title was' Detection of Salient Events in Large Databases of Underwater Video', and it followed up with new results that were obtained after her presentation at the Oceans 2012 Conference at Hampton Roads. The talk featured examples of detection of biological events from sea floor video from the NeptuneCanada underwater observatory. Dr. Albu's work is of current interest to NeptuneCanada scientists who are dealing with large data sets from various different instruments deployed on the underwater cabled network.

Spain

Gabriel Oliver

Organized by the TRIDENT project team (visit *http://www.irs.uji.es/trident*), the 2nd I-AUV field training workshop took place in Port de Sóller (Mallorca) from the 1st to the 5th of October 2012. During five days the project consortium prepared and made the final field experiments to demonstrate the TRIDENT objectives achievement. All the project Mechatronic's was successfully integrated and extensively tested in sea conditions. In addition, during the first two days, the workshop was open to the scientific community and some invited lectures and demo sessions were given. The open days program was partially cofunded by the Spanish Research Network AUTOMAR and by the IEEE-Oceanic Engineering Society.

The TRIDENT Project was launched on March 2010 and ends on February 2013. The field experiments made during the Sóller Workshop were the final integrated project achievements demonstrations.

Houston, USA

Michael Romer

Rebecca Roth of Intecsea presented to the Houston OES and Women in Engineering chapters on the evening of December 19, 2012.

Mrs. Roth's presentation topic was "Direct Electrical Heating (DEH) of Flowlines". She explained Electric Flowline Heating (EFH), both Direct and Indirect Electrical Heating, including how the technology works, the different types of systems, and the modes of operation. A listing of currently installed systems was provided. The purpose and benefits of DEH were discussed, including prevention and remediation of hydrate and paraffin formation, improving the flow of heavy oil, extended shutdowns without the use of chemical injection or hot oil circulation, reduction of infrastructure for such chemical injection and hot oil circulation, the handling of high water-cut during tail end production periods, and planning for third-party tie-ins with poorly-defined composition. A case study was presented to illustrate some of the benefits.

Mrs. Roth also discussed some of the challenges of designing and installing an Arctic DEH system, as well as other technology-stretch applications such as whether DEH can be used for hydrate plug remediation (after the plug has formed), whether it can be used in continuous flowing conditions, and how to maximize the length of a DEH-heated segment.

Abstract

Direct Electrical Heating (DEH) of flowlines is a flow assurance technology that facilitates development of fields in arctic regions, fields with long subsea tiebacks, fields with heavy oil, and marginally profitable offshore fields. By allowing for operation in conditions outside of the hydrate region and/or above the wax appearance temperature, DEH opens up areas of development not otherwise considered viable by production companies and can significantly reduce CAPEX and OPEX for already-viable fields. It is proposed for Arctic field development, where a colder subsea temperature compounds typical flow assurance difficulties and where traditional chemical injection becomes difficult or cost prohibitive to manage.

This paper provides an explanation of Electric Flowline Heating (EFH), both Direct and Indirect Electrical Heating, including how the technology works, the different types of systems, and the modes of operation. A listing of currently installed systems is also provided. The purpose and benefits of DEH are discussed, including prevention and remediation of hydrate and paraffin formation, improving the flow of heavy oil, extended shutdowns without the use of chemical injection or hot oil circulation, reduction of infrastructure for such chemical injection and hot oil circulation, the handling of high water-cut during tail end production periods, and planning for third-party tie-ins with poorly-defined composition. A case study is presented to illustrate some of these benefits.

As awareness of DEH's benefits grows, so does interest in applying it to the challenging environment of the Arctic. This paper discusses some of the challenges of designing and installing an Arctic DEH system, as well as other technology-stretch applications such as whether DEH can be used for hydrate plug remediation (after the plug has formed), whether it can be used in continuous flowing conditions, and how to maximize the length of a DEH-heated segment.

New South Wales, Australia

John Robinson

The IEEE NSW Section's Joint Chapter of the Communications/Signal Processing/Oceanic Engineering Societies organized two Technical Meetings in 2012 on Acoustic Systems Engineering. The first meeting on Thursday 23rd August marked the second anniversary of the IEEE Oceanic

Dr. Brian Ferguson presents to the NSW chapter.

Engineering Society's prestigious OCEANS '10 IEEE Sydney Conference and Exhibition 24–27 May 2010. This meeting was scheduled as part of Engineers Australia (Sydney Division) Joint Electrical Engineering Institutions' Program 2012 and held in the Engineers Australia Harricks Auditorium in Chatswood. A total of 67 people registered for the meeting. An Administrative Meeting of the Joint Chapter was held after the Technical Meeting. The technical presentation on "Passive Sonar Signal Processing for Underwater Vehicles: Autonomous Undersea Gliders to Submarines" was presented by Dr Brian Ferguson, DSTO. The second meeting scheduled for Wednesday 14th November at Engineers Australia in Newcastle is in response to an invitation from the Newcastle Division's Electrical Branch. The topic for presentation is "Acoustic Systems Research and Development for Defence Applications" and will be delivered by Dr Brian Ferguson. It will feature the inner workings of acoustic detection, classification, localisation and tracking systems designed for sources of military interest, which range from snipers to jet aircraft. The results of processing real data collected at Australian Army and Air Force bases in the Newcastle region will be demonstrated.

Washington, DC, USA

A chapter meeting was held in Bethesda, Maryland on June 14 with a presentation entitled Simulation Driven Design: The Harborscan AUV Development, by Rafael Mandujano.

Bits and Bytes

Call for Papers for Oceans '13 MTS/IEEE Bergen

The Oceans '13 MTS / IEEE Bergen conference is approaching fast.

Hosted in the city of Bergen, Norway, the conference will provide a unique opportunity to exchange information and expertise related to the high north.

Bergen, known as 'The Gateway to the Norwegian Fjords' and renowned for its marine and maritime history, is also a gateway to the Arctic with its special challenges and opportunities for marine technology.

We now call for papers in a range of special as well as general MTS/IEEE Oceans topics and look forward to your participation in exciting sessions in Bergen in June!

For more information about the scientific topics and submission information, please visit http://www.oceans13mtsieeebergen.org

Best regards
Oceans '13 MTS/IEEE Bergen Technical chairs,
Peter M Haugan, Professor, University of Bergen
Harald Yndestad, Professor, Alesund University College
TechnicalChair@oceans13mtsieeebergen.org

Request for Nominations to the Administrative Committee, Class of 2013

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

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

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

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

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

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

Jerry Carroll
Chair, IEEE/OES Nominations and Appointments Committee
Address: 411 Country Club Drive
Picayune, MS 39466 USA
Phone: 1.601.798.0277
Email: jerrycortez@charter.net

Request for Nominations for the Distinguished Technical Achievement Award

The Oceanic Engineering Society is hereby soliciting nominations for the society Distinguished Technical Achievement Award for significant accomplishments in oceanic engineering. A nomination form can be downloaded from the OES website under Professional Activities > Honors and Honorees > Award Forms. Nominations should be forwarded to the Awards Chair, Jerry Carroll at jerrycortez@charter.net. The deadline for nominations is 1-May-2013.

Request for Nominations for the Distinguished Service Award

The Oceanic Engineering Society is hereby soliciting nominations for the society Distinguished Service Award to honor an individual IEEE member for outstanding contributions towards furthering the objectives of the Oceanic Engineering Society. A nomination form can be downloaded from the OES website under Professional Activities > Honors and Honorees > Award Forms. Nominations should be forwarded to the Awards Chair, Jerry Carroll at jerrycortez@charter.net. The deadline for nominations is 1-May-2013.

OES Scholarship Winners

Congratulations to our fall scholarship winners. Applications are considered twice each year for $2000 awards per student.

- Eric Ferguson, University of Sydney, Australia
- Hannan Lohrasbipeydeh, University of Victoria, Canada
- Zachary Mildon, University of Alaska, Anchorage, USA
- Jerical Nolte, University of Hawaii at Manoa, USA
- Sebastian Villar, Universidad Nacional del Centro provincia de Buenos Aires, Argentina

Upcoming OES Event Calendar Items

See the full calendar online: http://www.ieeeoes.org/calendar/

- Underwater Intervention, 15–17 January 2013, http://www.underwaterintervention.com/
- UT13 International Symposium on Underwater Technology, March 5–8, 2013, http://seasat.iis.u-tokyo.ac.jp/UT2013/
- AIA-DAGA 2013 Conference on Acoustics, 18–21 March 2013, http://www.aia-daga.eu/index.php/it/
- Coastal GeoTools 2013, 25-28 March 2013, http://geotools.csc.noaa.gov/default.aspx
- US Hydro 2013, 25-28 March 2013, http://www.hypack.com/ushydro/2013/
- Oceans Business 2013, 9–11 April 2013, http://www.oceanbusiness.com/
- Sea Asia 2013, 9–11 April 2013, http://www.sea-asia.com/
- Bionav, Surrey UK, 11–13 April 2013, conference@rin.org.uk
- Electric Ship Technologies Symposium, 22–24 April, 2013, http://www.ests13.com/
- Offshore Technology Conference 2013, 6–9 May 2013, http://www.otcnet.org/2013/
- ICA 2013, 2–7 June 2013, http://acousticalsociety.org/meetings/ica-2013
- OCEANS 13 MTS/IEEE Bergen, 10–13 June 2013, http://www.oceans13mtsieeebergen.org/
- Underwater Technology Conference (UTC 2013), 19–20 June 2013, http://www.utc.no/
- Underwater Acoustics, 23–28 June 2013, http://www.uam-conferences.org/

AUV 2012—Southampton, England

Bill Kirkwood

AUV 2012 was another success in the string of meetings on Unmanned Underwater Vehicles from the Technical Committee chaired by Hanu Singh. The local organizing committee (LOC) was chaired by Gwyn Griffiths who is well known and recognized for his outstanding efforts in the field of autonomous underwater vehicles. Gwyn has hosted many AUV focused conferences with his AUV Master Class series, so it was not a hard decision to approach Gwyn and ask if he would be willing to host AUV 2012 at United Kingdom's National Oceanographic Centre. We were extremely pleased when Gwyn agreed.

Gwyn quickly involved his local students and fellow researchers as well as the usual administrative and accounting staff who were instrumental in the Master Class meetings. We had no concerns about the viability and pending success of AUV 2012. Special thanks to Maaten Furlong and Mario Brito who worked very closely with Hanu and Bill and were the tag team that made it comfortable for us while being in several different time zones. Gwyn also brought on industrial partners so a special thanks is also extended to Jim Mann. The team was very effective and did an outstanding job of organization, scheduling and assembling the after conference tutorial workshops.

The organizing committee also presented the AUV Distinguished Technical Achievement Award. The selected recipient for 2012 was a difficult choice with some 20 plus candidates or more deserving of recognition for their contribution to the field of Autonomous Underwater Vehicles. After a series of international telecons and some significant deliberations the candidate selected was Dr. Albert Bradley for his numerous efforts ranging back to his days at MIT and through his career at Woods Hole Oceanographic Institution. Beyond Al's obvious contributions to vehicle technologies with ABE and Sentry, Al was also recognized for his role in mentoring so many individuals and encouraging them to pursue careers in the field of AUVs. The list of professors, industry leaders and system managers who give accolades and credit to Al is long and so for his efforts with people as well as technology the AUV 2012 organizing committee was pleased to select him. A very special thank you to Dr. Dana Yoerger who made his way to England to present the award as one of Al's longest term collaborators and colleague in creating technology as well as a long list of publications.

An additional thank you goes out to the IEEE/OES ADCOM for awarding the funds to the student poster program. Bill Kirkwood dispersed $10,000.00 in awards to 16 students to assist with their travel costs and encourage them to continue their pursuits in our community. Liz Creed set up a booth in the coffee and lunch area as our membership chair. With her diligence we were able to get all the students and a few others to join IEEE/OES. I can't recall the numbers but I believe it was something approaching 30 individuals with 16 plus being students.

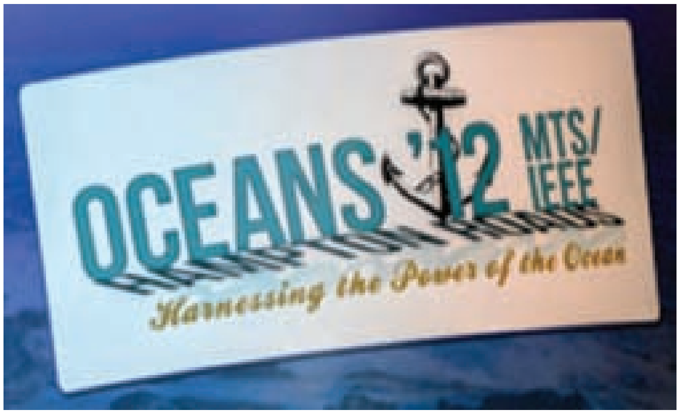
The gala was held at the new Maritime Museum and was a hit. The exhibits and the staff catering the event were outstanding. Bill Kirkwood thanked the entire organizing committee and called up Robert Wernli to present a plaque recognizing the local organizing committee for their outstanding efforts and assembling a fine program that was sold out. Gwyn was truly surprised and extremely gracious, a true gentleman at all times. Congratulations to the entire LOC who did a tremendous job and made AUV 2012 very successful. We are still getting the papers into pdf eXpress format for uploading into IEEE Xplore and have to close the books but it looks like we'll have a decent amount of funds to disperse once again to the students who attend AUV 2.

For those interested, AUV 2014 is on the books for being held at Southern Mississippi with Dr. Vernon Asper at the helm. For those who know Vernon we have the same high expectations of holding a great meeting with the individuals who are leading our field. Hanu and Bill are looking forward to working with Vernon and his team to make AUV 2014 the best it can be! Hope to see you all there.

Finally, once again we thank Gwyn for hosting AUV 2012 as his last AUV community activity. Gwyn is high on our list to be recognized in the future as a major contributor to AUVs on so many fronts. I would like to echo another hearty thanks for everything he has done for the AUV community over the years.

OCEANS '12 Conference Calls on Hampton Roads

Helen Worthington and Marc Steiner



PHOTOS BY STAN CHAMBERLAIN

OCEANS '12 made a big splash in Hampton Roads, Virginia, with nearly 2000 participants including walk-ins representing 5 continents and 35 countries. The conference, held October 14–19, 2012 at the Virginia Beach Convention Center, was sponsored by the Marine Technology Society (MTS) and the IEEE Oceanic Engineering Society (OES). With the theme "Harnessing the Power of the Ocean," OCEANS '12 was the first time that the conference series visited Hampton Roads, which is the metropolitan area in southeastern Virginia located at the mouth of the Chesapeake Bay. The area is home to the largest naval base in the world and one of the East Coast's largest and deepest ports. Several Hampton Roads local governments, academic institutions and multiple agencies and organizations cooperated to help the Hampton Roads section of MTS host the event.

The OCEANS '12 conference was dedicated to furthering the goals so eloquently articulated by ADM James Watkins, who led the U.S. Commission on Ocean Policy under President George W. Bush, leading to President Barack Obama's U.S. Ocean Policy. Even though ADM Watkins passed away on 26 July 2012, he leaves a legacy of commitment to ocean science and a desire for a comprehensive National Ocean Enterprise. Many conference speakers and participants paid homage to the contributions of ADM Watkins, and during the Wednesday OES awards luncheon, Ray Toll, Chair of the local organizing committee (LOC), read a citation for a special award to be presented to Mrs. Watkins in recognition of her husband's extensive efforts to advance a National Ocean Policy. Participants at OCEANS '12 studied, debated and discussed what it will take to achieve ADM Watkins' dream that has become the framework for the priority objectives of the Policy's implementation strategy:

Virginia Beach Convention Center.

1) **Ecosystem-Based Management:** Adopt ecosystem-based management as a foundational principle for comprehensive management of the ocean, our coasts, and the Great Lakes.
2) **Coastal and Marine Spatial Planning**: Implement comprehensive, integrated, ecosystem based coastal and marine spatial planning and management in the United States.
3) **Inform Decisions and Improve Understanding:** Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.
4) **Coordinate and Support:** Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government and, as appropriate, engage with the international community.
5) **Resiliency and Adaptation to Climate Change and Ocean Acidification**: Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.
6) **Regional Ecosystem Protection and Restoration:** Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, state, tribal, local and regional levels.
7) **Water Quality and Sustainable Practices on Land:** Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.
8) **Changing Conditions in the Arctic:** Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.
9) **Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure:** Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts.

The Hampton Roads section of MTS was established in 2005, according to Toll. In 2008, a core group of 14 volunteers accepted the challenge of organizing OCEANS '12.

Local Organizing Committee for Oceans 12 Hampton Roads 1st row L to R: Marc Steiner, Ray Toll, Joy Eyrolles, Kathy Shield, Mark Bushnell. 2nd row L to R: Bob Kugler, Tom Bosse, Tom Myers, Bob Heitsenrether, Fred Klein.

Their success in "garnering the support of the region's leadership, especially the Virginia Beach and Norfolk city governments, was spectacular," said Toll. The chapter volunteers implemented several innovative conference activities, including recruiting Old Dominion University (ODU), a major presence in Hampton Roads, to fully support the conference, preside over "University Row" on the exhibit floor, and have Dr. John R. Broderick, President of ODU, serve as one of three honorary conference chairs, along with Norfolk Mayor Paul D. Fraim and Virginia Beach Mayor William D. Sessoms.

Conference Highlights

The conference officially kicked off on Tuesday morning with welcomes from the two society presidents and Mayor Sessoms of Virginia Beach. Each honorary chair brought different perspectives to the conference: ODU's nationally recognized research in ocean science, climate change, and sea level rise; Virginia Beach's concern for sea level rise and promising future for offshore marine renewable energy; and Norfolk's concerns for flooding/coastal inundation, along with the distinction of being second only to New Orleans in its vulnerability to sea level rise.

Plenary Session

Other plenary speakers included U.S. Congressman Scott Rigell, National Oceanic and Atmospheric Administration (NOAA) Assistant Administrator Dr. Kathryn Sullivan, RADM Mark Guadagnini, Director of the Maritime Headquarters, U.S. Fleet Forces Command, and RADM Jon White, Oceanographer of the Navy. Each speaker focused on different aspects of ocean science, but each acknowledged ADM Watkins' legendary influence in U.S. ocean policy. The importance of global, national, regional, and local partnerships was highlighted, as well as the pivotal role that oceans will play in our future, and also in our economic progress. Most speakers also mentioned the challenges we face that are inherent in building an integrated "system of systems" within a resource-constrained budgetary environment.

Plenary Speakers (left to right): Ray Toll, Margaret Davidson, Jerry Carroll, Dr. Kathryn Sullivan, RADM Mark Guadagnini, RADM Jonathan White, Jerry Boatman.

"The plenary speakers did an excellent job in teeing up the rest of the conference, providing context and focus for all of the activities that followed the rest of the week," said Toll.

Technical Program

OCEANS '12 featured six tutorial sessions conducted on Monday before the official conference kick-off. Presenters covered topics such as storm tides/sea level change, acoustic seabed classification with multibeam and sidescan images, and high

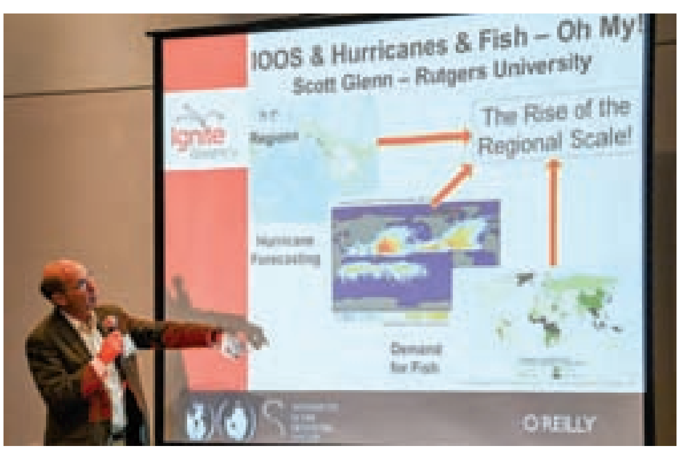
Mikhail Arkhipov presents a paper at one of the technical sessions.

The IOOS Town Hall featured several key dignitaries discussing ADM Watkins' vision for a National Ocean Enterprise.

resolution spectral and array processing. Workshop topics presented on Monday afternoon included marine spatial planning, integrating autonomous technologies in ocean observations, and coastal inundation associated with sea level rise. On Tuesday through Thursday, 87 sessions of technical papers were presented, with over 580 abstracts accepted, while the exhibit hall was buzzing with 171 exhibitors and 18 student posters. Technical Chair Mark Bushnell summarized his conference experience with enthusiasm and appreciation.

"When the abstracts poured in it was humbling to scan through them, said Bushnell. "The wide expanse of OCEANS topics and resultant papers really opened my eyes. Working with authors and chairs to form the technical program was a huge effort, but it was rewarded by a continuous stream of thank yous during the conference week. I really enjoyed the international interaction, and I'm very pleased with the strong student engagement our local organizing committee created. It was truly a once-in-a-lifetime experience!"

Town Hall presentations offered yet another format of panels and multiple presenters to provide diverse perspectives on ocean policy and observations. One of the more innovative approaches was Ignite the Crowd, a series of 10 dynamic leaders, each giving a five-minute talk on topics ranging from coastal resilience and seal level change to navigating the Nation's ports. Caris, a software company specializing in geospatial solutions, sponsored the Ignite the crowd Town Hall moderated by Zdenka Willis, Director of the U.S. Integrated Ocean Observing System (IOOS) Program. A second Town Hall included a panel discussion moderated by VADM Conrad C. Lautenbacher, Jr., USN (Ret.), former NOAA Administrator and now Vice President for Science Programs, Applied Technology Group at Computer Sciences Corporation. This particular Town Hall was considered a signature event as it featured key dignitaries, including former Secretary of the Navy Dr. Donald Winter, to discuss and debate the obstacles to achieve ADM Watkins' vision for a National Ocean Enterprise. The third Town Hall addressed the efforts of Norfolk, Virginia to adapt to living with storm tides and inundation and was moderated by Dr. Larry Atkinson of Old Dominion University.



Scott Glenn, one of ten speakers in the Ignite the Crowd Town Hall Presentation.

MTS Awards

MTS awards were presented at a luncheon held on Tuesday. Mr. Charles Royce was designated an MTS Fellow, which is the highest award a society member can receive. Royce was cited for his exceptional work on remotely operated vehicles (ROVs). Mr. Bob Winokur, Technical Director for the Oceanographer of the Navy, was presented the prestigious Compass (Publications) Distinguished Achievement Award for his lifetime work in the ocean sciences. Other awards include:

- Compass (Publications) International Award presented to EDT Offshore
- Compass (Publications) Industrial Award presented to Sonardyne
- Lockheed Martin Award for Ocean Science and Engineering presented to Mr. Franz Hover
- Ocean News and Technology Award 'Next Generation' presented to Mr. Jeremy Childress
- MTS Outstanding Service Award presented to Teledyne RD Instruments

MTS Awards Luncheon.

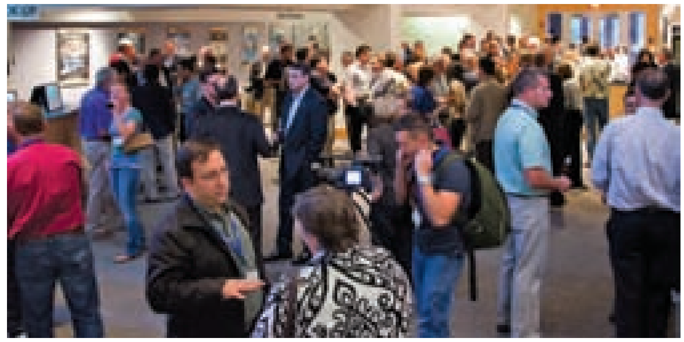
- Outstanding MTS Section Award presented to MTS Hawaii Section
- Outstanding Student Section Award presented to College of William and Mary Student Section

OES Awards

On Wednesday, the 2012 OES Distinguished Technical Achievement Award was presented to Joseph Vadus. The award was based on his accomplishments over a lifetime of involvement with technical developments related to the advancement of concepts, research and development for radar systems, deep submergence submersibles, instrumentation and other advancements for undersea vehicles. The 2012 OES Distinguished Service Award was presented to Dr. Robert C. Spindel. Dr. Spindel has been a member of OES since its inception, has chaired three OCEANS conferences, and has worked to make OES an integral part of the profession. IEEE Fellows honored at the luncheon include Malcolm L. Heron and Shahriar Hegahdaripour Other awards presented include the President's Awards to Barbara Fletcher, Marinna Martini, and Albert J. Williams, III.

Social Happenings

The conference addressed the challenges and interests as conveyed by the speakers and three honorary chairs, but it also showcased the Hampton Roads region's attributes and accomplishments. For example, the Virginia Beach Convention Center is located less than one mile from the oceanfront and is LEED® Gold Certified, the first such facility in the U.S. The 75-degree autumn weather in Hampton Roads during the week may have tempted some conference attendees to visit the beach, but conference planners took the opportunity to showcase two other local attractions, the Virginia Aquarium and Marine Science Center and Nauticus, as venues for social events—an icebreaker on Monday evening at the Virginia Aquarium, and a gala reception on Wednesday evening at Nauticus. OCEANS12 broke attendance records at each venue. Of note, the Aquarium also hosted almost 30 teachers on October 13th for an educators' forum. At the gala, the NOAA Ship FERDINAND HASSLER was available for ship tours, and Nauticus Executive Director Hank Lynch, Norfolk Mayor Fraim, and U.S. Congressman Bobby Scott took the microphone to address the crowd.



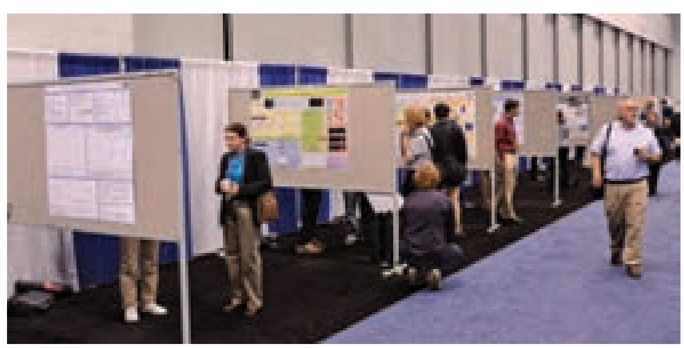
The Icebreaker reception was held Monday evening at the Virginia Aquarium.

Cadets from the Massachussetts Maritime Academy were ushers at several of the conference events.

Student Participation

Education was front-and-center at OCEANS '12. ODU organized the conference's first-ever University Row, which included representatives from ODU, College of William and Mary's Virginia Institute of Marine Science (VIMS), Virginia Tech, NASA Virginia Space Grant, Johns Hopkins University Applied Physics Lab, Nova Scotia Community College, and Halifax Marine Research Institute. These institutions and agencies offered a wealth of information about activities and opportunities for students and other conference participants. According to Tom Bosse, Volunteer Coordinator on the LOC, students from ODU and Thomas Nelson Community College also provided volunteer support at the registration booths. Several undergraduate, graduate, and post graduate students were selected to co-chair technical sessions, providing valuable experience that can enhance the students' résumés.

The Gala reception was held Wednesday evening at Nauticus, the National Maritime Center Foundation.



The student poster competition featured 18 student posters selected from more than 100 applicants.

OCEANS ’12 was the first time students have been recruited to co-chair technical sessions, and their participation may become a standard practice at future OCEANS conferences.

The Student Poster competition, chaired by LOC member Bob Heitsenrether, featured 18 posters selected from more than 100 applicants. “There were so many excellent entries that it was hard to pick even the finalists,” said Heitsenrether. The awards presentation was held on the exhibit floor in Thursday, October 19 at noon. Giancarlo Troni, a PhD candidate from Johns Hopkins University, received first place for his poster, Experimental Evaluation of a MEMS Inertial Measurements Unit for Doppler Navigation of Underwater Vehicles. Also on hand for the award presentation was Norman Miller, who was also honored at the conference for his work establishing the student poster award. The Office of Naval Research underwrote conference expenses for the students whose posters were selected as finalists in the poster competition.

In keeping with the desire to encourage and mentor future leaders in ocean sciences and technology, the LOC intends to establish a scholarship fund with conference proceeds for those students interested in marine technology. The success achieved by OCEANS ’12 by exceeding past records for the number of students involved as conference volunteers and participants will serve as a model for future events.

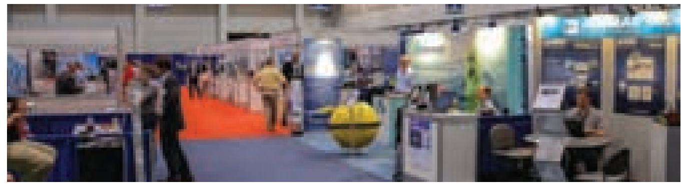
The Future: Building a National Ocean Enterprise

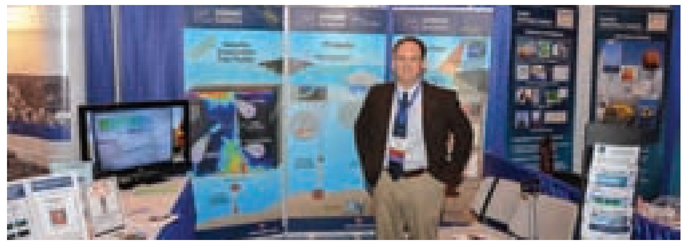
This conference contained several unique aspects ranging from a new location to innovative town halls and speaker panels. Some speakers/panels centered on the idea of building a National Ocean Enterprise and the technical, economic and political challenges associated with achieving such a “systems of systems.” An important part of an ocean enterprise is the ability to observe and model the complex ocean environment. As such, there was a strong emphasis on ocean observing. Zdenka Willis commented, “from the National U.S. IOOS perspective, we are supportive [of] a partnership with the OCEANS because of its emphasis on the ocean technology industry in additional to government and academia. This allows us to connect with users and producers of equipment and data. The [Wednesday AM] Town Hall was gratifying since senior ocean leaders saw enough importance [in the IOOS effort] to participate and to set forth the challenges to move forward over the next 10 years.” She concluded that OCEANS ’12 was an important precursor to the November IOOS summit, which will celebrate a decade of progress and define the next 10 years of direction for the National U. S. IOOS.

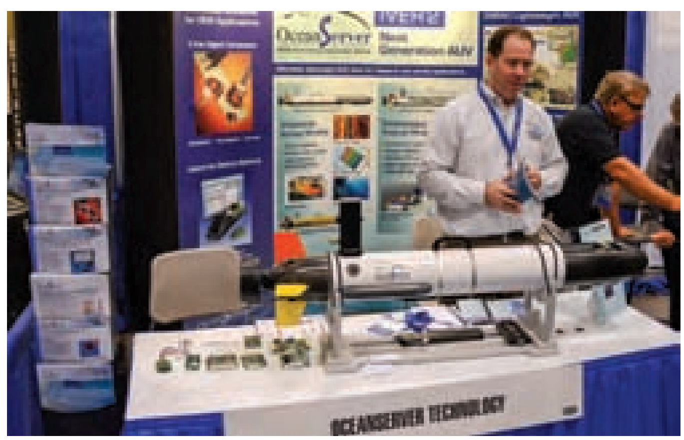
As the U.S. and other economies are faced with challenging budget environments, the ocean science and technology community will be challenged to provide solutions that provide economic value through innovation and collaboration. OCEANS ’12 Hampton Roads clearly demonstrated that through creative thought, energy and enthusiasm that we can collectively Harness the Power of the Ocean.

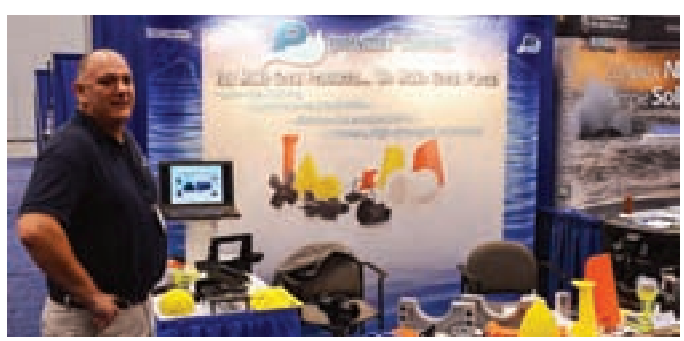
Exhibitors

Exhibits from a wide variety of vendors and organizations were presented at the conference. The exhibits are an opportunity to connect with potential partners and suppliers.









2012 IEEE OES Distinguished Technical Achievement Award—Joseph Vadus

Mr. Joseph Vadus has been selected to receive the Oceanic Engineering Society Award for 2012. His career has been focused on advances in research and technology development of: patented radar systems for deep submarines; instrumentation for undersea technology; new concepts for undersea vehicles; advanced development of renewable ocean energy technology. 15 years leadership in U.S. Technology exchanges in Bilateral Programs with Japan and France. Organizing and chairing symposia and workshops for technology exchange with: Japan, France, Russia, Norway, Taiwan, Chile, Argentina and the 3 Baltic States.

His accomplishments related to ocean engineering topics include the following:

- 11 patents (six awarded, 5 pending) including: radar for NR-1 and USS Dolphin; V-Beam 3D radar; automatically tracking targets; using the radar beam for communications; enabling one digital computer to check out another; submersible tracked vehicle for recon; function generator for computer.
- IEEE Life Fellow. Past Vice President for Technical Activities, International Activities and Conference Development
- IEEE Centennial Medal & IEEE Millennium Medal; OES Distinguished Service Award
- The First Techno-Ocean Award by the Consortium of Japanese Organizations—for leadership in ocean science and technology
- MTS Emeritus Fellow. Past Vice President Technical Activities. Compass Distinguished Technical Achievement Award. 2006 Lockheed-Martin Award for Ocean Science & Engineering
- For 20 years service, including the project finding the RMS TITANIC, the President of France selected him for the French Order of Merit.Member, American Society of French Legion of Merit.
- Sperry Rand Corporation: Project management for Deep submergence R&D: US Navy's NR-1, Trieste II, DSRV; and USS Dolphin. Letters of commendation for Marine Corps Radar for 3D air control in Vietnam.
- Organized and Chaired: Underwater Technology Symposia in Tokyo and Taiwan; US/EU-Baltic International Symposia in Lithuania, Estonia and Latvia; Chile-US and Argentina-US Symposia
- U.S. Chairman (15 yrs.) for Marine Technology R&D in the U.S.-Japan Bilateral Program.
- Japan Government and US State Dept. Awards for sustained performance as U.S. Chair in US-Japan Bilateral (1980–1995).
- Fellow Award in the UK Society for Underwater Technology,
- Mexican Academy of Sciences' Distinguished Achievement Award for Coastal and Ocean Engineering
- Contributing author to IEEE's book "Engineering Tomorrow: Challenges in the 21st Century".
- Lecturer for two semester course in Ocean Engineering in the Graduate Division of Long Island University

Joe Vadus receives the Distinguished Technical Award plaque from Jim Barbera.

2011 IEEE OES Distinguished Service Award—Robert C. Spindel

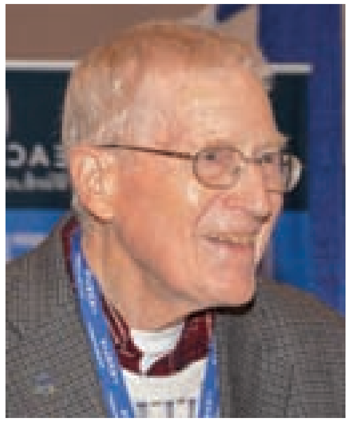
Dr. Robert C. Spindel has been selected for the Distinguished Service Award of the Oceanic Engineering Society for 2012. He has served OES since its inception and is proud of the fact that he published a paper in Issue 1 of the journal. He was an Associate Editor of JOE for 32 years, from 1980 to 2012, and remains active in JOE affairs. He has chaired three OCEANS conferences in Seattle in 1989, 1999 and 2010, and has been a member of the AdCom and the predecessor to the Oceanic Engineering Society, the Council of Oceanic Engineering. During his tenure as president of the Marine Technology Society he was a leading voice in uniting MTS and OES in what have become annual joint conferences. Throughout his career he has enthusiastically worked to make OES a fundamental part of the fabric of our profession.

Dr. Spindel is the Emeritus Director of the Applied Physics Laboratory of the University of Washington and Professor Emeritus of Electrical Engineering. He received a bachelor's degree from The Cooper Union in 1965 and a Ph.D. from Yale University in 1971, both in Electrical Engineering. He joined the Woods Hole Oceanographic Institution in 1972 and was appointed Chair of the Ocean Engineering Department in 1982. He left Woods Hole for APL in 1987 where he served as director until 2003.

His research interests are underwater acoustics, acoustic signal processing and ocean engineering. He has authored or co-authored over 100 scientific and technical publications, and has been Chief Scientist on many research cruises. Dr. Spindel is a Life Fellow of the Institute of Electrical and Electronic Engineers, a Fellow of the Acoustical Society of America and the Marine Technology Society. He served as president of the latter from 1993 to 1994. He was awarded the A.B. Wood Medal by British Institute of Acoustics in 1981, the Gano Dunn Medal by The Cooper Union in 1988, the Distinguished Technical Achievement Award by the IEEE Oceanic Engineering Society in 1990, the Walter Munk Award by U.S. Navy and The Oceanography Society in 2001, the U.S. Navy Meritorius Civilian Service Award in 2003, the Vice Admiral Charles B. Martell-David Bushnell Award by the Undersea Warfare Division of the National Defense Industrial Association in 2009 and the Silver Medal in Acoustical Oceanography from the Acoustical Society of America in 2009. He has served on numerous national advisory panels and committees including the National Research Council's Naval Studies Board and the U. S. Navy's Naval Research Advisory Committee.

Bob Spindel receives the Distinguished Service Award plaque from Jim Barbera.

Student Activities Award—Norm Miller



A special award was presented to Mr. Norman Miller at the IEEE Awards luncheon of the OCEANS12 Hampton Roads conference. Norm has been active in OES for over 25 years and is especially remembered for his work with coordinating Student Activities over the last many years. The text below is Norm's own account of his experience with OES over the years. He is retiring now and handing over his responsibilities to Christophe Sintes.

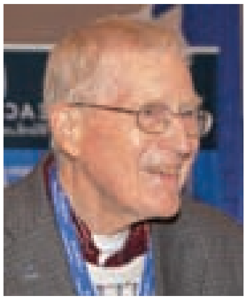
As 2012 comes to an end and my OES AdCom time expires, I am reminded of all of the wonderous experiences and friends I have made over the years in the OCEANS Community. I first experienced an OCEANS Conference in 1971 in San Diego. I followed this in 1972 as I was on the organizing committee for OCEANS '73 in Seattle. I continued attending the OCEANS Conference and was then on the organizing committee for OCEANS '80 in Seattle. My good friend, Ed Early suggested that I should run for the OES AdCom and in 1986 I was elected to the AdCom. This began an illustrious adventure for me in the Oceans Community. In 1990 I was elected Vice President West. At that time we had two Vice Presidents, Vice President East and Vice President West. I began to study the bylaws and constitution and decided they need to be brought up to date to reflect how we were actually operating. I rewrote the bylaws to include a Vice President, Technical Activities to direct conferences and a Vice President, Professional Activities to develop membership and do the administrative activities of the Society. I presented them to the AdCom in 1993 at OCEANS Victoria. They were accepted and I was elected Vice President, Professional Activities. We later included a Vice President International to develop the society outside of the USA. Ferial El-Hawary became our International VP.

Meanwhile in Seattle I became very active in our Puget Sound Section of MTS and in 1995 was the Chapter Chair. In 1988 I participated in the Acoustical Society meeting in Seattle and was impressed by their Student Poster program. As we were preparing for OCEANS '89 in Seattle, I spoke with the OES President, Dan Alsbach, about having a Student Poster program at OCEANS '89 in Seattle. I thought is was a good idea and granted me $5,000 to start a program. I brought this back to our organizing committee and Bob Spindel agreed to trying it. At this time the Sea Grant program was alive and we contact various schools through Sea Grant. We received 16 poster abstracts. Bob agreed to sponsor all of them and our first Student Poster Program was launched at OCEANS '89 Seattle. This was followed at OCEANS '91 in Honolulu and has continued ever since. We have been fortunate to get funding from ONR to support the program in recent years. The program has grown in size and interest. At the OCEANS Conference in Quebec, in honor of Quebec City's 400 years, we had our 400th Student Poster presented! The young lady received a special award in recognition.

From my perspective one of the most memorable OCEANS Conferences was in Sydney in 2010. I was called forward at the Gala to present the Student Awards. As I approached the podium, our OES Treasurer stood up and announced to the audience that I was celebrating a birthday and asked them to sing "Happy Birthday" to me! Wow! I was them presented a birthday card that all of the Poster Students had signed. Needless to say it was a memorable birthday. Another memorable OCEANS was in Nice, France where I received the Distinguished Service Award for my work with the students over the years. And of course, I shall never forget the OES Luncheon at OCEANS '12 in Hampton Roads, Virginia. After the usual awards were given out, I was called forward and was presented a very special plaque for my service to the Society for the past 25 years! It was a very fitting way to complete my OES activities and career!

OCEANS '12 MTS/IEEE—Student Poster Program

Norman D. Miller, OES Student Activities Coordinator



The 31st Student Poster Competition was held at OCEANS '12 MTS/IEEE October 14–19, 2012. The venue was the Virginia Beach Convention Center and provided an ideal arrangement for the Student Poster presentation in the Exhibition Hall. The right aisle was designated "University Row" and had exhibition booths from various universities on one side and the Student Posters along the other side of the aisle. Hence the students received many visitors. The Student Poster competition was organized by Mr. Robert Heitsenrether, NOAA/NOS/CO-OPS and assisted by Dr. Christophe Sintes, Institut TELECOM Bretagne, France. The program was funded by a grant from the Office of Naval Research. Eighty four student poster abstracts were received and reviewed. Twenty four posters were accepted. Six were unable to attend and at the last minute one additional student dropped out. Seventeen posters were displayed, reviewed, and judged.

The Student Program began with an organizational meeting on Monday. October 14, 2012. The students were given instructions on when to be at their posters along with expense report forms and general instructions on meeting with the visitors. Each student was then introduced and gave a short summary of their work and poster. Following the opening plenary session on Tuesday morning the students went to their posters and continued there at break times and noon times. Each judge received a package of judging forms and instructions as to when to have them completed. All proceeded well and on Wednesday afternoon the judges turned in their forms and Mr. Heitsenrether and Mr. Norman D. Miller selected the winning posters.

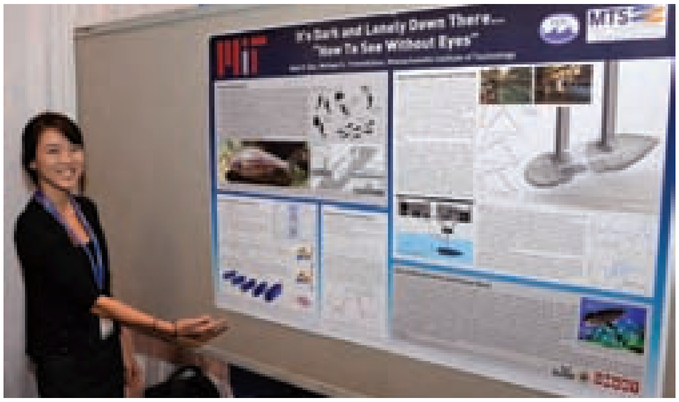
The Student Awards Presentation was held in the Exhibition Area during the lunch break on Thursday 17 October. Mr. Heitsenrether called the students forward and each received a certificate of participation from the Conference Chairman, Mr. Ray Toll. Mr. Heitsenrether then called Mr. Norman Miller, OES Student Activities Coordinator, to come forward to present the awards. Each award winner received an engraved plaque along with a prize check. Photos were taken at each presentation. At the conclusion of the awards Mr. Miller welcomed them all to "The OCEANS Student Poster Alumni Association" and they were all given a big hand. Group photos were then taken and the awards ceremony was concluded. The students receiving awards were:

First Place:	Giancarlo Troni—Johns Hopkins University
Second Place:	Augustin Saucan, Institut Telecom-Bretange and Bruno Ferrrita, Faculty of Engineering, University of Porto
Third Place:	Amy Gao, Massachusetts Institute of Technology, Jonathan Odom, Duke University, and Jon Loftis, Virginia Institute of Marine Science

The students, their schools, poster titles and abstracts are listed below:

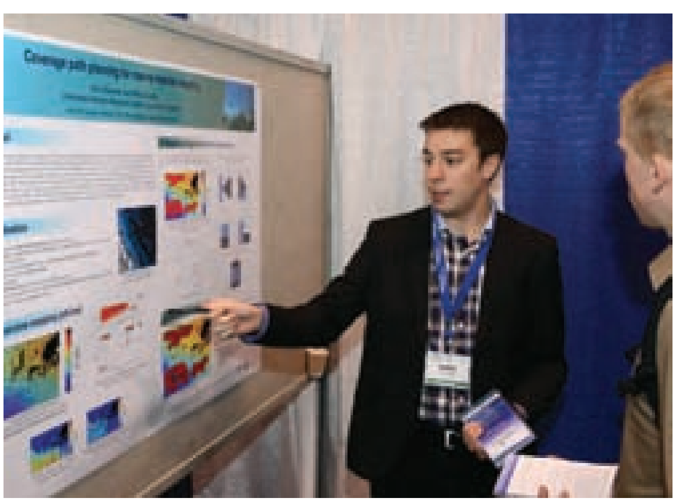
PHOTOS BY STAN CHAMBERLAIN

Amy Gao, Massachusetts Institute of Technology, *Bio-Inspired Pressure Sensing for Active Yaw Control of Underwater Vehicles*



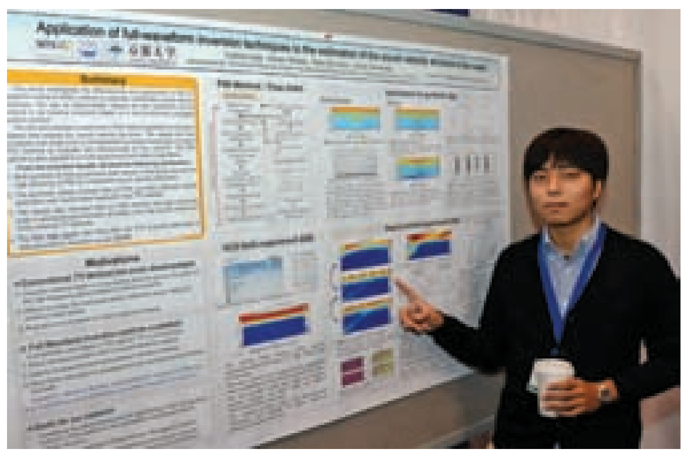
Abstract—A towed underwater vehicle equipped with a bioinspired artificial lateral line (ALL) was constructed and tested with the goal of active detection and correction of the vehicle's angle of attack. Preliminary experiments demonstrate that a low number of sensors are sufficient to enable the discrimination between different orientations, and that a basic proportional controller is capable of keeping the vehicle aligned with the direction of flow. We propose that a model based controller could be developed to improve system response. Toward this, we derive a vehicle model based on a first-order 3D Rankine Source Panel Method, which is shown to be competent in estimating the pressure field in the region of interest during motion at constant angles of attack, and during execution of dynamic maneuvers. To solve the inverse problem of estimating the vehicle orientation given specific pressure measurements, an Unscented Kalman Filter is developed around the model. It is shown to provide a close estimation of the vehicle state using experimentally collected pressure measurements. This demonstrates that an artificial lateral line is a promising technology for dynamically mediating the angle of a body relative to the oncoming flow.

Enric Galceran, University of Girona, *Coverage Path Planning for Marine Habitat Mapping*



Abstract—A framework for generating coverage paths for marine habitat mapping is proposed in this paper. The framework combines two existing coverage path planning algorithms with new ideas to provide automated, efficient survey paths that take into account the particularities of the application. On one hand, a recent algorithm especially targeted for marine environments is used to generate a survey path of a previously unmapped area. The method has the advantage of minimizing repeated coverage when using a surface vehicle or while surveying at constant depth with an underwater vehicle. On the other hand, only the regions where the marine habitat is present (which often come in the form of widespread "blobs") need to be surveyed in future monitoring missions in the area. However, due to the changing nature of the marine habitats, determining the exact extent of those regions prior to mission is not possible. Rather than surveying the whole area anew, we propose to use a sensor-based planner that, given their approximate locations from a previous survey, covers the regions of interest (ROIs) on-line using acoustic or optical camera information. Additional procedures to generate a path that visits all the ROIs are provided. The approach is tested in simulation using a real world bathymetric dataset and synthetic ROIs. Results show the feasibility of the proposed approach.

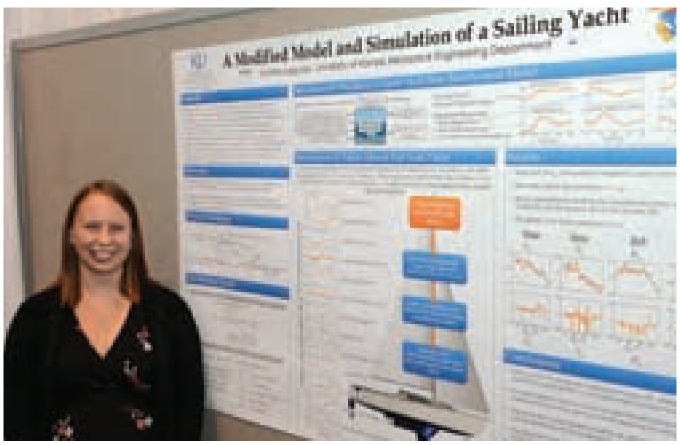
Yukihiro Kida, Kyoto University, *Applications of Full-Wave Intervention techniques to the estimation of the sound velocity structure in the ocean*



Abstract—The travel-time inversion method has been developed using a ray-tracing scheme in the Munk's Ocean Acoustic Tomography (OAT) method. The method has some similarity with seismic exploration both in the theory and data processing methods except for the direct utilization of waveform in seismic exploration. The waveform analysis is a powerful tool to investigate the velocities in the areas of interest, and the importance to use waveform is widely recognized in seismic explorations. However there are few precedent studies dealing with waveform inversion in the application of OAT. This study investigates the effectiveness and applicability of the full waveform inversion method to estimate underwater sound velocity structures. We use an adjoint-state method for the calculation of the gradient in an iterative

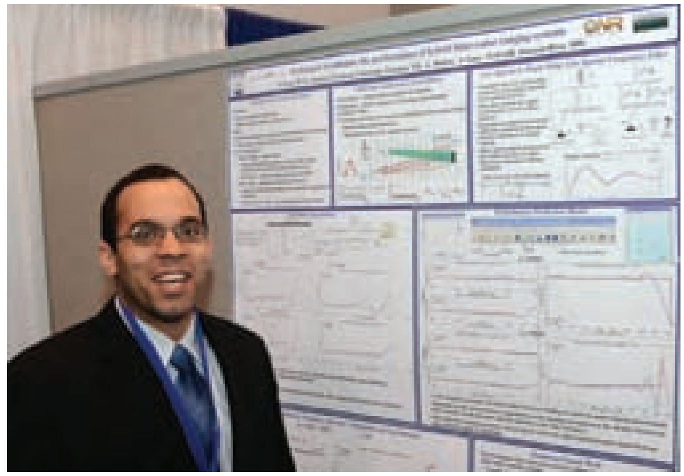
inversion based on a pre-conditioned conjugate gradient method. We first demonstrate results from a full waveform inversion method applied to a synthetic dataset that reflects the sound velocity structure. The results are then compared with those from a conventional ray-based travel time inversion method to evaluate the effectiveness of the method. The results show that the full waveform inversion method could provide more precise image with higher resolution than the ray-based method. The full waveform inversion method is also applied to a VCS experiment field data in Lake Biwa. In spite of very limited path condition using only direct arrival wave, the full waveform inversion method could describe the horizontal velocity structure possibly due to seasonal thermocline in the lake. We conclude that the FWI method could be the key success factor for the higher resolution at estimation of underwater sound velocity structure.

Katrina Legursky, University of Kansas, *A Modified Model, Simulation, and Tests of a Full-Scale Sailing Yacht*



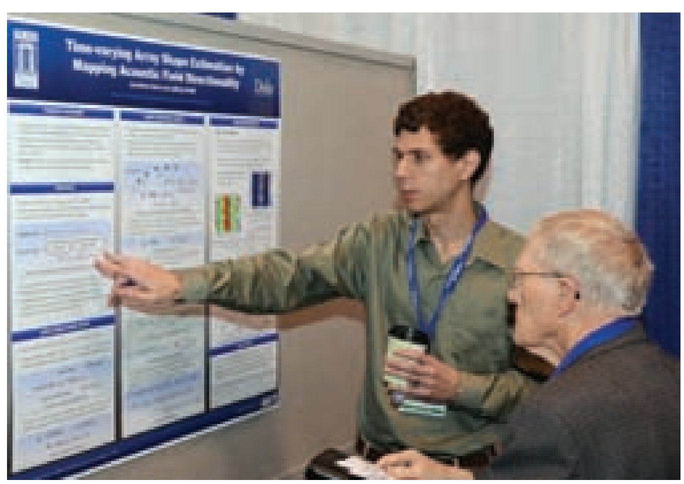
Abstract—Sailing yachts have great potential to act as future long-term oceanic observing platforms, yet to date there have not been complete autonomous sailing systems robust enough to handle long term operation in the harsh and continually changing ocean environment. The basis of control system design is a mathematical model capable of describing and capturing the physics based dynamics of the sailboat. The mathematical model represents the system to be controlled, however, a sailing yacht is a very difficult system to model from a controls perspective because of its heavy reliance on the uncontrolled spatial and temporal distribution of the wind. Presented in this paper is a modified aerodynamic force model which includes the sail angle as a control input to the sailing yacht system. The new model has been incorporated into a 4 degree of freedom (DOF) rigid body dynamic yacht model, and implemented in MATLAB/Simulink. The simulations shows model exhibits similar behavior to that observed in full scale sailing yacht sea trial data. Data taken aboard a Precision 23 day-sailer is analyzed, and it is found that the model is a likely candidate for including sail input to a physics based dynamic model for identification and control system design.

Paul Perez, Clarkson University, *Techniques to enhance the performance of hybrid lidar-radar ranging systems*



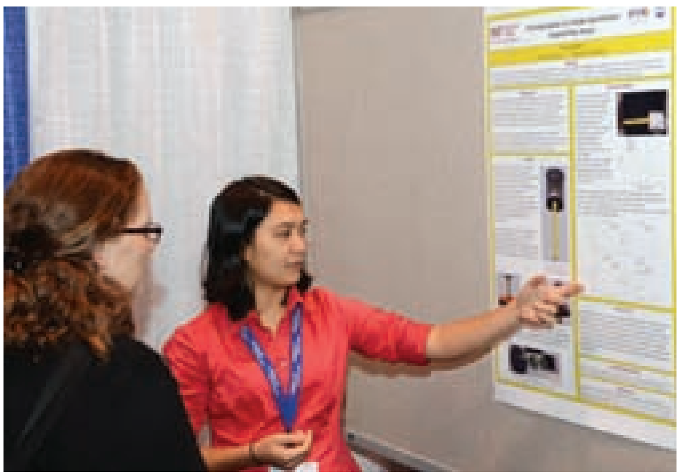
Abstract—Hybrid lidar-radar uses a combination of techniques to enhance underwater detection, ranging, and imaging. In turbid water, the lidar return signal includes a significant amount of backscatter in addition to the object-reflected light. System performance is highlylimited by the backscatter which results from volumetric scattering of the transmitted light signal off the particulates existing in the water channel. A new backscatter reduction technique based on spatial frequency filtering will be discussed. The spatial filter algorithm leverages radar techniques developed to enhance through the wall imaging (TTWI) performance. Algorithm validation via experimental data is provided.

Jonathon Odom, Duke University, *Time-varying Array Shape Estimation by Mapping Acoustic Field Directionality*



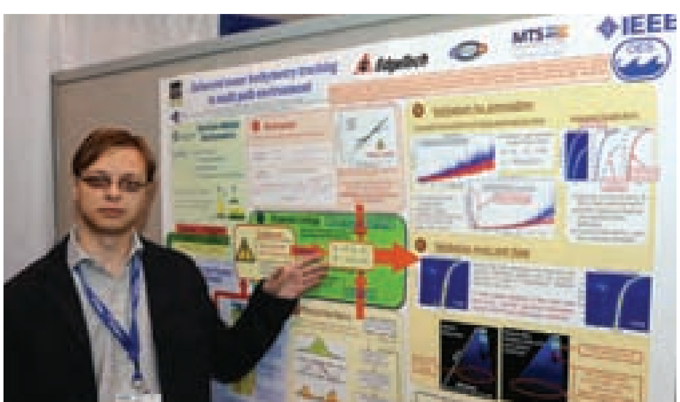
Abstract—This paper introduces a towed-array shape estimation technique that exploits the directional structure of the time-varying acoustic field. Unlike conventional array shape estimation methods that use discrete sources of opportunity, the proposed approach does not assume knowledge of the number of sources in the field or their estimated directions. Instead, the entire time-varying field directionality map is used. Additionally, maneuverability of the array is exploited to improve endfire resolution and left/right discrimination for a nominally linear array. The algorithm forms an approximate joint maximum likelihood estimate of time-varying field directionality and array shape using an iterative Expectation-Maximization (EM) approach. Simulations are given to evaluate the array shape estimation error during a maneuver. In a simulated multisource scenario, the proposed method is shown to be more robust than methods that rely on direction-of-arrival estimation when the full field around the array is considered.

Heather Beem, Massachusetts Institute of Technology, *Characterization of a harbor seal whisker-inspired flow sensor*



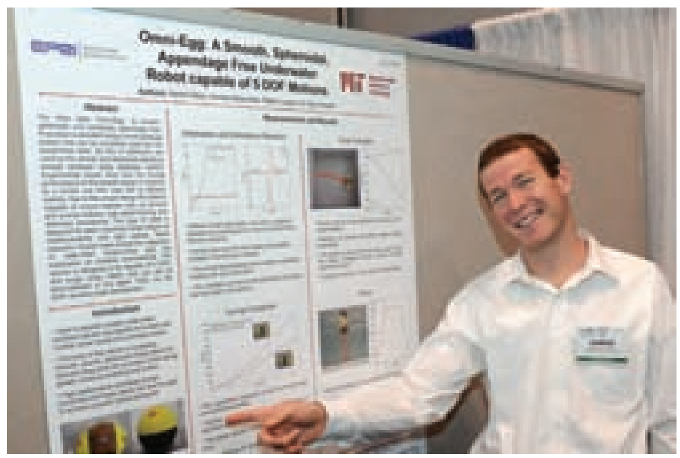
Abstract—A sensor with the undulatory geometry of a harbor seal whisker has been designed, fabricated, and characterized for use as a mechanical sensor of flow velocity. Bend sensors at the whisker base provide deflection information in four directions. A waterproof design with a pressure housing has been made, allowing the sensor to operate at depth, in a stand-alone configuration. Characterization was performed by correlating tip deflection to voltage output in each of the four sensors.

Augustin Saucan, Institut Telecom-Bretagne, *Enhanced sonar bathymetry tracking in multi-path environment*



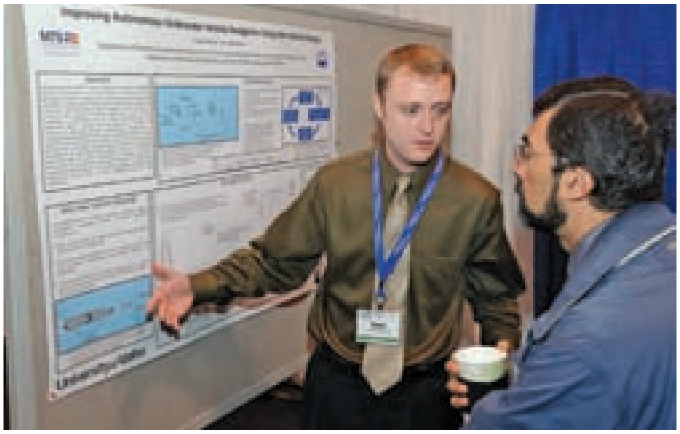
Abstract—In this paper we address DOA estimation for the side scan sonar in the presence of multiple interfering echoes. We illustrate the potential usage of high resolution methods and tracking algorithms. The proposed tracking algorithm is based on a apriori information on the sea-floor DOA angle. Because of the non-linearity of the model and non-Gaussian behavior of the observed 4600 data, the implementation of the proposed algorithm is based on the particle filter. The proposed tracking algorithm is shown to be able to resolve the multi-path interference problem. The heavy-tailed/non-Gaussian character of the data is noted and the Laplace distribution is shown to better characterize the tails of the observed data. The multivariate Laplace distribution is derived for the observed data and the particle filter coupled with the multivariate Laplace distribution is shown to provide better estimates than with the Gaussian assumption.

Aaron Fittery, Massachusetts Institute of Technology, *OmniEgg: A Smooth, Spheroidal Appendage Free Underwater Robot capable of 5 DOF Motion*



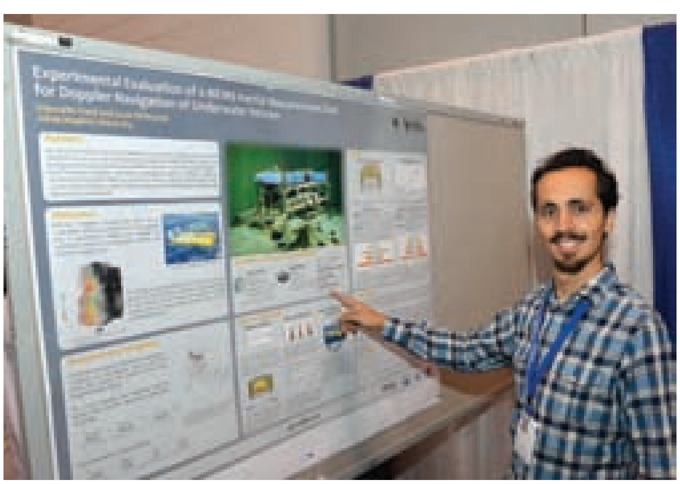
Abstract—This paper describes the performance of a new type of highly maneuverable underwater robot developed at MIT. The robot, titled “Omni-Egg,” is smooth, spheroidal, and completely appendage free. Propulsion is provided using a novel pump-jet system that can be completely built into the streamlined shell. No fins or stabilizers are used on the vehicle, and directional stability is instead achieved using feedback control. Experimental results show how the turning performance of this smooth design is superior to a similar one that uses fins to achieve stability. Due to this unique design the robot is capable of unique motions such as forward and reverse motions, high speed turning, and sideways translations. This type of robot is designed for tasks requiring a large degree of maneuverability within tight spaces. Some examples of such tasks include the inspection of water-filled infrastructure and the exploration of cluttered environments. Such applications have a high risk of collisions or snagging on obstacles, so a smooth outer shape is desirable. The vehicle is designed to be capable of 5 DOF, and surge, sway, heave, and yaw are all demonstrated in this paper. Pitch, the 5th DOF, remains under development.

Jesse Pentzer, The Pennsylvania State University, *Autonomous Underwater Navigation Using Inter-Vehicle Ranging*



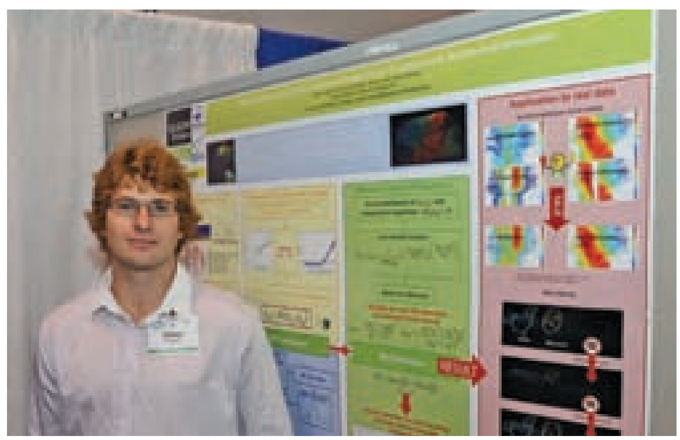
Abstract—One-way-travel-time (OWTT) acoustic ranging has received considerable attention as improvements to acoustic modems and electronic clocks have made it a feasible navigation tool. This paper reports the results of simulations investigating the effect of utilizing inter-vehicle ranging for autonomous underwater vehicle (AUV) navigation. In these simulations, a fleet of AUVs operates in shallow water with a pair of fixed transponders. A rigid timing cycle for acoustic communications was implemented with a message queuing approach to simulate the handicaps of underwater acoustic communication. Furthermore, a simple path following algorithm was used to navigate the AUVs through a waypoint course, and a kinematic motion model was used to simulate AUV movement. The position of each vehicle in the fleet was estimated independently by combining the propagation steps of an extended Kalman filter with the update equations of an extended information filter. Results of the simulations showed the addition of inter-vehicle ranging improved accuracy by 1-2 cm when navigating using four fixed transponders and by 9-24 cm when navigating using two fixed transponders.

Giancarlo Troni, Johns Hopkins University, *Experimental Evaluation of a MEMS Inertial Measurements Unit for Doppler Navigation of Underwater Vehicles*



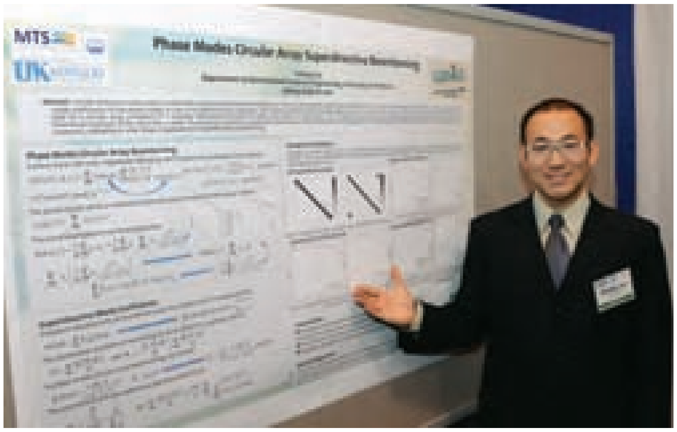
Abstract—This paper reports the results of an in-water laboratory experimental evaluation of the attitude estimation accuracy of a low-cost micro-electro-mechanical systems (MEMS) attitude and heading reference system (AHRS), and the effect of the accuracy of this sensor on Doppler-based underwater navigation. We report a comparative analysis of Doppler navigation obtained employing MEMS AHRS in comparison to Doppler navigation obtained with a high-accuracy inertial navigation system (INS) including a true-North-seeking gyrocompass and high precision accelerometers. The data indicate that Doppler navigation performance with MEMS AHRS is sensitive to instrument calibration including Doppler/AHRS alignment calibration, calibration of AHRS magnetometers for hard-iron & soft-iron errors, and calibration of AHRS angular rate sensors. When carefully calibrated, MEMS AHRS Doppler navigation error is shown to be within an order-of-magnitude of that obtained with high-end INS for the conditions and vehicle trajectories studied. The goal of this evaluation is to quantify Doppler navigation performance using MEMS AHRS. These results may be useful in the development of lower-cost Doppler navigation systems for small and low-cost underwater vehicles.

Yoann Ladroit, Institut Telecom-Bretagne, *Maximum Likelihood Estimator based on Quality Factor for Bathymetric Multibeam Echosounder*



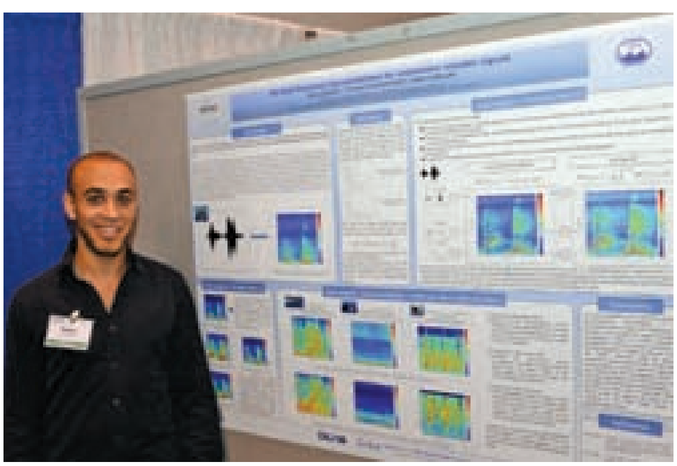
Abstract—For modern multibeam echosounders, the use of a robust and reliable quality estimator associated with each sounding is an absolute necessity. Indeed, due to the large volume of data acquired, a lot of time is lost, both during the survey and the post-processing. This is a costly problem for 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. Based on the Quality Factor and on the existing way of processing a sounding, we defined a new sounding estimator using a maximum likelihood approach. This new approach was developed under several hypothesis which are plausible under certain conditions. This new estimator was successfully tested and implemented on real data with good results.

Yukang Liu, University of Kentucky, *Phase Modes Circular Array Superdirective Beamforming*



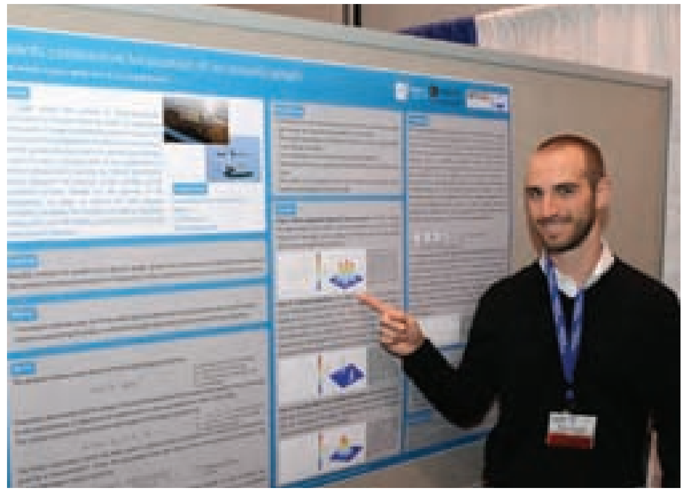
Abstract—Circular arrays are widely used in underwater acoustics array signal processing due to their two dimensional symmetrical characteristics. In this paper a new method to analytically calculate the superdirective mode coefficients of the phase modes circular array beamforming is proposed. The maximum Directivity Index (DI) achievable for phase modes circular array beamforming is also derived. Computer simulation is held for a circular array composed of 12 separate hydrophones mounted on either open sphere or rigid sphere. The calculated DI achieved by the proposed superdirective beamforming corresponds to the theoretical maximum DI for up to the 5th order. The proposed method to calculate the superdirective mode coefficients is also applicable for calculating mode coefficients for arrays of any shape and any kind of expansion, indicating its wide range of applications in superdirectivity beamforming.

Samir Ouelha, DCNS, *On time-frequency representations for underwater acoustic signal*



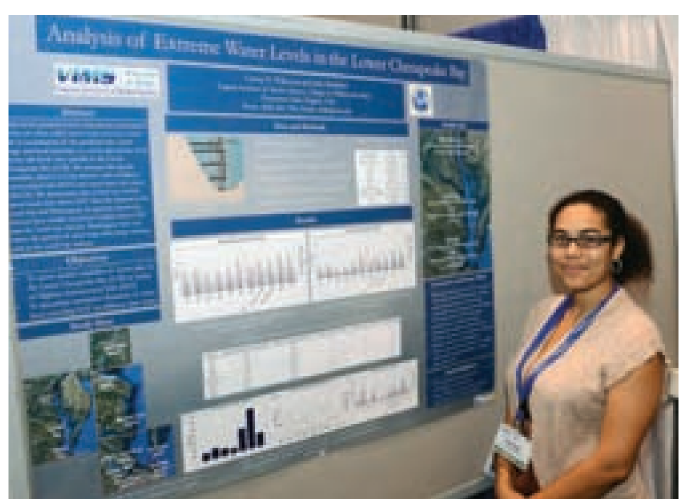
Abstract—In order to develop a new human perception inspired process useful for underwater acoustic signal processing, the purpose of this paper is to present a new human physiology based time-frequency representation. This method is based on the use of the Mel filters, classicaly used for the voice recognition. Several experimentations on real underwater signals are presented and discussed.

Bruno Ferreira, INSEC TEC—University of Porto, *Towards cooperative localization of an acoustic pinger*

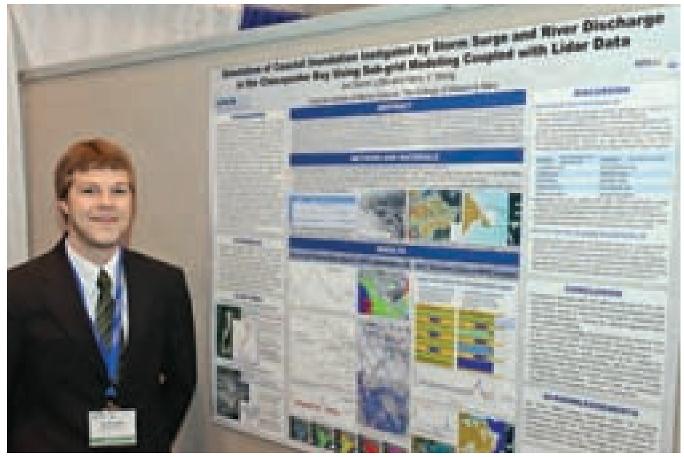


Abstract—This paper tackles the problem of localization of an acoustic pinger by a team of cooperative marine robots. A pinger, whose location is unknown, intermittently emits an acoustic ping which is sensed by hydrophones mounted on marine robots. In addition to position, the instant of emission is unknown. A team of robots carrying a total of four hydrophones is therefore (theoretically) required to estimate the position without ambiguity. The precision of the estimate and the uncertainty critically depend on the position of the hydrophones. In order to obtain the best possible estimation, we explore the possibility of using a cooperative method that leads the robots to points where the overall observability is improved.

Carissa Wilkerson, Virginia Institute of Marine Science, *Analysis of Extreme Water Levels in the Lower Chesapeake Bay*



Abstract—The lower Chesapeake Bay (LCB) experiences coastal flooding due to both tropical and extratropical systems. Water levels produced from these events is often called storm surge; however, storm tide (a combination of the predicted tide, storm surge, and local anomaly), is a more appropriate term. Storm tide levels vary spatially in the LCB. Here we assess this spatial variability relative to local datums, such as highest astronomical tide (HAT) and mean lower low water (MLLW). We determined whether there was any difference in hours above HAT between each of our stations for each storm. We revealed a trend that central bay stations, such as Windmill Point and Lewisetta, spend more time above HAT than the stations in the south bay and Washington. The maximum water level above MLLW and HAT was determined for each station and storm and then analyzed for spatial trends. We found that, in general, central bay stations have smaller maximum heights above HAT than the south bay stations. Washington does not follow the pattern of other large tidal-range stations, such as the south bay stations.



Jon Loftis, Virginia Institute of Marine Science, *Simulation of Coastal Inundation Instigated by Storm Surge, River Discharge, and Precipitation in the Chesapeake Bay Using Sub-grid Modeling with LIDAR Digital Elevation Models*

Abstract—A storm surge is an aperiodically anomalous rise of sea level accompanied by a tropical or extratropical storm system, wherein water level is the distinction between the observed sea level and the forecasted water level (Blain et al., 1994). Several distinct processes can potentially alter the water level in tidal regions; the pressure effect, the wind effect, the Coriolis effect, the wave effect, and the rainfall effect (Harris, 1963). Coastal inundation initiated via storm surge along the U.S. East Coast is a substantial threat to residential properties, community infrastructure, and human life. Furthermore, prolonged inundation from heavy precipitation and upland drainage during and after the storm has passed can significantly increase coastal flood damage. There are additional implications for inundated coastal habitats, as a major flood event can dramatically alter the regular function of an ecosystem. In order to mitigate human life loss and damage of coastal properties, several numerical models have been developed to provide an early warning system for storm surge and inundation events in various coastal study areas. Modeling of the Chesapeake Bay has been successfully performed previously with the serial version of SELFE (Cho, 2009). To expand upon this success, this study will make use of the MCI parallel version 3.1 of SELFE to capitalize on the additional computing power provided to process a large domain cast on a spherical coordinate system. These features being of paramount importance for a large-scale super regional model, the entire model domain covers the U.S. Atlantic coastline from 30 to 42°N (Figure 1). This expansive large domain grid increases the likelihood of properly modeling the effects of an approaching tropical storm system.

Winning Student Paper

Experimental Evaluation of a MEMS Inertial Measurements Unit for Doppler Navigation of Underwater Vehicles

Giancarlo Troni and Louis L. Whitcomb

Abstract— **This paper reports the results of an in-water laboratory experimental evaluation of the attitude estimation accuracy of a low-cost micro-electro-mechanical systems (MEMS) attitude and heading reference system (AHRS), and the effect of the accuracy of this sensor on Doppler-based underwater navigation. We report a comparative analysis of Doppler navigation obtained employing MEMS AHRS in comparison to Doppler navigation obtained with a high-accuracy inertial navigation system (INS) including a true-North-seeking gyrocompass and high precision accelerometers. The data indicate that Doppler navigation performance with MEMS AHRS is sensitive to instrument calibration including Doppler/AHRS alignment calibration, calibration of AHRS magnetometers for hard-iron & soft-iron errors, and calibration of AHRS angular rate sensors. When carefully calibrated, MEMS AHRS Doppler navigation error is shown to be within an order-of-magnitude of that obtained with high-end INS for the conditions and vehicle trajectories studied. The goal of this evaluation is to quantify Doppler navigation performance using MEMS AHRS. These results may be useful in the development of lower-cost Doppler navigation systems for small and low-cost underwater vehicles.**

I. Introduction

Bottom-lock Doppler sonar navigation is a common method for high-precision near-bottom underwater vehicle navigation. Doppler sonar navigation typically employs a 3-axis Doppler velocity log (DVL), a precision pressure depth sensor, and a 3-axis attitude sensor [15]. High-end North-seeking gyrocompasses are often employed to estimate vehicle attitude [3], but advances in inertial measurement technology have enabled the development of a new class of compact, low power, low-cost attitude and heading reference system (AHRS), [10].

This paper reports the results of a comparative experimental analysis of the performance of Doppler navigation using low-cost micro-electro-mechanical systems (MEMS) AHRS versus the performance of Doppler navigation using high-end inertial navigation system (INS). Unlike most previous studies which report numerical simulations, e.g. [2], we report an in-water comparative experimental evaluation of these navigation systems on the Johns Hopkins University (JHU) remotely operated vehicle (ROV).

This paper is organized as follows: In Section II we give a brief overview of Doppler navigation and the attitude estimation. In Section III we describe our experimental setup and evaluation methodology. In Section V we report the results of laboratory experiments to evaluate the performance of the different attitude sensors. Section VI summarizes and concludes.

This work was supported by the National Science Foundation under NSF award IIS-0812138. Support for the first author was also provided by a Fulbright/Conicyt Fellowship.

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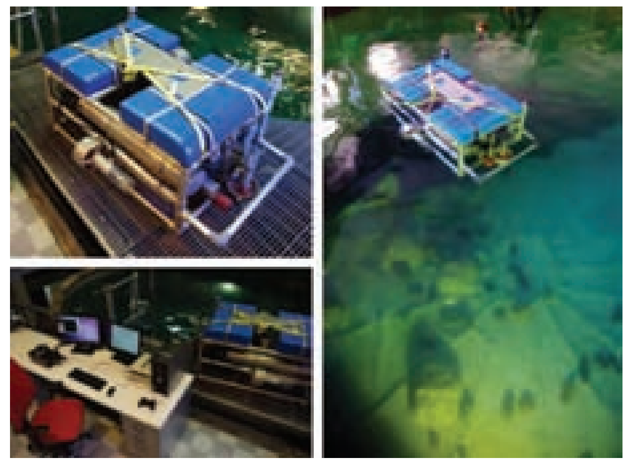

Fig. 1. JHU ROV inside the Johns Hopkins Hydrodynamic Test Facility

II. Background

This section briefly reviews basic concepts of attitude estimation and Doppler navigation of underwater vehicles.

A. Notation

For each vector, a leading superscript indicates the frame of reference and a following subscript indicates the sensor source, thus ${}^{w}p_{l}$ is the LBL position in the world coordinates, ${}^{v}v_{d}$ is the Doppler velocity sensor in the vehicle frame and ${}^{i}a_{i}$ is the accelerometer linear acceleration in the inertial sensor frame.

The set of 3×3 rotation matrices forms a group, known as the special orthogonal group, SO(3), defined as

$$SO(3) = \{R : R \in \mathbb{R}^{3\times3}, R^{T}R = I, det(R) = 1\}. \quad (1)$$

For each rotation matrix a leading superscript and subscript indicates the frames of reference. For example, ${}^{w}_{v}R$ is the rotation from the vehicle frame to the world frame.

B. Overview of Doppler Navigation

A Doppler sonar measures the vehicle's three-axis velocity in instrument coordinates with respect to the fixed sea floor. The most common Doppler sonar configuration for underwater vehicle navigation consists of four downward-looking acoustic transducers each oriented at 30° from the instrument vertical axis. Each transducer measures acoustically the velocity of the instrument parallel to its beam with respect to the fixed sea floor [8]. The instrument velocity in the world frame sensor is given by

$$ {}^{w}v_{d}(t) = {}^{w}_{v}R(t)\, {}^{v}_{d}R\, {}^{d}v_{d}(t) \quad (2) $$

where ${}^{v}_{d}R$ is the constant rotation matrix from Doppler instrument coordinate frame to the vehicle coordinate frame, and ${}^{w}_{v}R(t)$ is the time varying rotation matrix from the vehicle coordinate frame to the inertial world coordinate frame provided by an attitude sensor.

To obtain DVL position estimate, ${}^{w}p_{d}(t)$, a common solution use the dead-reckoning equation as follows [15]

$$ {}^{w}p_{d}(t) = {}^{w}p_{d}(t_0) + \int_{t_0}^{t} {}^{w}v_{d}(\tau)\, d\tau. \quad (3) $$

C. Overview of Attitude Sensors

MEMS AHRSs typically contain (i) a three-axis angular rotation rate sensor, (ii) a three-axis linear accelerometer, and (iii) a three-axis magnetometer. Data from these sensors are employed to estimate the the direction of the earth's gravitational field vector in instrument coordinates, $a = [a_x, a_y, a_z]^T$. The estimated roll $\hat{\varphi}$ and pitch $\hat{\theta}$ angles [14] are given by

$$ \hat{\varphi} = atan2(-a_y, -a_z) \quad (4) $$

$$ \hat{\theta} = atan2(a_x, \sqrt{a_y^2 + a_z^2}). \quad (5) $$

Roll/pitch accuracies on the order of 0.1° (static) and 1°–5° (dynamic) are reported [6]. Three-axis flux-gate and magnetostrictive magnetometers are a common and inexpensive sensors used to estimate heading. The measured magnetic field ${}^{i}m \in \mathbb{R}^3$ in the instrument frame can be transformed from the instrument frame to the local-level frame by the relation ${}^{l}m = {}^{l}_{i}R\, {}^{i}m$, where ${}^{l}_{i}R \in \mathbb{R}^{3\times3}$ is a rotation matrix using pitch and roll data estimates. Then the estimated true-north heading $\hat{\psi}$ [14] can be computed as

$$ \hat{\psi} = atan2(-{}^{l}m_y, {}^{l}m_x) - \psi_0 \quad (6) $$

where ψ_0 is the known local magnetic variation. Magnetic distortions are commonly categorized as a hard iron and soft iron effects [1]. Properly calibrated magnetometers can provide heading accuracies on the order of 1°–3° with respect to local magnetic North [6]. To improve the dynamic performance of the AHRS attitude estimation, angular velocity gyrocompasses are used with a filter (such as the Kalman filter or the complementary filter) to dynamically estimate attitude.

High-end navigation-grade attitude sensors typically employ three-axis fiber-optic or ring-laser gyrocompasses to estimate the Earth's rotation and to estimate the direction of true-North. Such sensors can yield dynamic heading accuracies on the order of 0.1° and roll/pitch accuracy on the order of 0.01° [4].

III. Performance Evaluation

The experimental evaluation reported herein used data obtained with the JHU ROV, Figure 1, in the JHU Hydrodynamic Test Facility [5]. This Section gives an overview of the experimental setup.

A. Experimental Setup

The facility contains a 7.5 m diameter × 4 m deep indoor fresh water tank made of steel. The JHU ROV is actuated by six 1.5 kW DC brushless electric thrusters and is capable of being actively controlled in 6 degrees of freedom (DOF). A suite of sensors commonly employed in deep submergence underwater vehicles is present on the JHU ROV. Table I details the JHU ROV attitude sensors. Table II specifies the additional JHU ROV navigation sensors used in our performance evaluation.

TABLE I
JHU ROV Attitude Sensors Precision and Update Rate

Instrument	Model	Variable	Specification	Update Rate
High-end INS	IXSEA PHINS III [4]	Heading Pitch/Roll Angular Rate Acceleration	0.1° 0.01° $0.01°/s$ (1) 1 mg (1)	10 Hz
MEMS AHRS	Microstrain 3DM-GX3-25 [6]	Heading Pitch/Roll Angular Rate Acceleration	±2° ±2° $0.245°/s$ 0.65 mg	100 Hz

[1]: Phins raw output data is degraded to complain with exportation regulations. Internally the sensors have a higher performance.

TABLE II
JHU ROV Navigation Sensors Precision and Update Rate

Instrument	Model	Variable	Specification	Update Rate
DVL	Teledyne RDI 1200 kHz [9]	Velocity	±0.2% ±1 mm/s	8 Hz
Pressure sensor	Paroscientific [7]	Depth	0.01%	15 Hz
LBL	Marquest Sharps 300 kHz LBL System	XY Position	5 mm	5 Hz

The MEMS AHRS and high-end INS attitude data were re-sampled to the DVL sampling time to estimate the Doppler navigation position. Then the estimated Doppler positions were re-sampled to the LBL position to estimate the position error. The Doppler velocity, the high-end INS attitude and MEMS AHRS attitude are used in these experiments without any extra post-processing or filtering. The LBL fix data outliers were manually removed. In these experiments the vehicle followed pre-programmed trajectories under close-loop control.

B. Evaluation Methodology

To analyze the DVL position estimation performance based on the MEMS-based attitude sensor, we calculate the following quantities:

a. *Position error metric*: Using the attitude estimation, ${}^{w}_{v}R(t)$, from each sensor we recomputed the Doppler track of the vehicle, ${}^{w}p_d$, using (3). We evaluated the performance of each sensor by comparing the estimated position with the "ground truth" LBL position, ${}^{w}p_l$, and calculate the standard deviation,

$$\hat{\sigma} = [\hat{\sigma_x}\, \hat{\sigma_x}\, \hat{\sigma_x}]^\top = \sigma(p_l -^{w} p_d) \tag{7}$$

and a position error metric (PE) is defined as

$$||\vec{\sigma}||_2 = (\sigma_x^2 + \sigma_y^2 + \sigma_z^2)^{\frac{1}{2}}. \tag{8}$$

b. *Percentage of distance traveled*: Using the standard dead-reckoning navigation metric reporting the error of the final position as a percentage of the distance traveled (DT).

IV. Experiments and Results

First a set of experiments was conducted to explore the performance of each sensor required for attitude estimation. Second, we compared the MEMS AHRS attitude estimation with that of the high-end INS. Third, an experiment following a standard survey trajectory was conducted to evaluate the influence of the attitude sensor performance on the Doppler navigation position estimation.

A. Performance and Calibration of Internal Sensors

1) Static Noise: We analyzed the static noise characteristics of the internal sensors of the MEMS AHRS. Table IV-A.1 shows the standard deviation of each sensor's output data while the vehicle was motionless for a period of 20 min. The AHRS MEMS on-board sensors are internally filtered within the AHRS. A user-selectable digital moving average filter is applied to the sensor output. A digital window size of 66.7 Hz was used for the accelerometers data and angular rate sensors, and a windows size of 58.8 Hz for the magnetometer. Observed noise is in agreement with the manufacturer's specifications, as shown in Table IV-A.1. The accelerometers and angular rate sensors are exactly in the range specified, and the magnetometers shows less noise than specified. For the high-end INSs the specifications are artificially degraded for export regulations, but internal inertial sensors in high-end INSs have several order of magnitude better precision than those in MEMS AHRSs.

2) Magnetometers: The magnetic disturbance due to the presence of the 7.5 m diameter × 4 m deep steel water tank degrades the heading estimation performance. Figure 2 shows the error in heading due to magnetic field distortions inside the tank. We have identified a region of operation in the upper half of the tank with more uniform magnetic field. The experiments reported herein were conducted within this region, thereby limiting the magnetic disturbances.

Calibration of the magnetometers sensors was performed to remove the effect of hard and soft iron magnetic disturbances. Figure 3 shows the performances improvement in heading estimation for the magnetic calibration for a specific location in the center of the tank. The raw magnetic heading measurement show more than 35° of heading error in this case. After a standard hard-iron calibration the heading error was reduced to less than 5°. Then, after performing a soft-iron calibration, the heading error is reduced to less than 1° for this specific location in the center of the tank. For the rest of this study this full hard-iron and soft-iron calibration is used to improve the performance of the magnetometers.

TABLE III

Internal Sensors Noise Performance

	Magnetometers [mili-Gauss]	Accelerometers [mili-g]	Angular Rate sensors [deg/s]
MEMS AHRS - Microstrain 3DM-GX3-25			
Meas.X	0.225	0.625	0.245
Meas.Y	0.215	0.641	0.215
Meas.Z	0.354	0.618	0.279
Specs	0.767	0.653	0.245
High-end INS - IXSEA Phins III			
Specs	-	1.000[1]	0.020[1]

[1]: Phins raw output data is degraded to complain with export regulations. Internally the sensors have better performance.

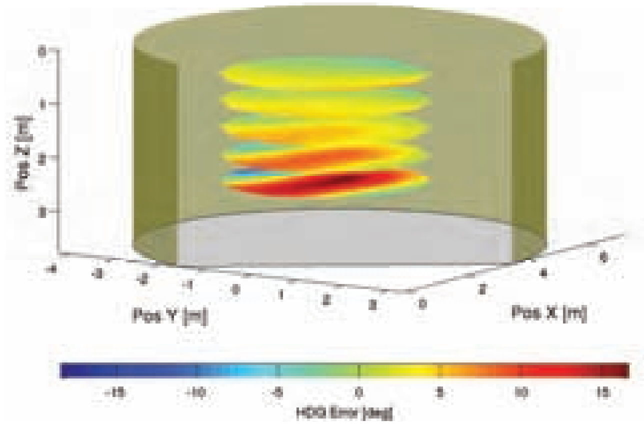

Fig. 2. Tank heading disturbance effect: Heading error between the MEMS AHRS and the high-end INS as reference. Colors show the heading error in degrees for the sensor in different locations of the tank.

3) Accelerometers: We compared the individual performance of the MEMS AHRS internal accelerometers to the output from the internal accelerometers from the high-end INS. The high-end INS specific unit used for this study only reports the acceleration after the 1 G gravity vector is removed. For this analysis the gravity vector is added in post-processing. A calculated alignment calibration between both attitude sensors is used to compare the acceleration.

To evaluate the performance of MEMS accelerometers an experiment with sinusoidal vehicle motion in each degree of freedom was implemented. Figure 4 shows an histogram of the error between the high-end INS acceleration and the MEMS AHRS internal accelerometers output data. The error, similar to a normal distribution, shows a offset bias less than 0.15 mg in each axis. The standard deviation is approximately 0.6 mg in each axis.

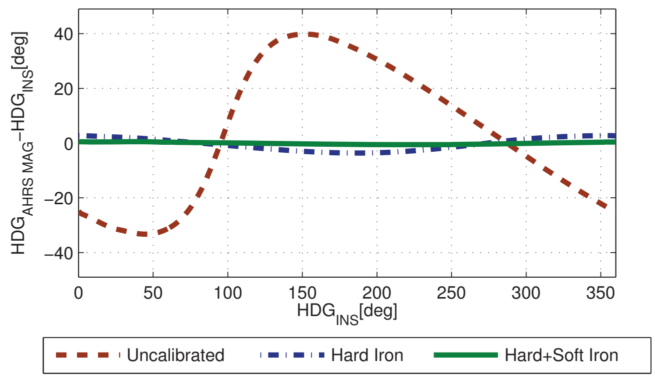

Fig. 3. Heading estimation performance after different magnetometer calibration methods. X-axis shows the reference heading from the high-end INS. Y-axis shows the relative heading error between the attitude sensors.

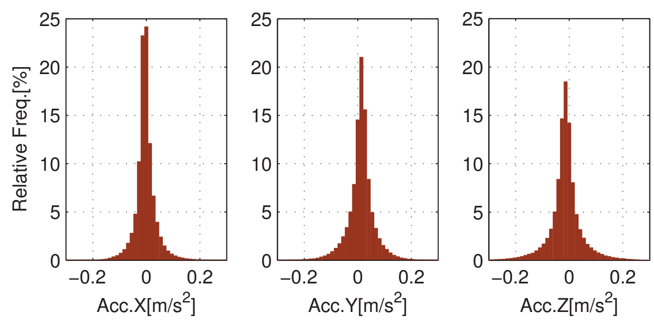

Fig. 4. Accelerometers output comparison histogram. X-axis shows difference between the MEMS AHRS and the high-end INS acceleration. Y-axis shows the relative frequency of each acceleration error.

4) Angular Rate Sensors: We compared the individual performance of the MEMS AHRS angular rate sensors to the output from the fiber-optic gyrocompasses in the high-end INS. A calculated alignment calibration between both attitude sensors is used to compare the angular rate sensors.

To evaluate the performance of the MEMS angular rate sensors an experiment with sinusoidal vehicle motion in each degree of freedom was implemented. Figure 5 shows an histogram of the error between the high-end INS angular rate and the MEMS AHRS internal angular rate sensors output data. The standard deviation is less than 0.3$^\circ/s$ in each axis. The normal distributed error shows a high component of bias in several axis. The mean error for the angular rate error in each axis is 0.682$^\circ/s$ in X, 0.015$^\circ/s$ in Y and -0.533$^\circ/s$ in Z axis.

B. Attitude Estimation Performance

This section reports the attitude estimation performance of the MEMS AHRS in comparison to the high-end navigation-grade INS. Heading, pitch and roll are evaluated under standard underwater vehicle navigation conditions.

The accurate calibration of MEMS AHRS is critical to get accurate results. Section IV-A.2 shows the performance improvement in heading estimation due to an accurate calibration of the magnetometers.

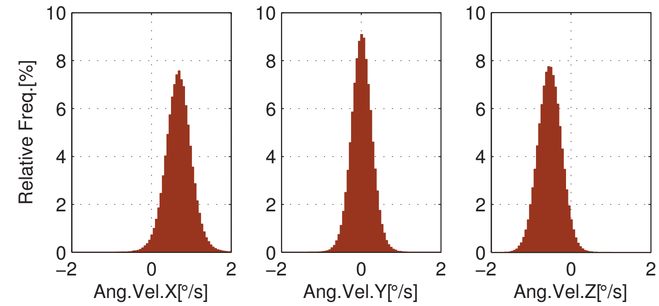

Fig. 5. Angular rate output comparison histogram. X-axis shows difference between the MEMS AHRS and the high-end INS angular rate. Y-axis shows the relative frequency of each acceleration error.

The AHRS employed in this study, a Microstrain 3DM-GX3-25 [6], estimates attitude (heading, pitch, and roll) in real-time with a complementary filter employing data from the unit's 3-axis magnetometer, 3-axis accelerometer, and its 3-axis angular rate sensors. Most MEMS angular-rate sensors are affected by a bias offset that changes with time and temperature and, in consequence, they are often provided with a calibration procedure to correct the observed angular-rate sensor bias. We observed with this model AHRS that an uncorrected bias offset in the angular-rate sensors, as shown in Figure 5, will cause a bias in the resulting estimated attitude. Figure 6 shows the attitude estimated in real-time by the AHRS's complementary filter in the presence of uncorrected angular-rate sensor bias and the attitude estimated in post-processing using equations (4), (5) and (6). These data show a mean difference between the two attitude estimates of of $+1.7^\circ$ in heading, -0.3° in pitch and -1.8° in roll. This internal AHRS bias error, if uncorrected, is an extra source of error to the Doppler navigation position estimation. In the following experiments, the angular-rate sensor bias was corrected at the beginning of each experiment by calculating a 30 second average of the angular-rate sensor output while the vehicle was motionless. Correcting the angular-rate sensor bias was observed to reduce the AHRS reported attitude bias by an order-of-magnitude.

A standard survey trajectory, shown in Figure 8, was used to measure the performance of the MEMS AHRS filter estimation output. The attitude error is measured comparing the reported attitude from the MEMS AHRS and the high-end INS. For comparison purposes, the attitude is estimated from the magnetometers and accelerometers data without using the filter with angular rate gyroscopes data using equations (4), (5) and (6). Table IV shows the mean, peak-to-peak (P2P), and standard deviation (STD) for attitude error performance for the complete trajectory. Results shows that the under these laboratory conditions with a high magnetic disturbances the heading is highly affected with a mean of 1.7°, STD of 2.3° and P2P of 8.8° of error. Pitch and roll estimation error is under 1° P2P. Figure 7 shows a section of the attitude estimation error.

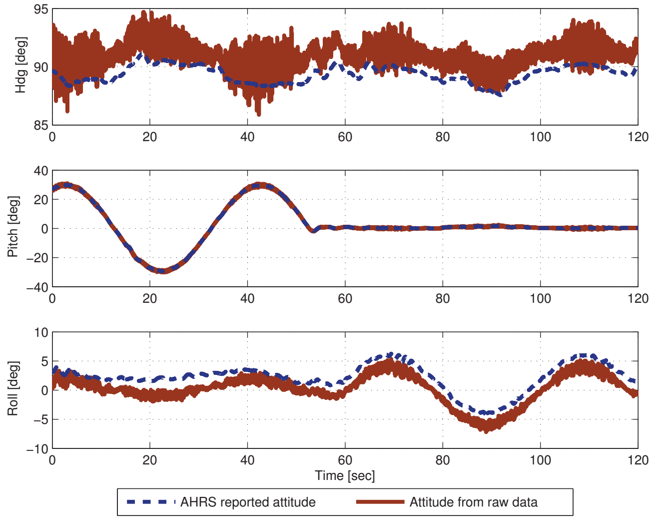

Fig. 6. AHRS estimated attitude vs the calculated attitude from the magnetometers and accelerometers. X-axis shows the time in seconds. Y-axes show the attitude for the MEMS AHRS and the calculated attitude.

TABLE IV
ATTITUDE ESTIMATION PERFORMANCE

		Error Heading [deg]	Error Pitch [deg]	Error Roll [deg]
MEMS AHRS Filter Output	Mean	1.668	0.013	-0.129
	STD	2.261	0.125	0.094
	P2P	8.880	1.018	0.695
Calculated from MEMS AHRS Mag. and Acc.	Mean	1.603	-0.042	0.024
	STD	2.397	0.272	0.302
	P2P	15.403	3.574	3.640

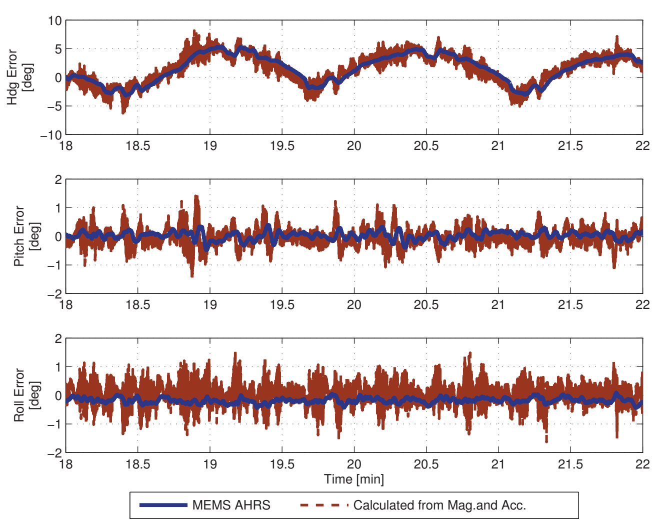

Fig. 7. MEMS AHRS Attitude Estimation Error from high-end INS. X-axis shows the time in minutes. Y-axes show the error attitude for the MEMS AHRS and the calculated attitude.

C. Doppler Navigation Performance

This section reports the performance comparison of the Doppler navigation using data from both attitude sensors, the MEMS AHRS, and the high-end INS.

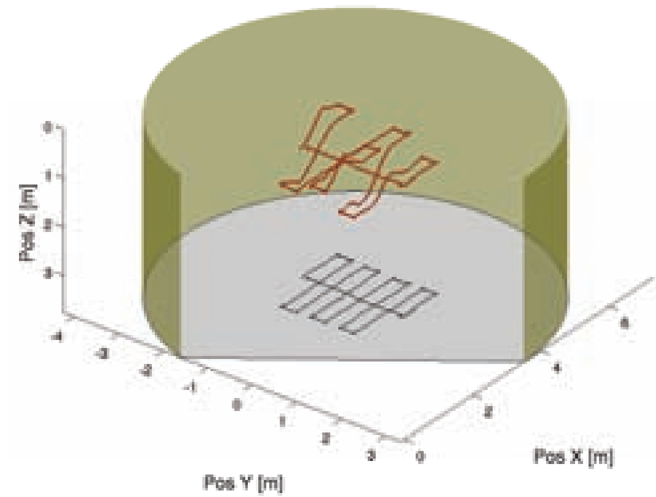

Fig. 8. LBL three-dimensional vehicle trajectory.

Although there are several sources of error that limits Doppler navigation precision, previous studies have reported that the accuracy of the calibration of the alignment between the attitude sensor and the DVL can be a significant (and often dominant) source of navigation error, e.g. [11], [12]. Using the method reported in [13], the estimated DVL/MEMS AHRS alignment calibration, ${}^{v}_{d}R$, was the rotation matrix of +45.4° in heading, -1.1° in pitch, and +1.2° in roll. Then based on the estimated alignment between both attitude sensors the alignment matrix for the high-end INS and the DVL sensor is calculated as +46.4° in heading, -0.4° in pitch, and +0.2° in roll.

1) Doppler navigation based on each attitude sensor: We analyze the performance of the Doppler navigation using data from the MEMS AHRS and compared to the case using the high-end INS, for the case of the vehicle following a standard survey trajectory, shown in Figure 8. Each estimated position is then compared with data from long-baseline (LBL) and used as "ground truth" position. Figure 8 shows the JHU ROV vehicle trajectory measured by the LBL. During the 35.8 min experiment the vehicle traveled 144 m.

Table V shows the position error for the complete trajectory and the percentage of the distance traveled for each solution. Examination of the position error show that the best performance is achieved by the high-end INS solution. The estimated position error using the high-end INS is almost three time smaller than the position error from the MEMS AHRS. Figure 9 shows how the position error grows over time for both solutions. Although the error depicted in Figure 9 correspond to a single realization of a random process, the results show how a better attitude estimation reduce the position drift over time.

2) Doppler navigation performance under different configuration scenarios: We analyze two test scenarios to

TABLE V
SUMMARY OF THE DOPPLER NAVIGATION EVALUATION RESULTS

	σ_x	σ_y	σ_z	$\|\|\vec{\sigma}\|\|_2$	%DT XYZ
High-end INS	0.062	0.048	0.021	0.081	0.043
MEMS AHRS	0.086	0.205	0.064	0.232	0.448

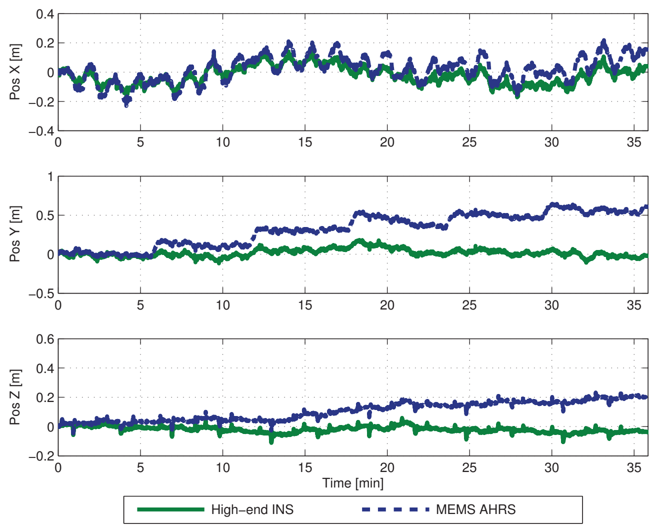

Fig. 9. Doppler navigation estimated position error. X-axis shows the time in minutes. Y-axes show the error for each calculated position.

evaluate the Doppler navigation performance under different conditions:

a. *AHRS(S1)*: This scenario simulates the case of having accurate heading without magnetic disturbances. In this case, to estimate the Doppler navigation position, we use the high-end INS reported heading after adding a hard-iron disturbance equivalent to $\pm 1^\circ$ of heading error. Pitch and roll are from the MEMS AHRS.

b. *AHRS(S2)*: This second scenario simulates the case of not having an attitude filter implemented or angular rate data available. In this case we used the low-pass filtered data from the magnetometers and accelerometers and equations (4), (5) and (6) to calculate the attitude used to estimate the Doppler navigation position.

Figure 10 and 11 show the results for the Doppler navigation performance under the two defined scenarios, and also the basic cases reported in previous section. Figure 10 shows the position error distribution. Figure 11 summarize the position error and the percentage of the distance traveled for all the scenarios defined.

Examination of the position error shows that the scenario AHRS(S1) improve the navigation performance by 35% compared to the case using of the MEMS AHRS. The position error performance is only two times worse than the best case using of the high-end INS. This case should represent the best expected performance under this circumstances for Doppler position navigation based on the MEMS AHRS. Also scenario AHRS(S1) shows that for this analyzed trajectory Doppler navigation is very sensitive to heading errors.

The second scenario, AHRS(S2), shows how the position estimation performance decrease when using a less accurate attitude estimation. As shown in Table IV, the magnetometers calculated heading can be several degrees less accurate than the heading estimated by the MEMS AHRS filter. This less accurate estimated attitude makes the navigation performance a 44% worse than the original case using the attitude estimated by the MEMS AHRS filter. In all the cases is important to notice that the performance is under 0.7% of the distance traveled.

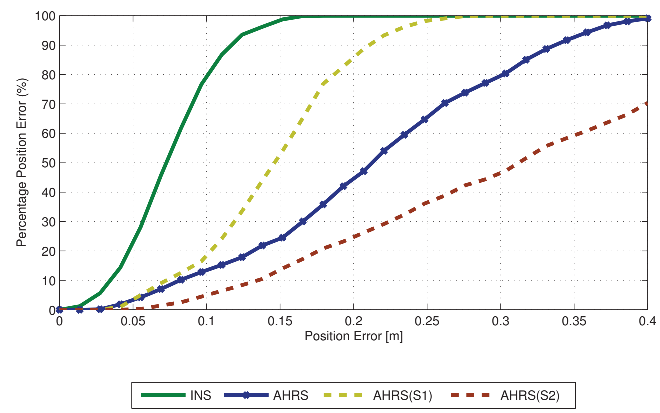

Fig. 10. Position Error Distribution. The y-axis shows the percentage of the XYZ position error that was under certain threshold (x-axis).

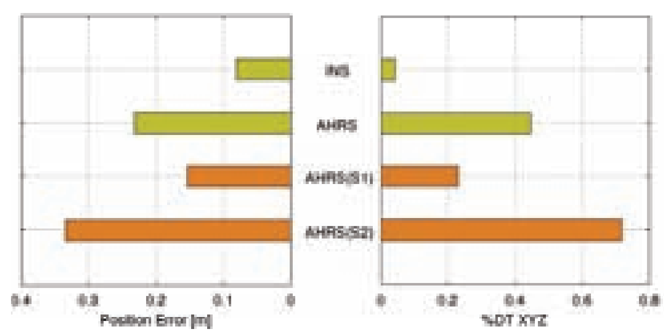

Fig. 11. Summary of the Doppler navigation evaluation results under different scenarios. Left figure shows the potion error performance (x-axis). Right figure shows the final position error as a percentage of the distance traveled (x-axis).

V. CONCLUSIONS

We conclude the following from our comparative in-water experimental evaluation of underwater Doppler navigation with a MEMS AHRS in comparison with a high-end INS.

Accurate MEMS AHRS instrument calibration is required to obtain fair Doppler navigation performance. Results showed that calibration of AHRS magnetometers for hard-iron & soft-iron errors highly improves the heading estimation, and thereby improves Doppler navigation performance. Calibration of AHRS angular rate sensors offset degraded the reported attitude estimation and consequently Doppler navigation performance. Also Doppler/AHRS alignment calibration is a significant source of Doppler navigation error.

Results for the conditions and vehicle trajectories studied allows us to quantify the position estimation performance under different scenarios commonly found in underwater Doppler navigation. Doppler navigation error, based on a carefully calibrated MEMS AHRS, is shown to be within an order-of-magnitude of that obtained with high-end INS. Also for the trajectories studied, Doppler navigation shows to be very sensitive to errors in MEMS AHRS heading estimation. Finally, MEMS AHRS attitude estimation filter shows to improve the Doppler navigation performance within a third of that obtained with the calculated attitude only based on the AHRS on-board magnetometers and accelerometers.

These results may be useful for better understand the performance of Doppler navigation systems under different configurations and ultimately lower the cost of underwater vehicles.

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Albert (Sandy) J. Williams III, OES Vice President, Technical Activities

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- Acoustic multi-beam systems for tracking small animals
- Design and operational goals for swarms of miniature vehicles
- use of diffraction tomography for inferring size, shape, and perhaps the taxa of marine organisms that range from microbes to fish

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- Introductions to passive and active acoustics
- Sounds made in the ocean, and how sonars work
- How seabirds find aggregations of prey in the Bering Sea and how they choose between krill and fish as prey

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- Experimental measurements, in the laboratory and in situ
- modeling of acoustic scattering from sediments
- Classification of ocean sediments from autonomous underwater vehicles

Albert J. Williams 3rd from Woods Hole, Massachusetts speaking on:
- Technology of flow measurement
- Oceanographic instrumentation
- Microstructure and mixing
- Bottom boundary layer turbulence and sediment transport

Paul C. Hines from Halifax, Nova Scotia speaking on:
- The application of aural perception in humans to active and passive sonar classification
- Vector sensors: Over 40 and Still Hot

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National Competition on Student Autonomous Underwater Vehicle (SAVe-2012)

Dr. M.A. Atmanand, Chair, OES India Chapter

Jointly sponsored by IEEE/OES India Chapter, the Ocean Society of India, and IEEE Madras Chapter, the National Institute of Technology (NIOT), under Ministry of Earth Sciences, announced a competition for students pursuing engineering degree to visualize and design an autonomous underwater vehicle. The conceptual basis for Student Autonomous underwater Vehicle (SAVe), is a highly mobile autonomous underwater vehicle (AUV) to be built based on engineering principles. The main focus of this competition is to involve students on the new frontier areas of ocean technology and kindle their innovative thinking in this unexplored area of ocean environment and observation. NIOT will support the winning teams with their expertise and sponsor for the International competition being held annually in USA.

Overwhelming response is shown by the students on this initiative and last year, Indian Institute of Technology Kharagpur, West Bengal team won the competition and participated in the International AUV competition on 17th July 2011 at San Diego, USA.

Drawing on the success of last year's SAVe competition and the interest shown by young engineering minds, NIOT decided to continue the efforts and SAVe—2012 announcement was made on 4th November 2011 in NIOT's website and through leading National Newspapers.

PHOTOS BY KRUPA RATNAM

Dr. Misra, chief guest (center) along with (from left) Dr. M.R. Nayak, jury chair, Dr. Atmanand, chair, OES India council, Mr. Rangarajan, chair, IEEE Madras chapter and Dr. Venkatesan, coordinator, Save competition.

This year about 57 registrations were made and 17 teams had submitted their Preliminary Design Reports (PDR). The scrutinizing committee verified the PDR documents received based on the concept, Literature Review, Design Method, Simulation, Theory Design, Block Diagram, Project Document, Theory Modeling, Method of Operation and other requirements.

The detailed Conceptual Design Report and oral presentation by the selected 17 teams was held at NIOT on 30th Jan 2012.

A High Level Committee under the Chairmanship of Dr. M.R. Nayak with members from National Institute of Oceanography, Goa, Naval Science and Technology Laboratory, Vizag, Indian Institute of Technology-Madras, Chennai and senior scientists from NIOT evaluated the students on the basis of oral presentation, CDR Report, work done on design and development of AUV, methodology adopted, team spirit shown and ability to define their ideas etc.

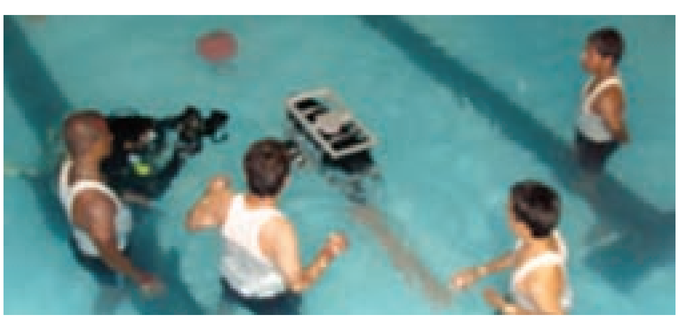
The committee expressed their sincere appreciation to all the teams involved in this Competition and shortlisted 8 final teams to demonstrate the working AUV model. The working AUV developed by teams were demonstrated for evaluation to the national committee on 30th April 2012 at Sports Development Authority of Tamil Nadu, Chennai.

AUV Models Being Demonstrated

After demonstration, the committee recommended that joint team of students from Panimalar Institute of Technology, Chennai to be adjusted as the winner of the competition. The winning team would be sponsored by NIOT to participate in the International Competition to be held at San Diego, USA during July 2012.

Dr. P. Misra, Principal Officer cum Jt. DG (Tech.) Mercantile Marine Department, Chennai was the Chief Guest and announced the winning team.

Dr. M.A. Atmanand, Director, NIOT appreciated the participants and colleges. He also explained about the initiative taken by NIOT in conducting this national event and its importance in creating awareness and interest among the young engineers. Dr. R Venkatesan, Coordinator of the competition delivered the Vote of Thanks.



Winning team demonstrating at the swimming pool.

Winning team being facilitated.

Reefing Topsails

Walter Mitchell

THREE hand-spike raps on the forward hatch,
A hoarse voice shouts down the fo'castle dim,
Startling the sleeping starboard watch,
Out of their bunks, their clothes to snatch,
With little thought of life or limb.

"All hands on deck! d'ye hear the news?
Reef topsails all 'tis the old man's word.
Tumble up, never mind jackets or shoes!"
Never a man would dare refuse,
When that stirring cry is heard.

The weather shrouds are like iron bars,
The leeward backstays curving out.
Like steely spear-points gleam the stars
From the black sky flecked with feathery bars,
By the storm-wind swerved about.

Across the bows like a sheeted ghost,
Quivers a luminous cloud of spray,
Flooding the forward deck, and most
Of the waist; then, like a charging host,
It rolls to leeward away.

"Mizzen topsail, clew up and furl;
Clew up your main course now with a will!"
The wheel goes down with a sudden whirl.
"Ease her, ease her, the good old girl,
Don't let your head sails fill!"

"Ease off lee braces; round in on the weather;
Ease your halyards; clew down, clew down;
Haul out your reef tackles, now together."
Like an angry bull against his tether,
Heave the folds of the topsails brown.

"Haul taut your buntlines, cheerly, men, now!"
The gale sweeps down with a fiercer shriek;
Shock after shock on the weather bow
Thunders the head sea, and below
Throbbing timbers groan and creak.

The topsail yards are down on the caps;
Her head lies up in the eyes of the blast;
The bellying sails, with sudden slaps,
Swell out and angrily collapse,
Shaking the head of the springing mast.

Wilder and heavier comes the gale
Out of the heart of the Northern Sea;
And the phosphorescent gleamings pale
Surge up awash of the monkey rail
Along our down pressed lee.

Reefing topsails, 1832 Handcolored engraving by E. Duncan after W.J. Huggins, 1832.

"Lay aloft! Lay aloft, boys, and reef,
Don't let my starbolines be last,"
Cries from the deck the sturdy chief;
"'Twill take a man of muscle and beef
To get those ear-rings passed."

Into the rigging with a shout,
Our second and third mates foremost spring;
Crackles the ice on the ratlines stout,
As the leaders on the yards lay out,
And the footropes sway and swing.

On the weather end of the jumping yard,
One hand on the lift, and one beneath,
Grasping the cringle, and tugging hard,
Black Dan, our third, grim and scarred,
Clutches the ear-ring for life or death.

"Light up to windward," cries the mate,
As he rides the surging yard arm end;
And into the work we threw our weight,
Every man bound to emulate,
The rush of the gale, and the sea's wild send.

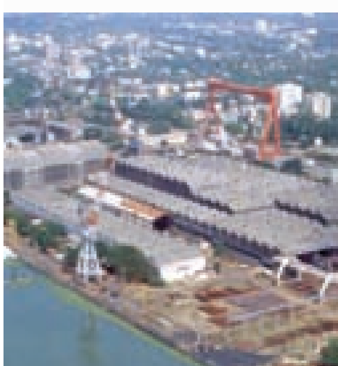
"Haul out to leeward," comes at last,
With a cheering from the fore and main;
"Knot your reef-points, and knot them fast,"
Weather and lee are the ear-rings passed,
And over the yard we bend and strain.

"Lay down men, all; and now with a will,
Swing on your topsail halyards, and sway;
Ease your braces and let her fill,
There's an hour below of the mid-watch still,
Haul taut your bowlines—well all—belay!"

SYMPOL 2013

INTERNATIONAL SYMPOSIUM ON OCEAN ELECTRONICS

The twelfth biennial Symposium on Ocean Electronics, 2013 (SYMPOL 2013)
at Cochin University of Science and Technology, is scheduled to be held during 23 - 25 October 2013.



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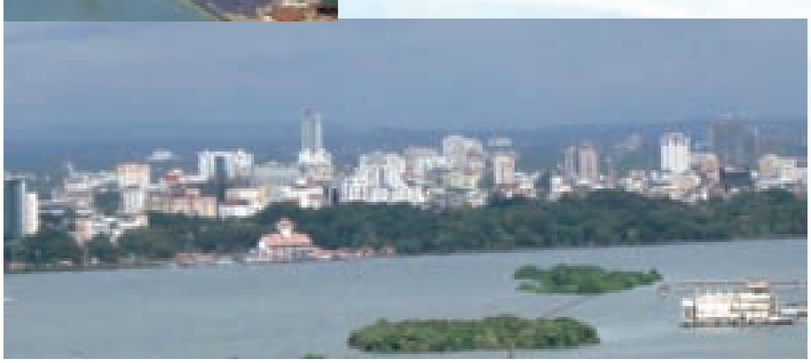
SCHFDULE

- **Submission of Full Paper Text : 31st May 2013**
- **Submission of Final Paper : 25th August 2013**
- **Communication of Acceptance : 16th July 2013**
- **Symposium Dates : 23-25 October 2013**



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