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President's Corner

Greetings and I hope everyone had a good 2009 and a very enjoyable holiday period. The Society had a very good year with very successful OCEANS Conferences in Bremen, Germany and Biloxi, Mississippi. Our RECON Committee headed up by Bob Wernli has done a marvelous job in picking sites and doing preliminary organization of our OCEANS Conferences and our JOAB Committee headed up by René Garrello has done an excellent job in helping conduct the Conferences. The Student Poster Program continues to be one of the highlights of our Conferences.



We also conducted our Underwater Technology Symposium in Wuxi, China, and held our first Conference in India as technical co-sponsor of SYMPOL with Sandy Williams and Jim Collins serving on the technical committee. We now have a new OES Chapter in Norway where the OCEANS Conference will be held in 2013 in Bergen. Liz Creed has done an excellent job in recruiting new members at our Conferences. We were able to cover our expenses in 2009 and are happy that the Society continues to be in good financial condition.

I would like to thank James Collins for his service as Vice-President of Professional Activities and Joseph Vadus for his service as Vice-President for Conference Development. Our new Vice-President for Professional Activities starting in 2010 will be Elizabeth Creed and Robert Wernli will be Vice-President for Conference Development. For 2010 we also have new ADCOM members William Carey, James Candy and Robert Wernli.

We completed our Society Review with the IEEE in November and I appreciate all the hard work that our EXCOM

and ADCOM did in preparing for the review. The Review Team seemed to be impressed with the Society and its accomplishments but we have not seen the final report so we will hold off on further comments and hope for good results. I am particularly pleased with our international efforts and with our plans to conduct a Conference in Vienna in 2011 with several other IEEE Societies in our Division.

The OCEANS Conference in Biloxi, which will be covered in greater detail by our Newsletter Editor, James Gant, had many new features including the Teacher Training Program prior to the Conference and the Student Activities with local high school classes which we hope to carry over to future OCEANS Conferences. We closed the Conference on the last night with the Gulf Guardian Awards which OES and MTS hosted at the Beau Rivage. The Gulf Guardian Awards are presented by the Gulf of Mexico Program to organizations who make a significant contribution to maintain and improve the environment of the Gulf of Mexico. This year there were seven first-place winners including the categories of Business; Education; Government; Civic/Non-Profit; Individual; Bi-Nation and Partnership. There were also six second-place winners and six third-place winners. Some of the winners included Conoco Phillips, Science Museum of Minnesota, Delta Farmers, Sarasota Bay, Matagorda Island Marsh Restoration Program, just to name a few of the winners to show you the diversity of the program. All of these folks

(continued on page 10)

OES Newsletter Editorial



The centerpiece of this issue is the OCEANS '09 conference held in Biloxi, Mississippi, USA. This conference, like all OCEANS conferences, was a great opportunity to network with other ocean engineering professionals, to learn the latest developments in technical areas of interest, see the latest products from a wide variety of product and service providers, and socialize with friends and colleagues. This conference also had some unique features that we hope to see continued in the future at other conferences. The organizing committee had extra challenges with this conference because of the hurricanes that ravaged the Gulf Coast in 2005. The Biloxi area is still recovering from the damage of those storms and this made the conference planning process very difficult; both because the normal planning was interrupted by the hurricane and the recovery period, and because the conference center had

to be completely rebuilt on the inside; the logistics planning became dynamic to say the least. When I heard some of the stories I was amazed at how well it came off. The planning committee deserves an extra dose of appreciation for their efforts.

We also present a report of the SYMPOL-2009 conference held in Cochin, India in November. This was the tenth symposium of the series and presented many papers in relevant topics.

There is also a somewhat belated report on the International Submarine Races held last June.

I have included some poems by John Masefield that I hope you enjoy as much as I do.

As always, there is an open invitation to write to me with your comments, opinions, and rebuttals – my e-mail address is j.gant@ieee.org.

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Jim Gant
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Request for Nominations to the Administrative Committee, Class of 2011

Jim Barbera, Junior Past President



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

The 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.oceanicengineering.org), and pointing to Bylaws 2006 under Governing Documents. The Bylaws specify that general nominations close on March 1, and nominations by petition close by April 15.

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

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Welcome New Members

New Members

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Stuart Babin	USA
Daniel Bedard	USA
Aaron J. Bell	USA
Marco Belloli	Italy
Leverett G. Bezanson	USA
Chung-Hee Lee	Korea
Kenneth Wayne Cooke	USA
William D. Craig	USA
Carolina Cruz-Neira	USA
Alberto Leandro Demelo	Brazil
Stephanie Dudzic	USA
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Mohamed A. Elsoury	Egypt
Emilio B. Espejo	Mexico
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Fengxiang Ge	China
Jonathan Gagnon	Canada
Pete Gelbman	USA
Andreas J. Haeusler	Portugal
Charles J. Herget	USA
Randol K. Hoffman	USA
Tin F. Hung	Hong Kong
Hung D. Nguyen	Australia
Greg Johnson	Canada
Ahmad Fauzan Kadmin	Malaysia
Glenn A. Knierim	USA
Mike Kosro	USA
Robert John Kraus	USA
Jonghun Lee	S. Korea
Joono Sur	S. Korea
Vasileios Karagiannakis	Greece
Brian J. Kidney	Canada
Dongbin Lee	USA
Bjorn Lillekjendlie	Norway
Noureddine Manamanni	France
Thom Maughan	USA

Michael T. McCann	USA
James A. McGeachin	Australia
Mehdi Mehdi	USA
Carl E. Miller	USA
Mark S. Minucci	USA
Cyrile Monange	France
Praveen Naresh	India
Colin O'Flynn	UK
Robert A. Olson	USA
Pablo Otero	Spain
Giovanni Paolo Papicchio	Germany
Stephanie Petillo	USA
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Marc E. Tarpenning	USA
Stephen Thompson	USA
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Jennifer G. Vining	USA
Michael M. Yeosock	USA

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Steven J. Barnett	USA
David S. Barrett	USA
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Ananda Ramadass Gidugu	India
J. Vincent Jelsema	USA
Donna M. Kocak	USA
C.E. Mast	USA
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Shanthni M.	India

OCEANS '09 Conference

Jointly sponsored by the Marine Technology Society (MTS) and IEEE Oceanic Engineering Society (OES), the OCEANS '09 conference was held 26–29 October, 2009 at the Mississippi Coast Coliseum and Convention Center in Biloxi, Mississippi, USA. The theme of the conference was “Ocean Technology for Our Future: Global and Local Challenges”

The Mississippi Gulf Coast has a rich heritage of maritime industry and technology, so the Biloxi venue was highly appropriate for an OCEANS conference. More than two dozen federal government agencies are located near the Gulf Coast including NASA’s Stennis Space Center, home of the US Naval Meteorology and Oceanography Command.

The conference opened with a plenary session on Tuesday, October 27 led by the General Co-chairs of the event, Laurie Jugan of MTS and Ed Gough of OES. During the opening ceremonies dignitaries greeted the conference, including representatives from the Governor of Mississippi, the Naval Meteorology and Oceanography Command, and the presidents of both MTS and OES.

After the opening ceremonies, three plenary speakers updated conference attendees with current developments in ocean science and policy. Dr. Jerry Miller, Senior Scientist for the White House Office of Science and Technology Policy discussed “Ocean Science and Technology Policy.” Next, Ed Gough, Technical Director of the Commander, Naval Meteorology and Oceanography Command presented “Ocean Data at Your Fingertips”, an initiative being undertaken to encourage the sharing of ocean data. Finally, Dr. John Delaney, Professor of Oceanography at the University of Washington presented “At the Leading Edge of a Global Environmental Renaissance: Next-Generation Science in the Ocean Basins.”

Following the plenary session a ribbon cutting ceremony was held to officially open the conference and exhibition.

A unique feature of this conference was the Town Hall sessions:

On Tuesday was the JSOST Town Hall with a theme of “Refreshing Our Ocean Research Priorities.” The US National Science and Technology Council’s Joint Subcommittee on Ocean Science and Technology (JSOST) advises the US government on national issues of ocean science and technology. JSOST published an ocean research priorities plan and implementation strategy titled “Charting the Course for Ocean Science in the United States for the Next Decade. In the years since its release, much has changed in our understanding of the ocean, its processes and its role in the Earth system as a whole. This Town Hall provided conference attendees an opportunity to provide input into the refresh process, and discuss progress to date with chairs of JSOST.

Wednesday’s Town Hall discussed the Integrated Ocean Observation System (IOOS) and explored its public-private use policy. On 30-March-2009, President Obama signed into law the Integrated Coastal and Ocean Observing Act of 2009. Among the requirements in the Act is a directive to the National Ocean research Leadership Council to develop a Public-Private Use Policy. This policy will define the processes for making



Ed Gough addresses the conference during the plenary session.



Dr. Jerry Miller delivers his address at the plenary session.



John Dunnigan at the NOAA Town Hall.

decisions about the roles of various organizations in both the public and private sector in providing to end-user communities environmental information, products, technologies and services related to the IOOS. This Town Hall meeting was an opportunity to discuss this issue and collect inputs.



Laurie Jugan, Charles Zang, and CAPT John Cousins cut the ribbon to officially open the conference and exhibition.



SAIC's booth provided literature and knowledgeable people to explain their many products and services.



The Naval Meteorology and Oceanography Command's exhibit featured their use of gliders to collect oceanographic data.



The National Institute for Undersea Science and Technology (NIUST) booth proudly exhibits their Eagle Ray AUV.



The Teledyne Marine booth displayed their connectors and other products.



The Mississippi Department of Marine Resources had an exhibit to inform conference participants about the services they provide along the Gulf Coast.

Thursday's Town Hall featured the US National Oceanic and Atmospheric Administration (NOAA) with a theme of "The Future of Ocean and Coastal Mapping." John H. Dunnigan, the National Ocean Service Assistant Administrator, shared his thoughts and heard participant's views on the importance of advancing a national vision for the future of ocean and coastal mapping. This vision is to develop a plan to collaboratively map U.S. ocean and coastal areas, and use the resulting data to meet the broadest suite of mandates and missions. An integral component of this vision will be to catalyze a technological

revolution in all steps in the ocean and coastal mapping process, including data collection, processing, management, dissemination, and the creation of useful products for decision makers.

A centerpiece of each OCEANS conference is the student poster exhibition. Thirty one posters were on display in the area between the exhibit hall and the technical session rooms. The posters and the students are covered in greater detail in a separate article later in this issue.

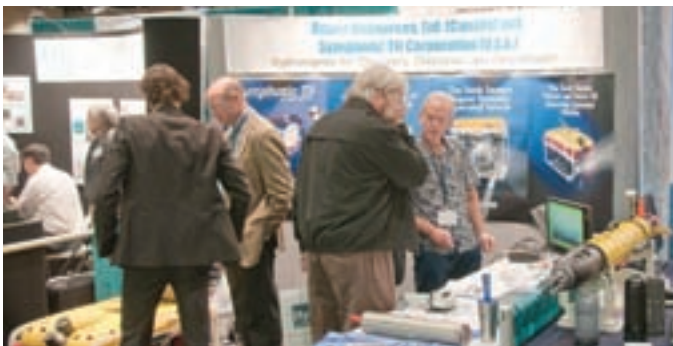
Papers were presented at the technical sessions in the following tracks illustrating the broad spectrum of rich technical



OES President Jerry Carrol presents the Distinguished Technical Achievement Award to Bob Bannon.



Jerry Carrol presents the Distinguished Service Award to Christian de Moustier for his many years of service on the OES Administrative Committee and as the editor-in-chief of the Journal of Oceanic Engineering.



Roper Resources Ltd stayed busy explaining their solutions to potential clients.



Chip Worsinger, Karen Lynn, Kevin Comer, Heidi Wilkers, Donna Kocak, and Rick Simonian enjoy a moment together at the Gala.



A live band kept everyone moving with lively music designed for Parrotheads of the Jimmy Buffet generation.



Diane DiMassa, Bob Wernli, and Barb Fletcher enjoying the music at the Gala.



The exhibit floor was great venue for companies and customers to meet, discuss projects, and strengthen relationships.



Bruce Magnell and Todd Morrison at the Gala.



Jim Collins and Ken Fereri at the carving table.

material presented at the OCEANS conferences. Some of these tracks required several sessions to present all of the papers.

- Marine Geology and Geophysics
- Autonomous Underwater Vehicles
- Remotely Operated Vehicles
- Inundation Modeling
- Array Signal Processing and Array Design
- Ropes and Tension Members
- Buoy Technology
- Data Visualization
- Coastal Radars
- E-M Sensing
- US IOOS and OOI Program
- Hydrography, Seafloor Mapping, and Geodesy
- Space and Airborne Systems
- Optical Underwater Communications
- Sonar Signal Processing
- Disaster and Catastrophe Management
- Acoustic Telemetry and Communication
- Renewable Ocean Energy
- Numerical Modeling and Simulation
- Calibration of Acoustic Systems and Metrology
- Operational Oceanography
- Model-Based Signal Processing Techniques
- General Oceanography
- Physical Oceanography
- Marine Life and Ecosystems
- Current Measurement Technology
- Sound Propagation and Scattering
- Classification and Pattern Recognition
- Acoustic Telemetry and Communication
- Alternatives to Decommissioning Offshore Structures
- Ocean Instrumentation and Sensors
- Ocean Color Observations
- Marine Spatial Planning Round Table
- Offshore Structures
- Data Assimilation
- Hyperspectral Observations
- Synthetic Aperture Sonar
- Vehicle Performance
- Habitat: Wetlands, Barrier Islands, and Bays

- Marine Outreach
- Nutrient Sensors
- Information Management
- Geoacoustic Inversion
- Sonar Imaging
- Vehicle Navigation
- Marine Education
- Underwater Imaging
- Ocean Acoustics
- Marine Materials Science
- Marine Policy for Unmanned Vehicles
- Hypoxia: The Dead Zone
- Ocean Observatories
- Marine GIS and Data Fusion
- Underwater Imaging System Results
- Signal Coherence and Fluctuation
- Ocean Observing Systems
- Marine Safety and Security
- Cables and Connectors

At Tuesday's luncheon the OES Distinguished Service Award was presented to Christian de Moustier and the Distinguished Technical Achievement Award was presented to Bob Bannon.

The exhibitions at the conference are always a highlight because they provide an opportunity for several types of organizations related to the maritime industry to present their products and services and to meet their customers. At this conference more than 120 exhibits were present. A few of these are featured below.

Several social events were also scheduled to encourage networking and to maximize enjoyment for all participants. These events included tours of local attractions, receptions, a local art show and sale, and a gala reception in the ballroom with a theme of "OCEANS in Paradise." The gala was also an opportunity to wear your favorite Hawaiian shirt and cut loose on the dance floor to live music.

Four cadets from the Massachusetts Maritime Academy attended the conference as guests of OES to enhance their education and awareness of the importance of professional societies like OES. Below we reprint a thank you letter received from cadet Peter Cornet.

On behalf of the four Massachusetts Maritime Academy cadets who attended OCEANS '09 MTS/IEEE in Biloxi, I would like to say thank you to the Oceanic Engineering Society for making the trip possible. The trip was a great experience, from the tour of the Stennis Space Center to the technical programs to the student poster program. I would also like to express our gratitude to everyone who coordinated and attended the conference for the courtesy that we were showed, while we were learning and taking in the experience of the conference.

The tour of the Stennis Space Center was an eye-opening experience that showed us the potential of determination and inventiveness, by showing us what has been achieved and what currently is being achieved in propulsion, computer programming, and marine engineering. I would like to also thank everyone at the Stennis Space Center for their professionalism and generosity in sharing their knowledge with us.

During the conference the cadets took the opportunity to meet many different companies that embrace innovation. To learn about these companies and the opportunities that were created would have been quite an experience in itself, but the technical programs were enlightening. While we enjoyed learning from all the presenters, we found the buoy, alternative energy, and AUV/ROV programs to be exceptionally informative. Not only did we learn from the technical program, but also from the student poster program. To see how diligently each student worked on each of their



projects and how much each student took their topic to heart was truly inspiring.

The OCEANS conference was an exceptionally coordinated and managed program that I feel helped open my eyes to the possibilities of the future, not just for myself and the other cadets who attended, but for my entire generation. There are breathtaking discoveries to be made and incredible feats to be accomplished in the years to come, and the promise that the future holds is exhilarating. There is no way to show the gratitude that we have to everyone who made this possible for us, so I will simply say thank you.

President's Corner *(continued from page 3)*

actually work at maintaining and restoring our environment and range from youngsters to retirees who devote their weekends and other free time to the program. For me it was really thrilling to see how our citizens are concerned about the environment of the Gulf of Mexico and working hard to clean it up.

These were only the Award winners that were featured in the Program and I am sure there are many other organizations that are doing the same.

We have a full calendar of events this year:

February 9–11 Underwater Intervention, New Orleans, LA USA (Booth)
 April 12–14 South American Symposium, Buenos Aires, Argentina

May 3–6 Offshore Technology Conference, Houston, TX USA
 May 24–27 OCEANS '10 Conference, Sydney, Australia
 June 24–25 PASSIVE '10 Conference, Brest, France
 August 24–26 Baltic Symposium, Riga, Latvia
 September 20–23 OCEANS 10 Conference, Seattle, WA, USA

I suspect we may have some other workshops or meeting in the last few months of the year as well.

**Jerry Carroll,
 OES President**

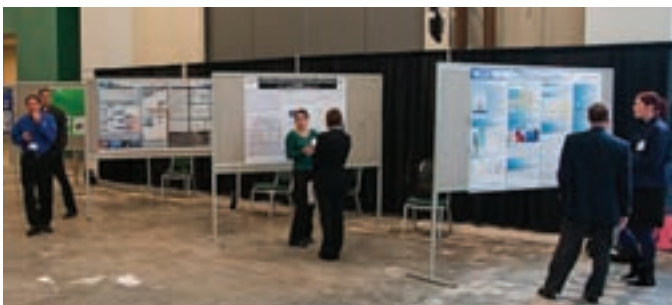
OCEANS '09 MTS/IEEE Biloxi Student Poster Program

Norman D. Miller, P.E., Student Activities Coordinator
Pictures by Stan Chamberlain

The twenty fifth Student Poster Program of the OCEANS Conference series was held in Biloxi, MS as a part of OCEANS '09 MTS/IEEE BILOXI. The program was organized by Prof. Stephan Howden of the University of Southern Mississippi and Greg Eisman of SAIC. The program was funded by grants from the Office of Naval Research, SAIC, Mississippi Technical Alliance, and Deep Sea Power and Light. Forty three poster abstracts were received and thirty four were accepted for presentation. Two invited students from China were unable to attend, however their posters were displayed. One other student was away on a scheduled research assignment and was unable to attend. Three students whose abstracts were accepted had to withdraw from the competition. Students came from Australia, Canada, Egypt, Germany, Korea, Portugal, and the United states.



Thirty one posters were on display and wonderfully located in the corridor where all conference attendees had to pass through them on their way to the meeting rooms.



The judging was completed by noon on Wednesday and the prizes were awarded at the Gala in the Beau Rivage hotel that evening. Prof. Howden called all of the students on stage and presented each student with a certificate for their participation in the program. Mr. Norman D. Miller, the OES Student Activities Coordinator was called up to present the awards. The audience gave the students a big hand following the awards presentations. The session ended with a photograph session in the lobby. The roster of students and their poster titles are given below with an abstract of their paper. The winning poster is reprinted in total following this article.

Ame Arakaki – University of Hawaii at Manoa
“Harnessing the SHM of Ocean Waves”

Abstract: Harnessing offshore ocean wave energy was the focus of our renewable energy project, specifically mechanical energy of the system derived from the Simple Harmonic Motion. Our design consists of an array of buoys (strung in rows arranged into a stacked configuration) along the surface of the ocean with them individually tethered to a static submerged platform. Our team constructed a prototype of a single buoy with a weight seated on the ocean floor in place of the platform. During the prototype’s lab and near-shore field test, the prototype successfully generated milliwatts of electricity. The recorded data were used to translate measurements of amps and volts per second onto a spreadsheet for the calculation of the mean power generation. To summarize the entire process, if the ocean wave contains sufficient power to overcome the forces needed to disrupt the buoy-platform equilibrium, then the resulting ΔL will determine how many times the turbine’s shaft will rotate and how much electricity is generated.

Nichoas Asseff – Florida Atlantic University

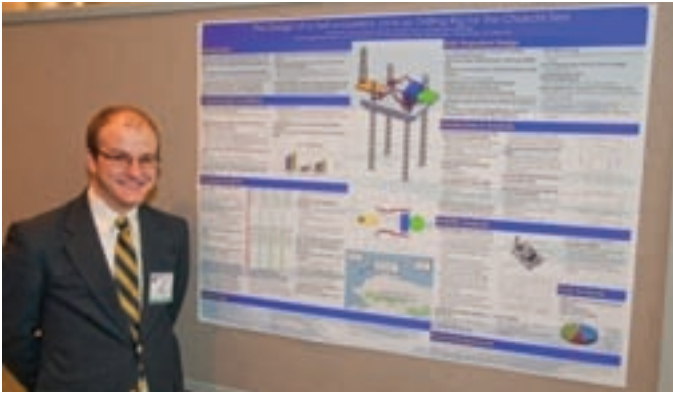
“Design and Finite Element Analysis of an Ocean Current Turbine Blade”

Abstract: A composite 3 meter ocean current turbine blade has been designed and analyzed using Blade Element Theory (BET) and commercial Finite Element Modeling (FEM) code, ANSYS. It has been observed that using the numerical BET tool created, power production up to 141 kW is possible from a 3 bladed rotor in an ocean current of 2.5 m/s with the proposed blade design. The blade is of sandwich construction with carbon fiber skin and high density foam core. It also contains two webs made of S2-glass for added shear rigidity. Four design cases were analyzed, involving differences in hydrodynamic shape, material properties, and internal structure. Results from the linear static structural analysis revealed that the best design provides adequate stiffness and strength to produce the proposed power without any structural failure. An Eigenvalue Buckling analysis confirmed that the blade would not fail from buckling prior to overstressed laminate failure if the loading was to exceed the Safety Factor.

John Bandas – Texas A&M University

“The Design of a Self-propelled Jack-up Drilling Rig for the Chukchi Sea”

Abstract: ConocoPhillips asked the team to design a self propelled jack up drilling rig for exploratory work in the Chukchi Sea, during the warm water season, at a location that is approximately 131 feet (40 m) in water depth. This was accomplished using computer programs including StabCAD, SolidWorks, AutoCAD, and Visual Analysis. The legs of the jack up were designed to withstand ice collisions with the aid



of patrolling ice breakers. The jack up rig had to be capable of traveling at speeds up to 11 knots (5.65 m/s). The stability during transit was analyzed for an intact condition as well as a damaged condition (assuming two ballast tanks are damaged). The centers of gravity and buoyancy were calculated, as well as metacentric height. A geotechnical analysis was performed on the spud cans of the rig. The rig was designed to comply with all safety regulations specified by the American Bureau of Shipping (ABS), the Mobile Offshore Drilling Unit (MODU) Rules, the International Maritime Organization (IMO) rules, and the T&R 5-5A Design Criteria set by the Society of Naval Architects and Marine Engineers (SNAME) and Marine Pollution Act (Marpol 73/78).

Stephen Barkby – Australian Centre for Field Robotics

“Incorporating Prior Bathymetric Maps with Distributed Particle Bathymetric SLAM for Improved AUV Navigation and Mapping”

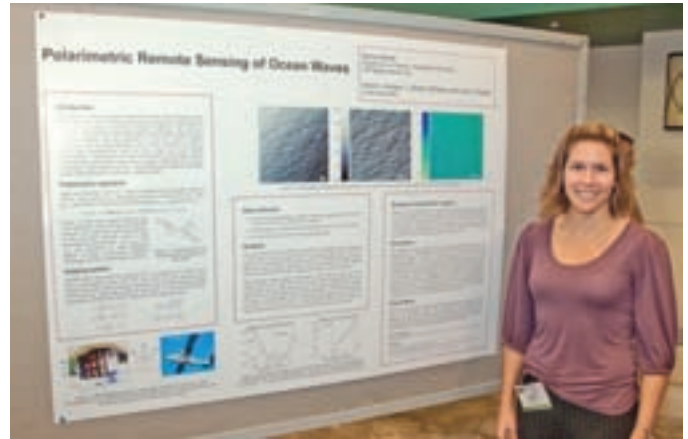
Abstract: We propose a method to improve the georeferenced accuracy and self-consistency of bathymetric maps generated by Autonomous Underwater Vehicles (AUVs), where the navigation solution is prone to drift when GPS or other methods of absolute positioning are unavailable. This is accomplished using a non-feature based approach to Simultaneous Localization and Mapping (SLAM) that utilizes a 2D grid structure to represent the map and a Distributed Particle Filter to track the uncertainty in the vehicle state. Our method does not need to explicitly identify features in the surrounding environment or apply complicated matching algorithms to our bathymetry, as is commonly done when performing terrain aided navigation. In this work we demonstrate how a prior low-resolution map generated by a surface vessel in a standard gridded form can be readily integrated into our approach to bathymetric SLAM to additionally enforce consistency between the prior map and the AUV bathymetry. We illustrate the proposed approach using data from recent survey work undertaken off the coast of the Tasman Peninsula in South Eastern Tasmania, Australia. The results achieved by the Bathymetric distributed Particle SLAM (BPSLAM) filter are shown to improve the maps and trajectories when compared to dead reckoning fused with USBL observations.

Stephen Barkby is currently working for the Australian Centre for Field Robotics in Sydney, Australia. The centre is affiliated with the University of Sydney which is where he is currently completing his PhD degree. This is also where Stephen

completed his undergraduate degrees, a BE in Mechatronics (Space) and a BSc in Physics. His research is focused on improving the quality of the bathymetric maps produced by the AUV Sirius using a Non Feature based approach to SLAM.

Becky Baxter – Georgetown University

“Polarimetric Remote Sensing of Ocean Waves”



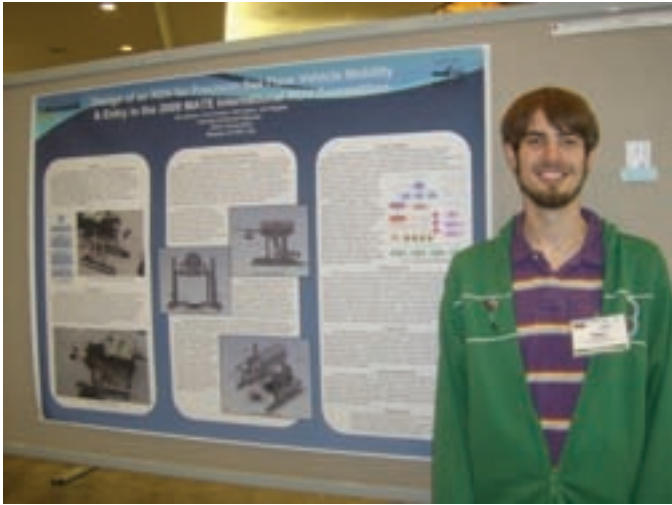
Polarimetric remote sensing provides information about imaged scenes which cannot be obtained from luminance and spectral measurements alone, such as surface orientation, surface roughness, and index of refraction. Exploiting the polarization state of light reflected off of the ocean surface will enable measurement of the two-dimensional slope field of the surface. From this measurement, the significant wave height of the waves can be calculated. This paper presents an initial investigation of remotely-sensed multi-spectral polarimetric timeseries imagery collected over a deep-water buoy using Areté Associates’ Airborne Remote Optical Spotlight System- MultiSpectral Polarimeter (AROSS-MSP). In addition to preliminary data analysis, we describe a model of the expected polarimetric signature of ocean waves as measured by a remote sensing electro-optical imager. Comparisons between the measured polarimetric data and the modeled polarization signature agree fairly well.

Samuel Bingham – University of Wisconsin – Milwaukee

“Design of an ROV for Precision Sea Floor Vehicle Mobility and Entry in the 2009 MATE International ROV Competition”

Abstract: The main goal of this project was to engineer a Remotely Operated Vehicle (ROV) to compete in the 2009 Marine Advanced Technology Education (MATE) International ROV competition. The vehicle was designed to operate in a submarine rescue fashion, while maintaining the maneuverability and precision actuations of a normal ROV. The vehicle has been designed for the efficient completion of tasks that a rescue ROV may have to perform. These tasks range from surveying the submarine, opening a hatch and inserting emergency supplies, supplying an airline, and providing a transfer skirt for rescue.

Sam Bingham is a Junior studying Computer Science at the University of Wisconsin – Milwaukee. This is his third year on the ROV Team at UWM. He works part time at the Great Lakes WATER Institute assisting with a remote buoy sensor network



and plans to continue his goals of applying computer science to environmental research after graduation.

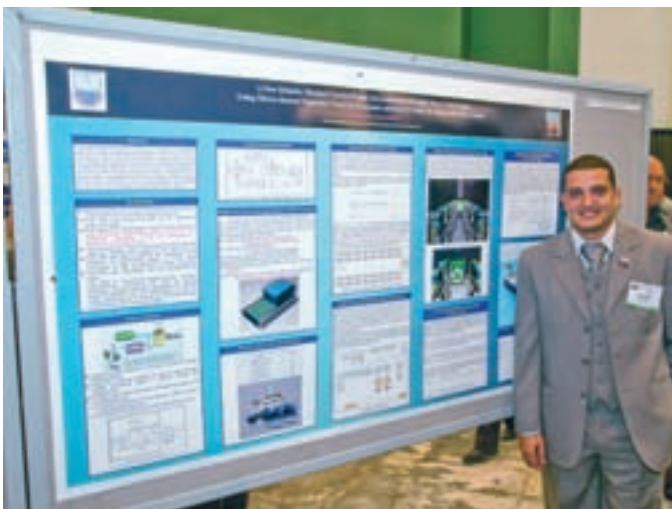
Clint Dunbar – Texas A&M University

“Texas A&M Student Design Project – East Central Gulf of Mexico Truss Spar”

Abstract: A student team at Texas A&M University has designed a truss spar for producing oil and gas in East Central Gulf of Mexico for a 4000 ft (1219.2 m) water depth. The Spar was designed to withstand a 100 year storm. American Bureau of Shipping (ABS) rules and American Petroleum Institute (API) guidelines were used in the design. The Truss Spar, known as “Sirena Dotada”, is located 176 miles southwest of Clearwater, FL. This area is located just off the continental shelf in an area known as “The Elbow”. The reservoir is estimated to contain 300 million barrels of oil and have a field life of approximately 20 years. The total length of the Spar hull, from the top of the hard tank to the bottom of the soft tank, is 646 ft (196.9 m) and the diameter of the hard tank is 120 ft (36.6 m). There are three heave plates that are spaced 85 ft (25.9 m) apart.

Sarah Epps – University of Southern Mississippi

“Distribution of Suspended Particulate Matter in the surface Waters of the Northern Gulf of Mexico: Interim Report”



Abstract: This research quantifies suspended particulate matter in surface waters observed during multiple research cruises that took place in the Northern Gulf of Mexico as part of the continuing study, “Satellite Assessment of CO₂ Distribution, Variability and Flux and Understanding of Control Mechanisms in a River Dominated Ocean Margin”, a NSF funded grant. For the purposes of this study, suspended particulate matter was defined as material located in the water column which may be captured on a filtration membrane with a pore size of 0.4 μm . The percent of particulate organic carbon (POC) was also quantified.

Girges Fath-Allah – Alexandria University, Egypt

“A New Reliable Minimal Volume/Weight Environmental Friendly Power Unit Design Using Microchannel Vaporizer Fuel Cell Processors and Slice Hulls for Super and Mega Yachts”

Abstract: The present paper proposes a simple easy to design and implement scheme to employ fuel cells as the sole power source for super-yachts. The scheme relies on using a microvaporizer to reduce the volume of the processor associated with each fuel cell and alleviate the need for hydrogen storage. Moreover, SLICE hull is used to take advantage of the SLICE to store the motors and fuel cell array. In addition to that, a simple strategy is suggested to enhance the reliability of the proposed fuel cell array. The feasibility of the proposed design is demonstrated through a case study of designing a super-yacht called Heaven.

Bruno Ferreira – Engineering of University of Porto, Portugal

“Modeling and Motion Analysis of the MARES Autonomous Underwater Vehicle”

Abstract: In the robotic domain, it is common to deduce and use models that allow translating mathematically the element behavior. In some cases, these would serve as base to determine and develop a controller, for example. Beyond this, the simulation and experiments are reasons that leave to the development of models, becoming evaluation tools of the system behavior, especially when there are constraints of implementation or in experiments. However, the modeling is an approach to the reality, since it is difficult to translate the behavior of an element in a strict way and the disturbances to which it is subject to. In this work, we address the modeling questions of an autonomous underwater vehicle. This paper describes the deducing of a dynamic model with six degrees of freedom of an underwater vehicle, considering all of its physical characteristics. This is achieved by the determination of all forces that actuates on the body during its motions and by the determination of the rigid body dynamic. The modeling method is presented as well as the coefficients determination. Finally, a comparison with experimental results is carried out.

Bruno Ferreira was born in 1986 at Bragança, a small city in the north-east of Portugal. He moved to Paris (France) at 6 years old where he attended elementary and middle school. He moved back to the Portugal attending high school in Bragança and then moved to Porto, completing a master’s degree in Electrical Engineering at the University of Porto. He is currently enrolled in a PhD program at the same school. His primary interests are control, modeling, and electronics applied to robotics.

Aaron Fisher – Florida Atlantic University

“Adaptive Control of Small Outboard-Powered Boats for Survey Applications”

Abstract: Four autopilot controllers have been developed in this work that can both hold a desired heading and follow a straight line. These PID, adaptive PID, neuro-adaptive, and adaptive augmenting control algorithms have all been implemented into a numerical simulation of a 33-foot center console vessel with wind, waves, and current disturbances acting in the perpendicular (across-track) direction of the boat’s desired trajectory. Each controller is tested for its ability to follow a desired heading in the presence of these disturbances and then to follow a straight line at two different throttle settings for the same disturbances. These controllers were tuned for an input thrust of 2000 N and all four controllers showed good performance with none of the controllers significantly outperforming the others when holding a constant heading and following a straight line at this engine thrust. Each controller was then tested for a reduced engine thrust of 1200 N per engine where each of the three adaptive controllers reduced heading error and across-track error by approximately 50% after a 300 second tuning period when compared to the fixed gain PID, showing that significant robustness to changes in throttle setting was gained by using an adaptive algorithm.

Aaron Fisher was born in 1985. He graduated from the University of Pittsburgh in 2007 with a Bachelor’s of Science degree in Mechanical Engineering. He is currently working towards a Master’s Degree in Ocean Engineering at Florida Atlantic University with a research interest in station keeping and vessel control.

Rowan Fox – Institute of Ocean Sciences – University of Victoria, Canada

“Slocum Glider Observations during the Spring Bloom in the Strait of Georgia”

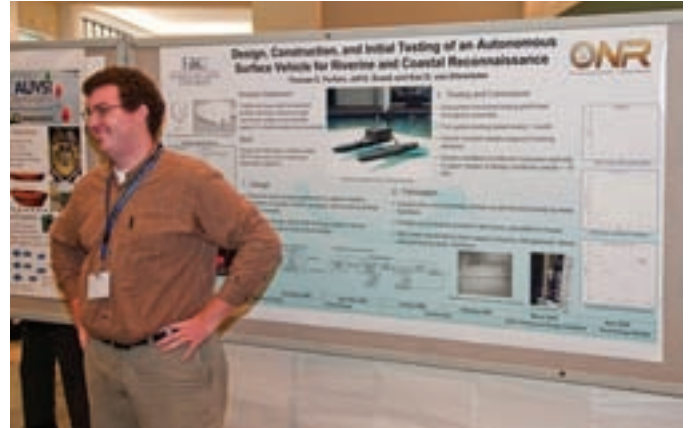
Abstract: A Slocum Glider mission was undertaken in the southern Strait of Georgia from February 18–March 10, 2009. The glider flew a repeated 10 Km transect across the Strait, providing excellent meso-scale resolution of measured temperature, conductivity, dissolved oxygen concentration and saturation, chlorophyll a fluorescence, coloured dissolved organic matter fluorescence, and optical backscatter. During this mission, the glider was able to observe the early stages of the spring phytoplankton bloom.

The sensors on the glider identify the physical and biological processes that occur in the Strait, many of which have been found to be important for the timing and development of the spring bloom. Glider fluorometer data show sub-surface pulses of high chlorophyll a concentration ($>20 \mu\text{g/L}$) in the Strait from February 19–25, 2009. These pulses were observed 5–20 m below the surface, to a maximum of 4 km wide. These signals were interpreted as part of the “Malaspina Dragon”, a pattern of phytoplankton growth preceding the spring bloom, previously viewed with the Fluorescence Line Height (FLH) algorithm of the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Medium Resolution Imaging Spectrometer (MERIS) ocean colour satellites in 2005 and 2008. The “Malaspina Dragon” is a phytoplankton bloom originating in

Sechelt and Jervis Inlets, spreading towards Malaspina Strait, and out into the Strait of Georgia. Strong winds in the Strait from February 25–March 1 mixed the surface waters, and spread the phytoplankton throughout the Strait. The glider observed a strong bloom in surface chlorophyll a concentration over the entire mission area ($10\text{--}15 \mu\text{g/L}$) from March 3, until the end of the glider mission on March 10. Wind events breaking up the Malaspina Dragon may be a mechanism for early spring blooms in the Strait of Georgia.

Thomas Furfaro – Florida Atlantic University

“Design, Construction, and Initial Testing of an Autonomous Surface Vehicle for Riverine and Coastal Reconnaissance”

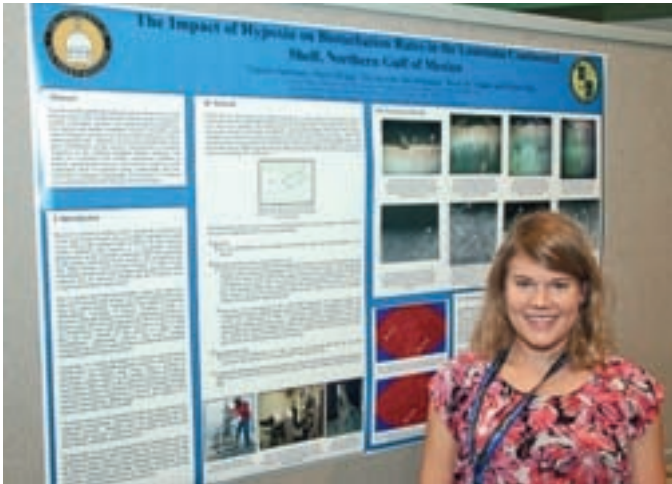


Abstract: This paper outlines the development and initial testing of the Nereus autonomous surface vehicle. Conceived specifically as a system for riverine and coastal observation, the ASV is capable of transmitting real-time audio and visual surveillance to a shoreside base station. In addition, Nereus is designed to transmit situational awareness data including, but not limited to, vehicle speed, position, and heading, as well as water depth and basic bathymetry. The vehicle consists of a catamaran platform with brushless DC motors housed in each hull. Driving four bladed propellers contained within Kort nozzles, the two motors produce differential thrust for all maneuvering. Control is provided by an LPC 2138 development board interfaced with a student-designed RS-232 multiplexer and power distribution board, and an infrared security camera and directional long range microphone to provide operators with real-time observations of a desired target both day and night. This paper discusses the motivation and necessity for the project, comments on initial modeling, performance prediction, and key aspects of the design, and concludes by presenting preliminary test results.

Valerie Hartmann – University of Southern Mississippi

“The Impact of hypoxia on bioturbation rates in the Louisiana continental shelf, northern Gulf of Mexico”

Abstract: Variation in the spatial and temporal extent of hypoxia in coastal bottom waters of the northern Gulf of Mexico leads to changes in benthic community structure and sediment physical properties. Past and present benthic community structure determines what types of biogenic structures are present



in the sediment as well as faunal mixing rates. Therefore, hypoxia has an important effect upon bioturbation. This study focuses upon the effects of hypoxia on bioturbation specifically on the continental shelf of Louisiana, where hypoxia has become an important issue due to its seasonal reoccurrence and increasing expansion across the northern Gulf of Mexico over the past 30 years.

In this project, characteristics of biogenic structures in the sediment including number, diameter, and depth are correlated with benthic communities dwelling in hypoxic, intermittently hypoxic, and normoxic conditions using non-destructive Computed Tomography (CT) imagery of sediment cores and Sediment Profile Imaging (SPI) photography. Biogenic structures are also correlated with sediment physical properties, bioturbation rates, and bioturbation behaviors (dilator or compactor) of benthic invertebrate fauna. Initial data for this project was collected during two cruises along the continental shelf of Louisiana, the first in April 2009 and the second in September 2009. Four different “provinces” were chosen for sampling using bottom water oxygen concentration data from the Louisiana Universities Marine Consortium (LUMCON) and archived sediment type data. These four sampling sites represent normoxic and hypoxic provinces with a consistent sediment type. The provinces consist of a normoxic site (NO) that has experienced hypoxia less than 25% of the time and briefly hypoxic (BH), frequently hypoxic (FH) and hypoxic (HO) sites that have experienced hypoxia greater than 25% of the time.

Xiaodong Kang – Shenyang Institute of Automation, China*

“Fuzzy logic based behavior fusion for multi-AUV formation keeping in uncertain ocean environment”

Abstract: In the complex and uncertain ocean environments, and under the conditions of current and sensor noises, multiple autonomous underwater vehicles (multi-AUV) keep a spatial formation to survey a large-scale unknown area with real-time obstacle avoidance ability. This paper presents a new behavior fusion method using fuzzy logic for coordinating multiple reactive behaviors. The inputs to the proposed fuzzy control scheme for the leader AUV in multi-AUV system consist of the deviation in yaw angle while performing obstacle avoidance and goal seeking action separately, and the fuzzy control scheme for the follower AUV consists of the



deviations in yaw angle while performing obstacle avoidance and formation keeping action separately. The outputs from the behavior fusion scheme are the behavior weights for the leader and follower AUV. A real-time simulation platform has been developed and several typical obstacle scenes have been demonstrated in this simulation platform, the simulation results verify the effectiveness and robustness of the proposed behavior fusion method.

YoungBum Kim – Inha University, Korea

“Application Scenario of Nautical Ad-hoc Network for Maritime Communications”

Abstract: In terrestrial wireless communications, high data-rate transmission can be readily achieved by installing base stations on the ground. However, the same system may not be adapted to maritime communication due to the geographically restricted nature of the sea, and therefore, MF/HF modems, capable of long-distance transmission, with low data-rate are frequently employed in maritime communication. Maritime satellite communication through Inmarsat is conventionally used to compensate for the low data-rate transmission of MF/HF modems, but its high cost still remains as a main drawback. In order to enhance the transmission speed with a fairly low price, in general, a network whose architecture is similar to Vehicular Adhoc Network (VANET), that allows peer-to-peer communications without base stations, i.e., ad-hoc network, is crucial. Herein, we propose an ad-hoc network for nautical



environment, which is named as Nautical Ad-hoc Network (NANET). In this paper, scenarios toward NANET development are described and analysis of multiple access and duplexing schemes for corresponding NANET scenarios is discussed. A guideline for further research and developmental strategies on NANET is also suggested.

William Kirkey – Clarkson University

“Long-Term Deployment of Liquid-Cooled High Frequency (HF) Radar”

Abstract: A liquid cooling system has been incorporated into a 5 MHz (long-range) SeaSonde HF radar system from CODAR Ocean Sensors. The cooling system consists of commercially available heat exchangers, connected in series and applied to various heat sources within the system. These include the central module within the transmitter chassis, as well as four locations within the receiver chassis. In addition, heat exchangers were also installed on the processor, northbridge, and hard drive of the Apple Mac mini computer used to govern the system. Bench testing showed that these heat exchangers are sufficient to effectively dissipate the roughly 200 W of heat generated by the radar equipment. We also designed and built a cooling reservoir for the dissipation of this heat to the external environment. In order to minimize power consumption, a passive cooling reservoir was developed. Four 55 gallon high-density polyethylene barrels are used to store the water, which is cooled by ambient air and wind. Water is circulated through the system by a single 39 W pump operating off of 24 VDC. This system was field-deployed for one year at Matagorda Island, located in Texas off the coast of the Gulf of Mexico. This is a remote site at which commercial power is unavailable. Instead, the system is powered by a photovoltaic array. Air conditioning at this site would more than double the total power requirements of the installation. In contrast, the water cooling system requires less than 20% of the total electrical power. From August 2008 to August 2009, the system operated with high reliability, producing surface current radial data which was transmitted in near real-time via a cellular signal to the National HF Radar Network and is publically available via the World Wide Web.

Justin Lorio – Florida Atlantic University

“Design of a Next Generation Surface Piercing Propeller Test Stand”



Abstract: In order to explore the open water characteristics of surface piercing propellers, a test stand was designed to perform towing tank experiments. The test apparatus will have automated control of propeller speed and depth of immersion as well as angles of inclination and yaw. The design methods and final design of the system are presented in this paper.

Justin Lorio is a native of Jeanerette, Louisiana. He earned his undergraduate degree from the University of New Orleans in Naval Architecture and Marine Engineering. After graduating he worked as a Naval Architect for nearly 2 years. Justin is currently working toward a Master’s Degree in Ocean Engineering at Florida Atlantic University, with a focus in Hydrodynamics. He is currently developing a prototype apparatus for tow tank testing of surface piercing propellers. He also designed the hull for FAU’s autonomous surface vehicle that was used at the 2009 AUVSI competition. Justin plans to complete his master’s degree in Spring 2010.

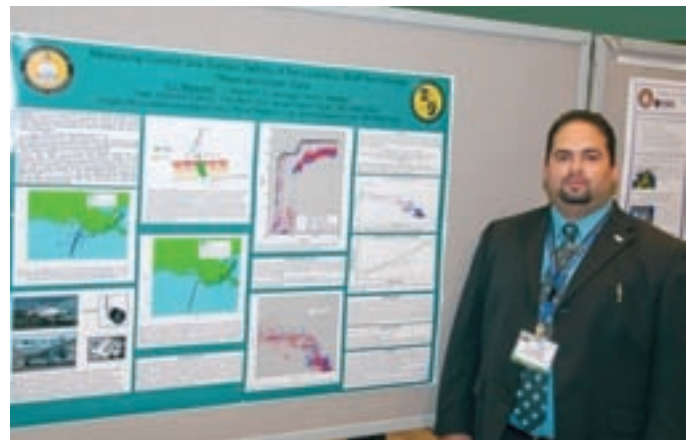
Virgilio Maisonet – University of Southern Mississippi

“Measuring Coastal Sea-Surface Salinity of the Louisiana Shelf from Aerially Observed Ocean Color”

Abstract: We have demonstrated the ability of airborne radiance and irradiance sensors to detect the persistent salinity gradient of the Atchafalaya plume and corresponding color fronts as observed by in-situ shipboard measurements as well as STARRS. We used an empirical algorithm

$$A_{\text{cdom}}(412) = 0.227 \times (R_{\text{rs}510}/R_{\text{rs}555})^{-2.022}$$

for CDOM from D’Sa *et al.* 2006. Their study was conducted in the same region (Louisiana Shelf) and time of year (March) as our study and it was performed with similar optical equipment. This study resulted in an Ocean Color Salinity model that can measure with ~88% accuracy the Sea-Surface Salinity of the Louisiana shelf. A multi-linear regression for salinity, based on two of the optical channels, provides an excellent qualitative proxy for large scale coastal salinity in the Atchafalaya plume region ($y = -0.0082 * x + 0.34$, $R^2 = 0.90$, $n = 5220$). We then developed two algorithms from the May and November data. This was done to create two seasonal equations for salinity.



Joule Mikhael – Alexandria University, Egypt

“Minimal Fuel Consumption and Highly Maneuverable Marine Vessels Designed Based on ASAP Hull Technology and Sontag Non-Linear Feedback Stabilization”



Abstract: The present paper proposes a new hull design called ASAP (All Speeds Array of Pods). The new hull combines both the advantages of SLICE and SWATH hulls. A fifth moveable pod is added amid the SLICE pods to achieve this goal. Computational Fluid Dynamics (CFD) software is used to optimize the proposed hull by adapting pods locations as well as fifth pod dimensions. The paper includes a comprehensive comparison between SLICE and ASAP hulls based on resistance, technology, cost, structural analysis and sea-sickness/ sea-keeping behavior aspects. To further ensure the feasibility of the proposed hull design and improve its dynamic stability and fuel consumption, a control scheme based on Sontag non-linear feedback universal stabilization formula is proposed. The control scheme can be employed at both fifth pod lifting mechanism level and autopilot level. The present study verifies that the proposed hull is a truly competitive alternative to existing hull technologies.

Ruth Mullins – Texas A&M University

“Real-time Environmental Monitoring from a Wind Farm Platform in the Texas Hypoxic Zone”



Abstract: Ocean observing systems (OOS) are useful tools for assisting coastal managers with informed decision-making. OOS are designed to monitor environmental, oceanographic, and atmospheric parameters and can be installed on a variety of offshore platforms. In the summer of 2009, a multi-disciplinary real-time OOS, Galveston Instrument Garden for Environmental Monitoring (GIGEM), was deployed off the coast of Galveston, Texas (Location: 29°08'29.654"N, 094°44'51.339"W) to monitor coastal waters and provide data to investigate the processes controlling coastal Texas hypoxia. Hypoxia occurs in the Gulf of Mexico and refers to low dissolved oxygen concentrations in the bottom waters caused by a combination of environmental and physical parameters. Hypoxic events commonly occur along the Louisiana and Texas coasts however, little research has been conducted to investigate the processes responsible for Texas hypoxia formation. GIGEM was designed to help solve this problem by contributing real-time measurements to compare with historical coastal data series. Unlike traditional coastal OOS, GIGEM is installed on an experimental wind farm platform, operated by Wind Energy System Technologies Inc. (WEST). GIGEM is comprised of two components, the underwater mooring and bottom package, with all instrumentation connected by a unique, intricate design of seawater and surface inductive modems. GIGEM is also the only coastal OOS collecting real-time environmental water quality measurements on the Texas shelf. The work presented describes the obstacles and challenges with deploying GIGEM, the flow of information from the water column to the user, and future plans for constructing a comprehensive picture of Texas coastal hypoxia. Details are also presented on how this type of OOS compares with additional OOS in the Gulf of Mexico and how the societal goals for protecting coastal ecosystems and improving coastal weather and ocean predictions implemented by the Integrated Ocean Observing System (IOOS) are fulfilled.

Julia O'Hern – Texas A&M University**

“Marine Mammal Habitat in Ecuador: Seasonal Abundance and Environmental Distribution”

Abstract: Marine mammals in the Eastern Equatorial Pacific play a vital ecological role toward structuring trophic systems and the distribution commercially valuable prey. However, scientific study of their populations within the waters surrounding Ecuador has been only infrequently conducted and largely neglected over the past decade. Our research including six marine mammal surveys will investigate the distribution of marine mammals inhabiting the oceanic areas between the Ecuadorian mainland and around the Galápagos Islands. Visual observers documented marine mammal sightings while aboard the Ecuadorian Navy's Oceanographic Vessel the (B/I) Orion last September/October 2008 and April 2009. The range of different species positively identified as well as the large proportion of sightings that could not be identified to species using current survey methodologies, suggests that the diversity and overall marine mammal abundance within Ecuadorian waters may be much higher than previously suspected. Four more surveys covering similar periods of the year will be conducted over the next two years.

Chudong Pan – University of Southern Mississippi

“A Preliminary Study of the Influence of Regional Winds on Bering Strait Transport”

Abstract: The goal of this study is to determine the role of the wind in the Chukchi and Bering Sea in the controlling transport through the Bering Strait. Wind data from 1990–1991 (6 hourly, 2.5×2.5 degree resolution) is analyzed using EOF (Empirical Orthogonal Functions) method. Hourly velocity measurements taken from a mooring station are used as representative average current velocity in the Bering Strait. Correlations between the wind EOFs and the Bering Strait current velocity are calculated. Together with spectrum analysis, principal component analysis and correlation analysis, the extent of the region where winds affect the transport using wind fields from different areas is determined. The correlations between 1st wind EOF and the current velocity are larger than the correlation with the local winds, which indicates that 1th wind EOF may play more important role for the transport in the region.

Allison Penko – University of Florida

“Mixture Theory Model Sensitivity to Effective Viscosity in Simulations of Sandy Bedform Dynamics”

Abstract: We perform a sensitivity analysis on a three-dimensional bottom boundary layer model (SedMix3D) that uses mixture theory to simulate the flow and sediment transport over rippled sand beds. SedMix3D treats the fluid-sediment mixture as a single continuum with effective properties that parameterize the fluid-sediment and sediment-sediment interactions using several closures for the sediment phase. The effective viscosity is one such closure that includes three adjustable parameters: the intrinsic viscosity, the maximum viscosity, and the maximum packing concentration of unconsolidated sediment. The sensitivity of suspended sediment concentration predictions by SedMix3D is tested by varying the intrinsic viscosity, which is a proxy for sediment grain shape. We qualitatively and quantitatively analyze the model output of suspended sediment concentration for a range of intrinsic viscosity values typical of quartz sand. Intrinsic viscosity values ranging from 2.5 to 3.5 produce total suspended sediment concentrations that differ less than 11%. However, there is approximately a 16% difference between the suspended

sediment concentrations from intrinsic viscosity values of 2.5 to 3.5 and 4.0 to 5.0. Simulations of sediment transport over bedforms performed here were not significantly sensitive to the choice of an intrinsic viscosity value in the range of 2.5 to 3.5. Using a baseline intrinsic viscosity value of 3.0, we subsequently tested two additional effective viscosity formulations. The suspended sediment concentrations predicted by the Eilers and Krieger-Dougherty formulations were very similar, but the Mooney formulation generated much less suspended sediment. We found the model to be more sensitive to variations of effective viscosity in the ripple-fluid interface than in the suspension range.

Miguel Pinto – Engineering University of Porto, Portugal

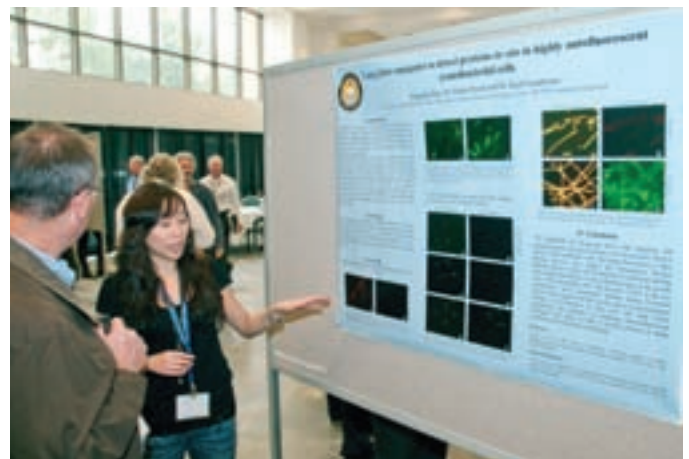
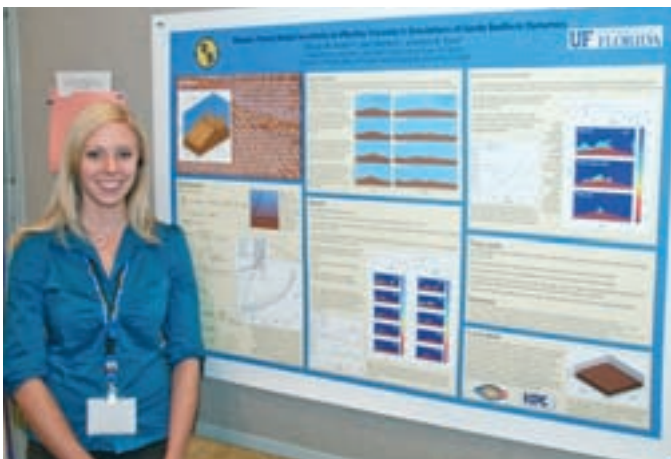
“Using Side Scan Sonar to Relative Navigation”

Abstract: This paper describes the interaction between the kinematic model of the AUV MARES and the measurement or observation of the environment through images obtained with a sonar. Three types of sonar are discussed in this paper: forward-look, side scan and multibeam – but the sonar used to develop this work was the side scan sonar. The type of observations and characteristics of the environment provided by the sonar are described here. The method which connects the sensory part of the vehicle with the observations from the sonar, was the Kalman filter (EKF). In this paper, we present two simulations of filters for two different characteristics. Both filters estimate the characteristics of the natural landmarks, creating an environment map, but both of them consider different states of the vehicle. Results of the simulation are obtained. The features that are considered are an underwater pipe on the floor and a vertical wall. A control loop for the vehicle that provides the capacity to move along the feature/landmark from a reference distance is also discussed.

Miguel Armando Migueis Pinto, from the city of Porto in Portugal is a 23 year old PhD student with a research area in Autonomous Underwater and Surface Vehicles, navigation and control. His master’s degree is in Electrotechnical and Computers Engineering.

Shanshan Ren – University of Southern Mississippi

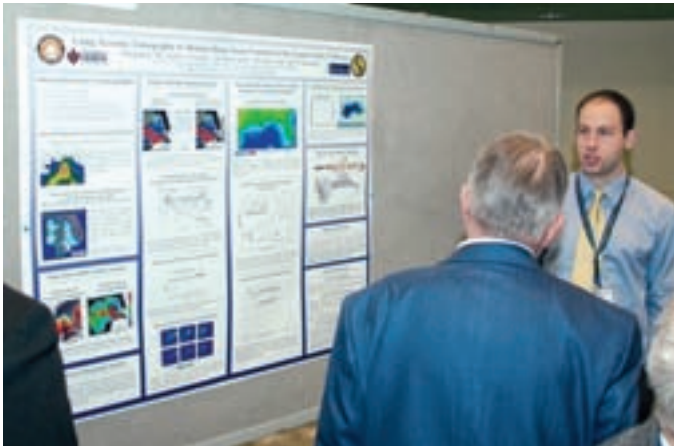
“Using Qdot conjugations to detect proteins in situ in highly autofluorescent cyanobacterial cells”



Abstract: Due to the low photostability of conventional organic fluorophores, their effectiveness in detecting proteins in highly autofluorescent cyanobacterial cells is limited. However, the inorganic fluorescent nanocrystal (Quantum Dot or Qdot) conjugates have the capability to overcome the limitation of organic fluorophores, and provide a promising tool for long-term imaging studies. In this study, we applied Qdot conjugated secondary antibodies associated with specific primary antibodies, and successfully detected nitrogenase and IdiA proteins in situ in highly autofluorescent cyanobacterial cells of the unicellular *Crocospaera watsonii* (WH8501) and the non-heterocystous *Trichodesmium erythraeum* (IMS101).

David Rosenfield – University of Southern Mississippi

“Using Acoustic Tomography to Monitor Deep Ocean Currents in the Eastern Gulf of Mexico”



Abstract: Toward the improved prediction and monitoring of deep-water currents and eddies in the Gulf of Mexico, the Gulf Eddy Monitoring System group (GEMS; researchers from University of Southern Mississippi, University of New Orleans, University of Louisiana at Lafayette, and the Naval Research Laboratory) proposes that a network of acoustic transmitterreceiver pairs be deployed in the northeastern Gulf of Mexico. Acoustic travel times are inverted to recover temperature and velocity between transmitter-receiver pairs. This data can be fed into ocean dynamical models to improve simulation and prediction of the circulation in the deep ocean. While a proven technique, it has only recently been used successfully in deeper waters. The location is ideal for this type of tomographic application for its predictable oceanic parameters and convenient geomorphology. With a sound-channel axis at about 900 m, a lower power output transmission is required, thus providing negligible impact on marine mammals. Because no other technology can be used to monitor for similar events, we are introducing this method to the marine technology community.

Patrick Rynne – Florida Atlantic University

“Visual-Based Navigation of an Autonomous Tugboat”

Abstract: This paper presents the work of a team of undergraduate and graduate students at Florida Atlantic University

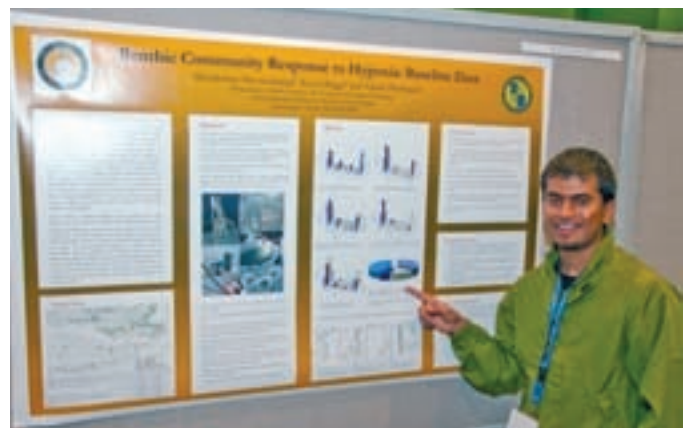


(FAU) who compete in the annual Autonomous Surface Vehicle (ASV) competition held by the Association for Unmanned Vehicle Systems International (AUVSI). The theoretical concept of the vehicle, the design modification and fabrication process, and the results of both preliminary testing and the final competition are presented. The initial configuration of a stereoscopic vision system and navigation algorithm is explored through testing in a controlled environment. With this approach, the vehicle is shown to be capable of navigating precisely through various courses of colored buoys; approximately 25% of the attempts results in successful navigation of all buoy pairs while 75% of the attempts result in successful navigation of half the buoy pairs or more.

Shivakumar Shivarudrappa – University of Southern Mississippi

“Benthic Community Response to Hypoxia: Baseline Data”

Abstract: World wide more than 400 aquatic systems are hypoxic, affecting an area of more than 245,000 square kilometers. The hypoxic area in Gulf of Mexico is the second largest in the world next to the Baltic Sea basin. In the northern Gulf of Mexico hypoxia is a phenomenon which occurs when the seasonal thermohaline stratification in the water column develops. Under normoxic or hypoxic conditions benthic organisms affect the physicochemical properties of sediment by their usual biological activity such as feeding, locomotion, and burrowing. According to the Pearson-Rosenberg model, changes in the benthos due to hypoxia occur at the community level of organization, with the pioneering community having different biological behavior than the equilibrium community,



which normally exists without hypoxic stress. These changes as a response to low oxygen include numerical density, species diversity, organism size, depth of bioturbation, and number of functional groups – all factors which ultimately can affect the physicochemical properties of sediment. Thus, to some extent there may be a feedback mechanism that conditions the sediment properties for the particular type of benthic community. The types of sediment properties that can affect the density and diversity of benthos include grain size distribution, bulk density, and concentration of organic matter. To study these changes, macrobenthos and sediment samples were collected from the northern Gulf of Mexico between the Atchafalaya and Mississippi Rivers. Four provinces were chosen based on the frequency of occurrence of hypoxic events for a comparison between pre-hypoxic conditions in early spring and hypoxic conditions in late summer. The macrobenthos data will be compared with the sediment properties of grain size, organic matter concentration, sedimentation rate, and depth of the redox potential discontinuity to help explain the variability in the biological data among provinces. The macrobenthos data will be statistically analyzed for species richness using Hurlbert rarefaction curves that enable the calculation of the richness for a set number of species, organism sizes, bioturbation depths, and functional groups. The macrobenthos data will be correlated with sediment properties using the principal component analysis. These baseline data will be compared with similar data collected in September for assessing the effects of hypoxia on benthic community structure in the northern Gulf of Mexico.

Marcia Silva – Great Lakes Water Institute

“Application of an automatic event-controlled sampler for biological analysis and monitoring: studies on plume tracking in Milwaukee Harbor, Wisconsin”

Abstract: An automatic remote-controlled sampling system for biological analysis and monitoring is presented and its functionality described. In order to test the automatic sampler’s ability to reproduce standard manual sampling methods, several trials were performed. The automatic sampler allows event-triggered samplings. Time series of these events are presented and interpreted. Significant patterns of bacterial concentrations and sonde parameters are expected during heavy rainfall and CSO events. Comparison of samples from

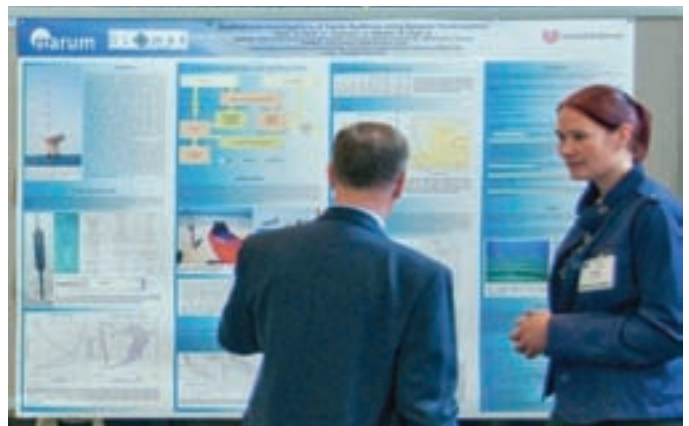
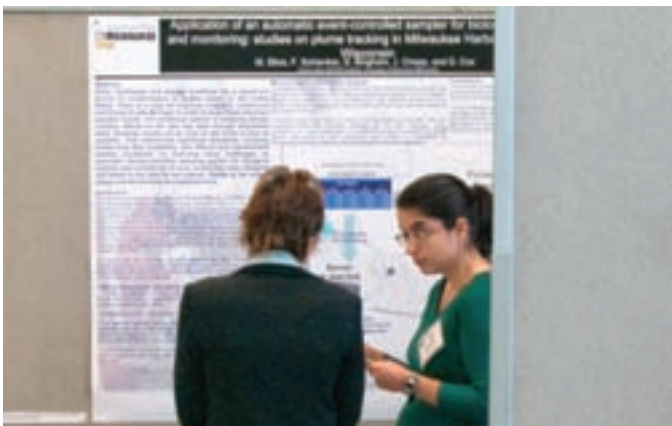
the automatic sampler and the manual samples collected at the south gap in Milwaukee Harbor showed the same results for samples analyzed the day of collection as for those that were stored at the bottom of the lake.

Marcia Silva is a Research Assistant at the Great Lakes WATER Institute. She received her BS in Food Engineering from the University of the Sinos Valley (UNISINOS) in Brazil and her MS in Civil Engineering from the University of Wisconsin-Milwaukee, Wisconsin, USA. She is currently pursuing her PhD in Civil Engineering at the University of Wisconsin-Milwaukee. She is conducting research in a cross disciplinary project that combines Engineering and Microbiology & Environmental Health. Her Dissertation is entitled: “An Integrative Investigation of Sources, Fate and Transport of Bacteria in Milwaukee Coastal Beaches through Field Studies, Laboratory Experiments, and Modeling.” under supervision of Dr. Sandra McLellan and Dr. Hector Bravo. She has worked with the Great Lakes WATER Institute for the past 6 years. Her research interests include coastal water quality, transport of bacteria and sediment transport.

Nina Stark – MARUM – University of Bremen

“Geotechnical investigations of sandy seafloors using dynamic penetrometers”

Abstract: Geotechnical in-situ characterization of the strength of the shallowest sub-seafloor sediment is an important factor in offshore engineering (e.g., scouring at wind energy plants), coastal engineering (e.g., sediment erosion close to the shores and beaches), navy applications (e.g., mine burial) and research (e.g., dunes in tide-affected areas). Dynamic penetrometers are well known as time- and cost-saving means to derive sediment physical properties in-situ and to detect layering or changes of strength of the shallow marine deposits. However, until now such instruments were rarely used on hard sandy seafloor because of their small penetration depth. The aim of this study is to unravel how applicable dynamic penetrometers are on sand and what kind of information they can deliver. Deceleration – depth signatures of the devices are used to compute quasi-static bearing capacity and related to governing parameters such as mineralogical composition, grain size distribution and sedimentary layering. We present the results of measurements on sand with two different types of dynamic penetrometers (FF-CPT and Nimrod)



developed at MARUM (University of Bremen, Germany). The devices were operated with different penetration velocity, with different deploying technique and in variable sedimentary conditions. The parameters monitored during penetration are deceleration and tip resistance. Data analysis follows two approaches. First, we directly compared deceleration – depth profiles from both instruments to extract typical profiles for the different materials and to quantify areas of sediment remobilization. Second, dynamic bearing capacity is derived from the deceleration (Nimrod) and from the tip resistance (FF-CPT) respectively. Following an empirical approach (Dayal and Allen, 1975; Can. Geotech. J.) dynamic bearing capacity can be converted into quasi-static bearing capacity for a chosen threshold penetration velocity to consider the varying impact force and penetration rates of the devices. This allows a better comparison of different dynamic penetrometers to each other and to standard CPT records.

Nina Stark is a geophysicist with focus on physical properties of the sea floor. After having designed the NIMROD (dynamic penetrometer to derive bearing capacity and shear strength of the sea floor) device, she investigates sea floor sediment remobilization owing to tides and currents (e.g., dunes), constructions and human impact (e.g., off-shore wind energy test farms, harbor development, dredging) by CPTU and NIMROD deployments.

Maria Stefanovich – Oregon State University

“Wave energy and public opinion in Oregon, U.S.A.”

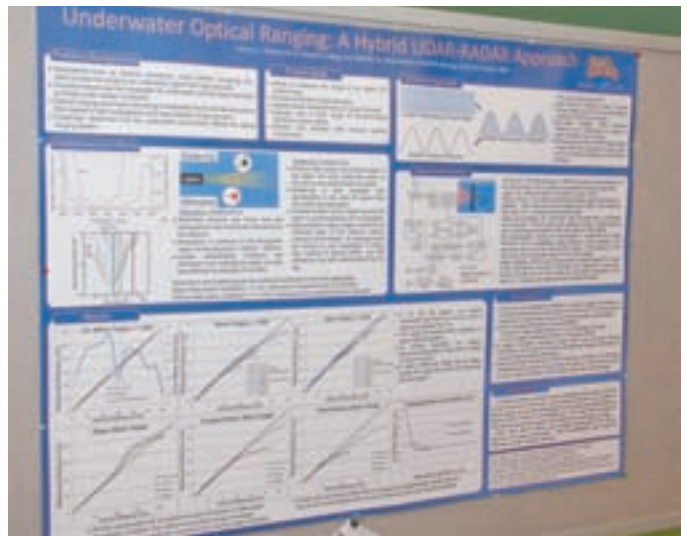
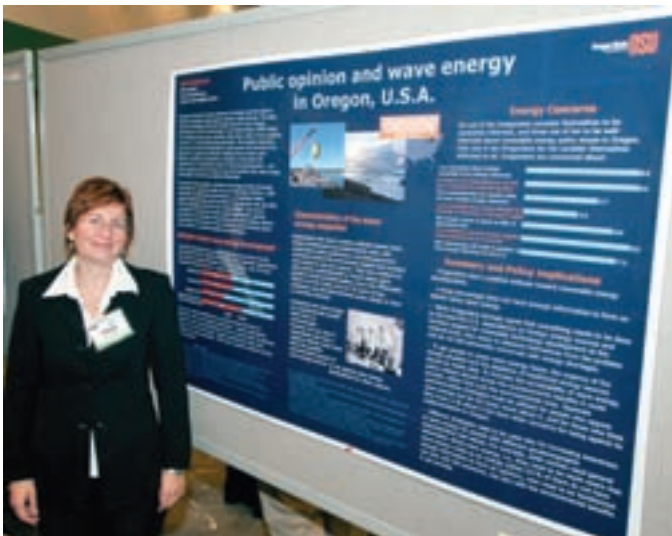
Abstract: Countries have been developing renewable energies for quite some time now, and people are starting to think of them as being affordable, readily available, and good for the environment. The time has come to develop wave energy. Governments around the world are finally seeing the benefits of its unstoppable grace and power and are starting to account for it in their renewable energy portfolios. There is one huge potential problem, however, and that is “public acceptability”. Even though public acceptability is not a new phenomenon – it has often been encountered with new technologies and even new things there is one unique factor this time. It is the common

space hugging the continents called the ocean. The traditional ocean uses, especially within three miles of the coastline in the U.S., do not include energy extraction. The question becomes how this new need for harnessing ocean power and turning it into electricity is going to fit within the existing array of ocean uses – fishing, recreation, transportation, aesthetics, and marine life conservation. The state of Oregon, U.S.A., has been identified as the most suitable place for wave energy development of all 23 coastal states in the United States [1]. Today, however, almost five years after the EPRI study was published, there is not a single commercial wave energy project in the waters off Oregon. Why? Does public opinion have anything to do with it? How should public opinion be interpreted? This study provides some insight and understanding about the determinants of public opinion with regard to renewable energy, the role these determinants play in public opinion formulation, and their relative importance in citizens’ support of or opposition toward wave energy development in Oregon. The findings of a statewide survey reveal that the typical respondent is supportive of wave energy development, even though s/he does not consider herself/himself well informed about renewable energy, and that s/he is least knowledgeable about wave energy of all renewable options. These results indicate that increased outreach efforts for wave energy are warranted; especially considering the fact that 83% of respondents believe it is “possible to increase energy supplies while protecting the environment at the same time”.

Dennis Waldron – Lafayette College, Pennsylvania

“Underwater Optical Ranging: A Hybrid LIDAR-RADAR

Abstract: Current systems designed for underwater ranging have limitations in how much range resolution and accuracy they can provide under certain conditions. Recognizing this short-coming, optical techniques for underwater ranging are being investigated. These optical systems can provide much greater resolution and accuracy in their measurements than existing systems, theoretically on the order of centimeters, or even sub-centimeter, depending on the configuration. Additionally, they can provide refresh rates on the order of mega-hertz,



as the system depends on the propagation speed of light instead of sound.

We applied the idea of a hybrid LIDAR-RADAR system to optical ranging in order to attempt centimeter-type range accuracy over the distance of meters with high range resolution. This would be a vast improvement over existing systems, optical or otherwise, at short ranges.

We also investigated environmental concerns. Traveling through a medium such as water, an optical signal will attenuate exponentially because of absorption and scattering. Using an optical wavelength in the near-infrared (NIR) region helped to harden our system against the effects of changing turbidity levels of the water, but at the cost of not being able to range as far in clean water as we could with visible, especially blue-green, wave-lengths. This is because NIR wavelengths absorb very quickly in even clean water, but are much less affected by scattering than shorter, visible, wavelengths.

Dennis L. Waldron III is a senior at Lafayette College in Easton, PA., where he is majoring in Electrical and Computer Engineering. At Lafayette College, he is the President of the student chapter of the Institute of Electrical and Electronics Engineers (IEEE), which he has pushed to begin various academic and community service projects around Easton to promote engineering among youths. Among other places he calls home is Germany, where he studied for one semester as part of a foreign exchange program at Jacob's University in Bremen, an international English speaking university. Since the summer of 2007, Dennis has been an intern at NAVAIR's Patuxent River, MD Naval Air Station facility, in the EO and Special Mission Sensors department. His projects in the past have included work on underwater optical communications and imaging. During his free time, Dennis enjoys cooking and grilling; tinkering with computers; traveling; and various "high adventure" activities such as hiking, rafting, camping, SCUBA diving, and sky-diving.

Baoju Wu – Shenyang Institute of Automation, CAS, China*
 "ARC Navigation and Control System at Arctic Research"

Abstract: ARV is a new concept unmanned underwater vehicle (UUV) which has both the characteristics of autonomous underwater vehicle (AUV) and that of remote operated underwater vehicle (ROV). It is a hybrid ROV/AUV. ARV can cruise at a range of 3 km at the speed of 3 kn, in a depth shallower than 500 meters. At the attractive point the vehicle can be operated as a ROV with the ability of dynamic positioning. The vehicle has a Fiber Optic Micro Cable (FOMC) system with the length of 5 km for transferring image and other payload sensors' data in real time. The payload segment is a reconfigurable module that can be changed according to different scientific related missions. ARV was used in China's third Arctic expedition in 2008.

The posters were judged by the judging team on Tuesday and Wednesday morning. The scores were collected and Prof. Howden and Mr. Miller reviewed the results. The students selected to receive the awards were:



First place winner Dennis Waldron with Student Activities Coordinator Norm Miller.



- 1st Place – Dennis Waldron
- 2nd Place – Virgilio Maisonet
Ruth Mullins
- 3rd Place – Justin Lorio
Allison Penko
Patrick Rynne

Each student received a round of applause as they received their award. Once again the quality of the poster presentations was out standing and the research work covered a wide spectrum. All of the students expressed their appreciation for being invited to the Conference and made good use of their time to attend sessions and view the exhibits as well as being at their posters at the appointed times.

*Students not able to attend the Conference, but submitted their posters for display.

** Student on a rescheduled research cruise and was not able to attend.

Underwater Optical Ranging: A Hybrid LIDAR-RADAR Approach

Dennis L. Waldron III
Dr. Linda Mullen, Advising
Lafayette College
NAVAIR

I. BACKGROUND

Proximity detection underwater is performed primarily by sending and receiving some form of magnetic or acoustic radiation. This is done by propagating a known output signal, and measuring the response of or disturbance from some target. However, these systems have limitations in how much range resolution and accuracy they can provide under certain conditions.

Recognizing this short-coming, optical techniques for underwater ranging are being investigated. Optical systems can provide update rates on the order of mega-Hertz because it depends on the speed of light instead of the speed of sound. Perhaps most importantly, they can provide much greater resolution and accuracy in their measurements than existing systems, theoretically on the order of centimeters, or even sub-centimeter, depending on the configuration. There is, in fact, a US Navy requirement for a high-precision, large dynamic-range, proximity detector that is as insensitive as possible to changing water conditions, with a range of less than two meters.

However, when traveling through a medium such as water, an optical signal will attenuate exponentially because of absorption and scattering. The absorption coefficient, or a , characterizes the photons that are extinguished and cannot be recovered by the detector. Physically, when dealing with wavelengths in the blue to IR spectrum (about 400nm to 100 μ m), this loss is caused by the photons interacting with the water molecules and some particulates in the water. Wavelengths in the near infrared (NIR) spectrum interact more strongly, and absorb more quickly [1]. Running out of signal due to absorption is called reaching your photon limit. An analogy would be like driving a car on a clear night- if the vehicle's high beams are turned on, the driver can see farther. In other words, sending more photons into the environment (i.e. using a greater optical power), will allow the system better range when this type of loss is dominant.

Scattering, characterized by the scattering coefficient, b , causes a photon to be deflected from its trajectory rather than simply being absorbed. This kind of loss comes from photons bouncing off of various particulates in the water, both organic and inorganic; the more turbid the water is, the more prone photons are to scatter [1]. A small percentage of photons have an angle of reflection large enough to become "backscatter." These photons are reflected back at the detector without making it to the target and are especially troublesome; they become noise, carrying no useful information. Reaching a point where the return signal is dominated by this backscatter noise is referred to as reaching the backscatter limit. Returning to the night-driving analogy, this type of loss would be like the driver turning on high beams in a fog- the driver might be able to see a little farther if the fog is light enough, but eventually he or she would just be blinded by the reflected light.

These two measures of signal loss are often combined additively into a single measure, called the beam attenuation coefficient, or c . This is the total loss in signal strength. The challenge in performing optical proximity detection in the underwater environment is to receive more photons from the underwater object than either the receiver noise floor or the ambient environment. In the next section, two different approaches for underwater optical proximity detection will be discussed.

II. DESIGN OF AN UNDERWATER OPTICAL RANGING SYSTEM

A. Previous Design

Fig. 1 shows a previous approach to an optical ranging system. A light source is set next to a receiver such that the cone of light emitted can be seen within the field of view (FOV) of the receiver when it is reflected off of a target. As the target gets closer, the amount of light received gets greater, and the signal amplitude increases. However, as the target is moved closer still, the common volume of the cone of light and the FOV gets smaller, causing the amplitude to fall off. Distance can then be determined relative to the peak amplitude observed [2].

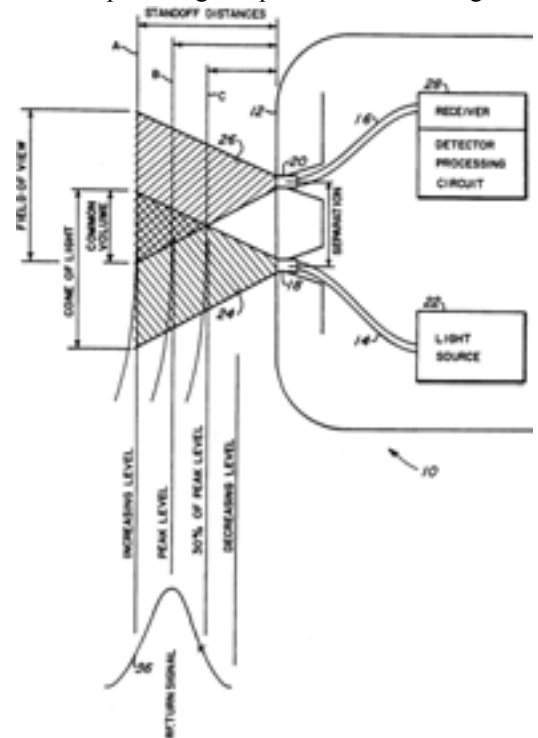


Fig. 1 A previous approach to optical ranging underwater using return signal amplitude [2].

While such a system is elegant in its simplicity and relatively compact, it is an extremely limited approach to ranging, as it is only able to operate over short distances, on the order of a few centimeters. In addition, a large amount of optical power is needed to operate such a system, especially if one wishes to increase the operating range. Practically, these factors limit the applications and usefulness of such a system.

B. A Hybrid Approach

A natural choice for precision ranging is coherent LIDAR (Light Detection and Ranging). However, it cannot be used directly in water because environmental effects cause a loss of optical coherence. On the other hand, RADAR (Radio Detection and Ranging) offers coherent detection, but since microwaves attenuate so rapidly in water, they cannot propagate. A solution is to modulate a light signal with a microwave signal, thus forming a hybrid approach. Using this hybrid signal, we are able to take advantage of the coherent detection of the RF modulation envelope, the RADAR signal, to measure range to a target.

Using this hybrid approach has previously been demonstrated by researchers at NAVAIR’s Patuxent River, Maryland facility to improve the performance of underwater imaging systems allowing for a range of greater than ten meters [3]. This system used a wavelength in the blue-green spectral region (450 to 550nm) due to the absorption characteristics of pure water, as seen in Fig. 2. However, since the optical proximity detector is being developed for a shorter range, less than two meters, other wavelengths are being considered. By choosing a higher wavelength in the red to NIR region (660 to 830nm in our case), optical loss will be dominated by absorption. This means that the effect of scattering on measurement accuracy is limited. And, since scattering is dictated by water turbidity, a change in water turbidity will not have as much of an effect on the measurement. Thus, the system will be able to operate more reliably in a number of environments. Laser diodes that can be modulated at megahertz rates are also readily available at these wavelengths, which is beneficial for making the system compact and efficient.

III. EXPERIMENTAL SETUP

A. Laser

Traveling the path of the signal through our experimental setup, seen in Fig. 3, we start with the laser. In our experiments, we tested three wavelengths: NIR, 830nm; red, 660nm; and green, 532nm. We used green as a basis of comparison, since we have used this wavelength extensively in the past.

All were continuous wave (CW) lasers. The NIR laser was a laser diode modulated via current injection with an average optical output power of about 50mW when modulated at 66MHz. The red laser was likewise a laser diode, this one with an average output power of about 10mW at 70MHz. The green was a solid state laser with an average output power on the order of a few watts, of which we only used a maximum of about 200mW. We used an external electro-optic (EO) modulator to achieve 70MHz modulation (the EO modulator and the necessary RF amplifier are not shown in the Fig. 3). In all cases, the laser was driven by the same RF generator as was the demodulator.

B. Target

Following the signal path, we come to the target. It was placed in a windowed water tank, 3.7m long and 1m tall and wide. It was suspended from an optical rail 2.5m long which was itself mounted over the tank so that the target distance could be easily varied. The target was 46cm wide and 30cm tall, and had a matte surface. We assumed this surface to be perfectly diffuse. In order to see the effects of target “strength,” the target was split vertically down the center. One side was then painted black, and the other painted a light grey so that

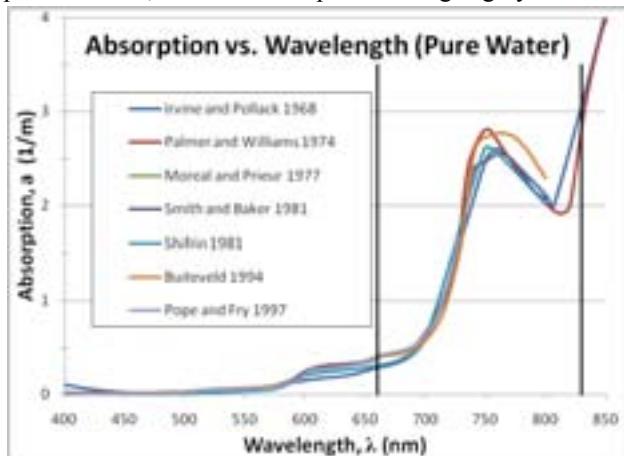


Fig. 2 Various data sets showing the effects of wavelength on absorption. Absorption is greater in the near IR region (800nm-1µm) compared to the visible (400-700nm). [4] [5] [6] [7] [8] [9] [10]

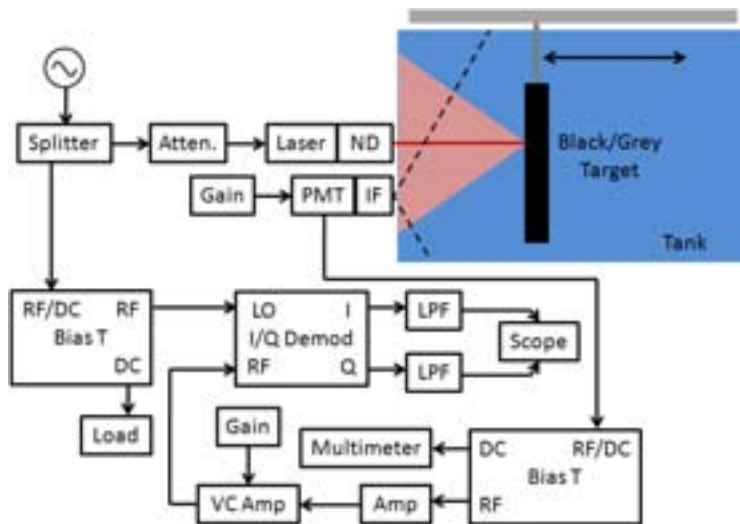


Fig. 3 A system block diagram. The dotted black lines from the PMT/ Filter assembly are a sample field of view. The red line from the laser/ ND assembly represents the beam. The lighter red is a diffuse reflection from the target.

they had different reflectivities. The target could then be positioned so that only one side or the other was being used at a time.

C. Detector

For our detector, we used a red enhanced photo-multiplier tube (PMT) with an 8mm aperture. A PMT was ideal because we did not need a large detector bandwidth, but we did need a relatively large detector surface area and moderately sized FOV. A PMT was also ideal for very low light levels, offering a gain of up to 10^6 . The gain of the PMT was set via a simple voltage divider circuit to the recommended maximum gain. Even being red-enhanced, the quantum efficiency at NIR wavelengths was much lower than at other wavelengths in the visible region, resulting in about two orders of magnitude less anode sensitivity [11].

An interference filter (IF) with a bandwidth of 10nm centered at 660 or 830nm was used for red and NIR, respectively. For the green, we used an IF centered at 532nm with a bandwidth of 5nm, as it was readily available in our lab. Additionally, the IF had the ancillary effect of helping to harden the system against backscatter by limiting the FOV slightly; the narrower the bandwidth of the filter, the narrower is the FOV, and the less backscatter is collected.

After the PMT, the signal continues to a bias-tee circuit so we could separately monitor the DC and RF information from the detector. The DC information was viewed and recorded via a multimeter so that it could be compared to the amplitude information from the I/Q demodulator (which will be discussed shortly) as a check to help convince ourselves that our data made sense. The RF signal was then passed first through a 20dB amplifier, then a voltage controlled variable gain amplifier (VGA) with a gain of -50 to 50dB. We used this amplifier chain to raise the signal to a level acceptable to our demodulator.

C. RF Demodulator

We used an analog I/Q demodulator to determine the phase difference between a local oscillator (LO) reference signal, and the returned (RF) signal. From the demodulator we get In-Phase (I) and Quadrature-Phase (Q) data:

$$I = 0.125A_{LO}A_{RF} \cos(\varphi_{RF} - \varphi_{LO}) \quad (2)$$

$$Q = 0.125A_{LO}A_{RF} \sin(\varphi_{RF} - \varphi_{LO}) \quad (3)$$

where A_{LO} = amplitude of the reference signal
 A_{RF} = amplitude of the return signal
 φ_{LO} = phase of the reference signal
 φ_{RF} = phase of the return signal.

Using trigonometry, it can be demonstrated that the change in magnitude, ΔA , and the change in phase in degrees from the original signal, $\Delta\varphi$, can be computed:

$$\Delta A = \sqrt{I^2 + Q^2} \quad (4)$$

$$\Delta\varphi = \tan^{-1}\left(\frac{Q}{I}\right) \quad (5)$$

From this phase information, an absolute measurement of distance to target can be made by relating the change in phase to a real distance. The received phase of the RF signal changes in reference to the LO signal because of the time delay as the signal propagates to and from the target. Thus, if the target is farther from the receiver, the delay will be greater, so the phase difference between the received RF and sent LO signals will be greater. Note that because the signal must propagate both to and from the target, the computed distance will be twice that of the distance to the target. Hence, the distance R to the target can be found by:

$$2R = \frac{\Delta\varphi \cdot \lambda_{RF}}{360} = \frac{\Delta\varphi \cdot c}{360n f_{RF}} \quad (6)$$

where: c = the speed of light in vacuum
 $n \cong 1.33$, water's index of refraction
 λ_{RF} or f_{RF} = modulation wavelength or frequency.

The LO signal into the demodulator, as aforementioned, is fed from the same RF generator modulating the laser.

The demodulator provides the sum and difference of the incoming RF and LO signals, so low pass filters (LPF) must be used on the outputs to strip off the un-needed sum term. When selecting the bandwidth of these filters, one must keep in mind that a lower bandwidth means less noise on the outputs, but it also will limit the frequency at which one can sample to twice that of the filter bandwidth. We wish to eventually sample at 1MHz, so we used 500kHz filters.

C. Choice of Modulation Frequency (RF)

In general, modulating faster enables more accuracy in range measurements, as the phase can be better resolved. Consider, for example, a wavelength of 226m in water, or $f_{RF} \cong 1\text{MHz}$. Plugging this into (6), along with a phase difference of one degree, we get a distance of about 31cm. This means that for every degree difference in phase between the RF and LO signals that is measured, there is a 31cm change in calculated range. So, to get centimeter accuracy in an ideal distance measurement, one must be able to resolve $\frac{1}{31}$ of a degree phase change reliably, which leaves very little room for noise and other error in the system.

Now, compare this with a wavelength of 2.26m in water, or $f_{RF} \cong 100\text{MHz}$. Again plugging into (6), we see that now a difference of one degree translates to only about $\frac{1}{3}$ cm of calculated range difference. This means one need only be able to resolve three

degrees of phase difference to get centimeter accuracy in distance. The benefits of modulating faster are immediately apparent; such a system is much more robust against noise and measurement error.

However, there is an upper limit to modulation frequency, determined by the “unambiguous range,” the maximum distance in which a phase measurement can be regarded as meaningful (i.e. $\Delta\phi \leq 360^\circ$). As discussed before, we used a modulation frequency of 66MHz for the NIR laser, and 70MHz for the red and green. This translates to an unambiguous range of 1.71m and 1.61m in water, respectively. We felt this would give us enough accuracy, and we would be able to measure our entire desired range within the unambiguous range.

D. Controlling Dynamic Range

One of the major challenges we faced when designing and implementing our system was the large dynamic range of the optical signal amplitude. Since water, as discussed before, will attenuate optical signals exponentially and geometrically, a relatively strong signal must be used to be able to range a respectable distance. This means, unfortunately, that at short ranges the return amplitude will be relatively much larger, by two to four orders of magnitude or more, than the amplitude at longer ranges; the detector and the demodulator cannot handle this sort of dynamic range.

In order to compensate, we built a number of mechanisms into our system design, as can be seen in Fig. 3. To stay within the dynamic range of the demodulator, the VGA was used. We also adjusted the optical power into the tank to ensure that we stayed within the dynamic range of the PMT.

Another option would have been to alter the gain of the PMT. This is done by increasing the reverse bias on the tube, which has the effect of increasing the output current for a given amount of light incident on the detector. We did not use this control, however, and instead left it at a constant 90% of the maximum (to stay within the manufacturer recommended range) for the duration of our tests. By changing the reverse bias, we would have been changing the phase delay through the tube, thus altering our phase measurement, and ultimately the range to target calculation.

E. Calibrating the Overlap Function

While calibrating the overlap of source and receiver is not as important here as it was in the previous system, it can still affect the accuracy of the results. If the target is close or far enough away, the laser will illuminate a section of the target which may not be within the FOV of the detector (imagine if the FOV in Fig. 3 was narrower and did not intersect where the beam met the target). We calibrated the overlap by choosing a distance about half that of which we wanted to measure, and aimed the laser to be in the center of the detector’s FOV at that distance. This allowed the illuminated portion of the target to enter into the detector FOV quickly, and remain there for the length of the distance of interest.

F. Adjusting Water Turbidity

Turbidity of the tank water was varied using commercially available Maalox[®], a common practice in the underwater optics community. The active ingredients, aluminum hydroxide and magnesium hydroxide, are particles which scatter the light, but do little to alter the absorption properties of the water [12]. We chose to approximate the marine environments “coastal ocean” and “turbid harbor,” shown in Table I, as well as other turbidities; tap water, not salt water was used, as the difference between clean and salt water is negligible [1]. To more precisely model actual aquatic environments, absorption, too, would have to be altered. This could be done with dye, such as the organic black dye, Nigrosin.

IV. RESULTS

A. 830nm Near-IR

As the first test of our prototype system, we wanted to gather some baseline “best case” data in air, not through water. Since environmental effects and dynamic range were limited, we can expect this to be the best possible result with our system. Fig. 4 shows the performance of our 830nm prototype

TABLE I
PROPERTIES OF SELECTED WATER TYPES AT GREEN 532NM
(CONDENSED FROM [1]) (ALL IN m^{-1})

Water Type	Properties at Green		
	a	b	c
pure sea water	0.045	0.0025	0.043
clear ocean	0.114	0.037	0.151
coastal ocean	0.179	0.219	0.398
turbid harbor	0.366	1.824	2.19

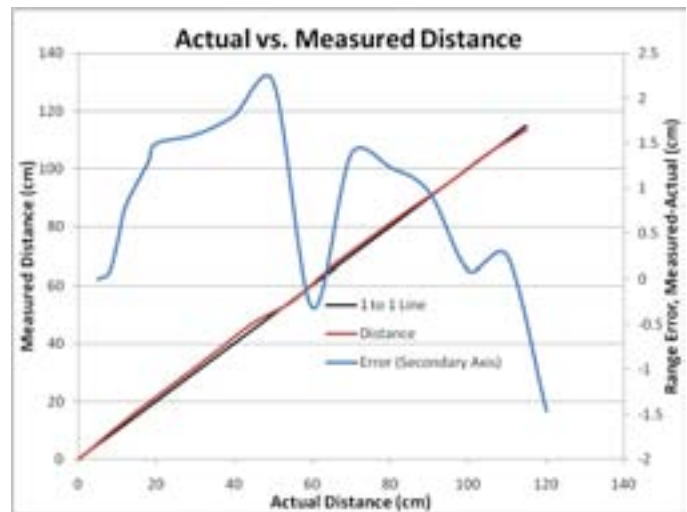


Fig. 4 Actual vs. Measured distance using our 830nm prototype system through air. Note that any deviation from the 1 to 1 Line is error, as shown by the blue line (secondary axis).

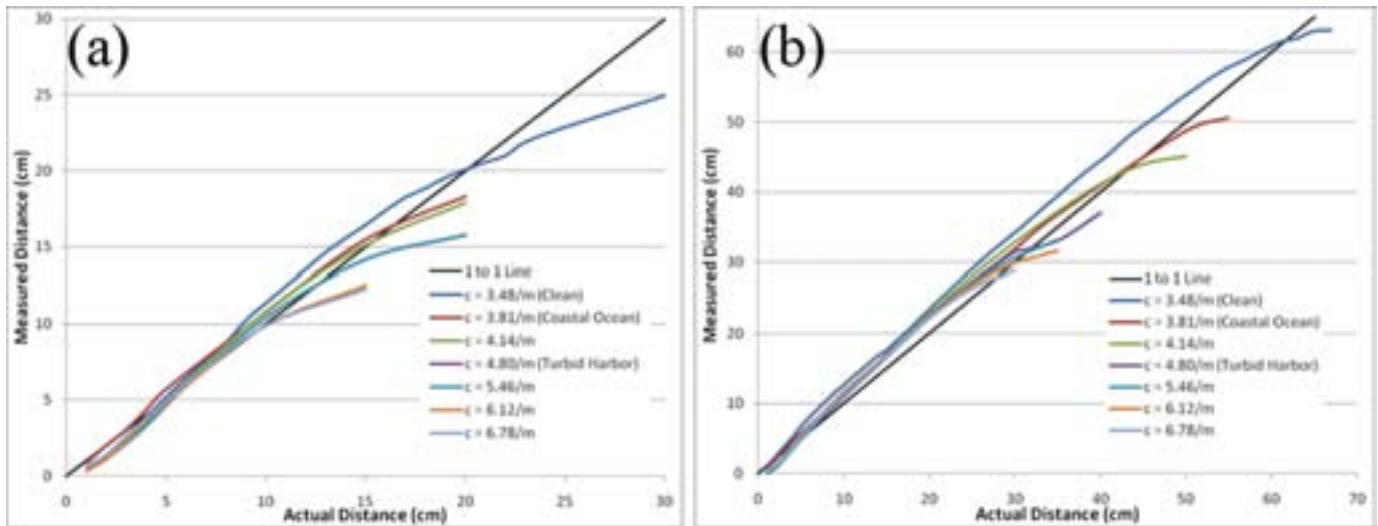
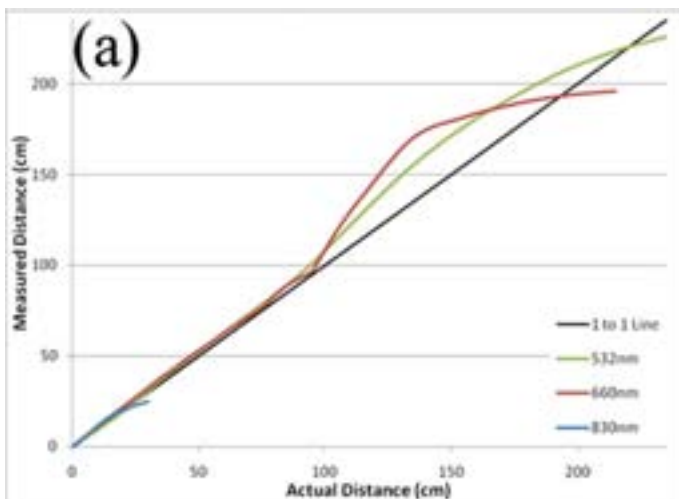


Fig. 5 Actual vs. Measured distance using our 830nm prototype system through water. (a) Weak target. (b) Strong target. Notice the increased ranging performance with a stronger, more reflective target.

in air. Actual distance and measured distance closely follow one another, as we expected; any deviation of this line from the “1 to 1 Line” ideal case is error. Note that the overlap function is very apparent in the error exhibited in the measurement- we aligned the laser to be in the center of the detector’s FOV at about 60cm, where the error dips to nearly zero.



Once the system was moved into the water tank, we were unable to range as accurately or as far as in air. Figs. 5a and 5b show a similar plot for both weak (black) and strong (grey) targets in water. Note the effect of a strong target- the return from the target is able to dominate the backscatter return for a greater distance, but eventually it too is backscatter limited. Also, as one might expect, more turbid water causes a degradation of system performance, leading to more error and less sensor range.

B. 660nm Red and 532 Green in Comparison

Having seen the effects of both beam attenuation due to turbidity and absorption, and of a strong or weak target, it is at this point most instructive to examine red and green wavelengths in comparison, using the NIR measurements as a baseline, as seen in Fig. 6. Since the worst case is typically the most useful in designing a system, a weak target will be

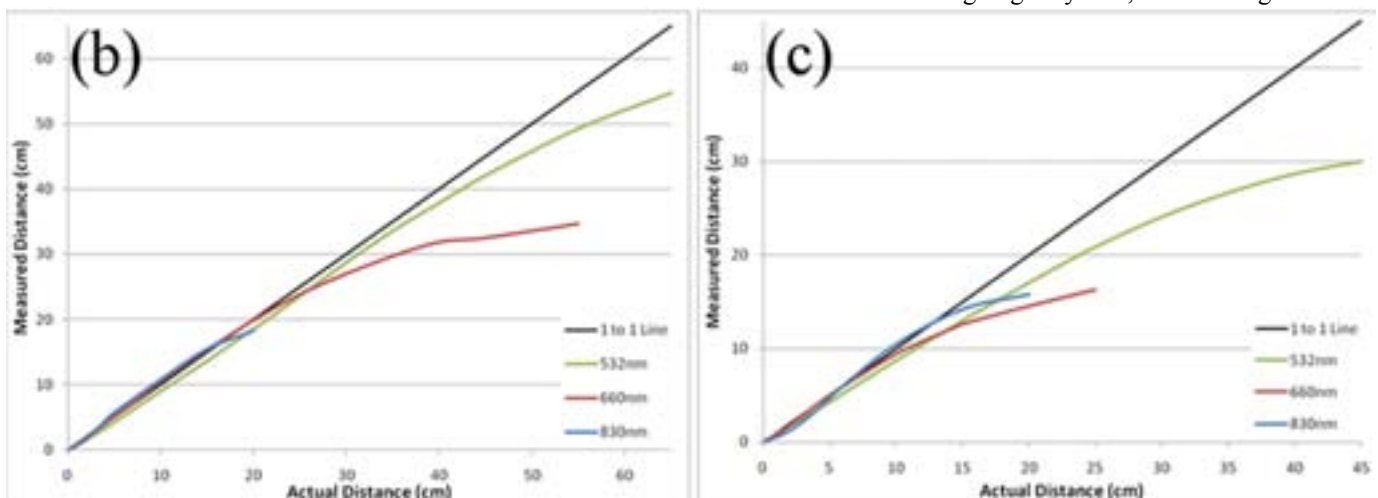


Fig. 6 Actual vs. Measured distance plots comparing all three of the wavelengths tested (black target). In clean water, the performance of lower wavelengths is much better, but as the water becomes more turbid, the performance converges. (a) Clean. (b) Coastal Ocean (c) Turbid Harbor.

considered when making the comparison. Fig. 6 shows Actual vs. Measured plots like those in Fig. 5, but instead shows all three wavelengths on one plot, separating plots by water turbidity. Selected turbidities include those for clean water (not pure), a coastal ocean area, and a turbid harbor.

In clean water, the shorter wavelengths vastly outperform the longer NIR. However, as the water begins to get more turbid, the different wavelengths' performance begins to converge. In fact, the NIR better maintains its performance characteristics over a range of turbidities compared to the green or red, just as predicted. This can be seen in Fig. 7, which shows clearly how the ability to range accurately converges for the red and NIR wavelengths as water turbidity increases; at first, the red is able to keep under 3cm of error for a much longer distance than the NIR, but they soon converge in performance.

V. CONCLUSIONS AND FUTURE WORK

We applied the idea of a hybrid LIDAR-RADAR system to optical ranging in order to achieve centimeter-type range accuracy over the distance of meters with high range resolution. This would be a vast improvement over existing systems, optical or otherwise, at short ranges.

Using an optical wavelength in the NIR region helped to harden our system against the effects of changing turbidity levels of the water, but at the cost of not being able to range as far in clean water as we could with visible, especially blue-green, wavelengths. This is because NIR wavelengths absorb very quickly in even clean water, but are much less affected by scattering, the two components that make up total attenuation.

A modulation frequency of around 66MHz allowed us a theoretical maximum range measurement of about 1.71m within the unambiguous range, and afforded a one-half centimeter change in distance for every one degree of phase change. At 70MHz, the unambiguous range drops to 1.61cm.

Using the phase information of the modulation envelope, we were able to achieve centimeter-type accuracy, but we were only able to do this over a meter or more in ideal conditions, such as clean water with a strong target. The most accurate we can hope to be with this setup is demonstrated by our measurements in air. We were able to achieve less than 2.5cm of error over the entire measured range, 1.2m, in air. Even when limited by environmental effects, our system is still an improvement over the existing optical ranging system discussed earlier.

More work could be done to minimize the effects of the environment in limiting the range of the system. Also, dynamic range is still an issue. Three orders of magnitude or more need to be examined, depending on optical wavelength, which is impossible with a conventional detector. Techniques involving passive or mechanical apertures will be examined, as well as systems employing multiple lasers and detectors. Such a system could use one laser and receiver pair for near-field measurements, and another for far-field measurements. This would reduce the dynamic range requirement of each individual sensor, as well as allow the use of multiple wavelengths. Wavelengths which are absorbed less readily in water, for example, could be used for longer range measurements.

If a higher modulation frequency could be achieved, more accurate ranging information would be able to be gathered. However, this would come at the cost of a shorter unambiguous range, which is a drawback of the sinusoidal modulation (LIDAR-RADAR) scheme in this application.

A different scheme involving chaotic modulation techniques (CLIDAR) will be looked into in the future. Using chaotic waveforms to modulate an optical signal, we can take advantage of a very high bandwidth signal, as high as 15GHz, which is non-repeating [13]. This could have the potential for extremely accurate ranging which is not bounded by an unambiguous range.

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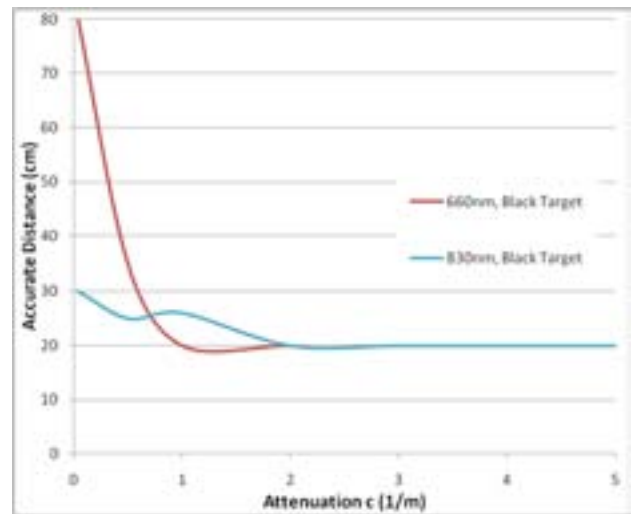


Fig. 7 The distance to which less than 3cm of ranging accuracy was maintained for NIR (830nm) and red (660nm) wavelengths for various water turbidities. (Here, attenuation is given at 532nm green as a reference.) The shorter wavelengths do better in clean water, but lose their advantage as the water gets more turbid.

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Dr. Victor Klemas Wins Science Award

On November 19 Dr. Vic Klemas, Professor of Marine Studies at the University of Delaware, was awarded the Science Prize of the Republic of Lithuania, for his lifetime achievements in applying remote sensing and other advanced techniques to study coastal ecosystems. Vic has also been active in helping the Baltic Sea University in Klaipeda to develop advanced coastal oceanography programs by teaching Fulbright courses and inviting other US scientists to do the same. With colleagues from Denmark, Sweden, Finland and Russia, Vic has also been a key organizer of the US/EU Baltic Sea symposia in various countries around the Baltic Sea.

The award ceremony took place at the Academy of Sciences in Vilnius, the capital, and was attended by cabinet ministers and university presidents. The US ambassador to Lithuania, the hon. Anne E. Derse, was especially delighted and expressed her gratitude to Vic for strengthening international ties by collaborating with local scientists and working hard to advance the marine sciences at Baltic Sea universities. The other two awardees were from Harvard (medicine) and the University of Illinois (linguistics). Vic's future plans include several environmental projects in the Baltic Sea and using the prize money to establish a scholarship for students majoring in the marine sciences.

Dr. Victor Klemas is Professor of Marine Studies at the University of Delaware and Director of the Center for Remote Sensing. He specializes in the application of remote sensing techniques to coastal research and management. He has published over 100 articles in refereed scientific journals



The US Ambassador to Lithuania and the Lithuanian Minister of Science and Education congratulate Dr. Klemas (right) on his award.

and is working on two books. Professor Klemas serves on the editorial boards of six scientific journals and has conducted sixteen workshops sponsored by UNDP, US/AID, NOAA, and NASA. He has served on six scientific committees of the National Research Council (NAS) and on various NOAA, NASA, EPA, and USGS advisory panels. Dr. Klemas is a member of the NOAA/NASA/ONR Coastal Ocean Application and Science Team. He also teaches at European universities as part of the Fulbright Program and organizes the US/EU Baltic Symposia.

Selected Works of John Masefield

Editor's Note: John Masefield (1878–1967) was an English poet who is known for his poems about the sea. Here we present a few favorites. Perhaps his most quoted line is found below in Sea Fever – “All I ask is a tall ship and a star to steer her by.” He is also known for his plays and children’s novels. He was the Poet Laureate of the UK for many years.

A Wanderer’s Song

A WIND’S in the heart of me, a fire’s in my heels,
I am tired of brick and stone and rumbling wagon-wheels;
I hunger for the sea’s edge, the limit of the land,
Where the wild old Atlantic is shouting on the sand.
Oh I’ll be going, leaving the noises of the street,
To where a lifting foresail-foot is yanking at the sheet;
To a windy, tossing anchorage where yawls and ketches ride,
Oh I’ll be going, going, until I meet the tide.
And first I’ll hear the sea-wind, the mewling of the gulls,
The clucking, sucking of the sea about the rusty hulls,
The songs at the capstan at the hooker warping out,
And then the heart of me’ll know I’m there or thereabout.
Oh I am sick of brick and stone, the heart of me is sick,
For windy green, unquiet sea, the realm of Moby Dick;
And I’ll be going, going, from the roaring of the wheels,
For a wind’s in the heart of me, a fire’s in my heels.

Sea Fever

I MUST down to the seas again, to the lonely sea and the sky,
And all I ask is a tall ship and a star to steer her by,
And the wheel’s kick and the wind’s song and the white sail’s shaking,
And a gray mist on the sea’s face, and a gray dawn breaking.
I must down to the seas again, for the call of the running tide
Is a wild call and a clear call that may not be denied;
And all I ask is a windy day with the white clouds flying,
And the flung spray and the blown spume, and the sea-gulls crying.
I must down to the seas again, to the vagrant gypsy life,
To the gull’s way and the whale’s way, where the wind’s like a whetted knife;
And all I ask is a merry yarn from a laughing fellow-rover,
And quiet sleep and a sweet dream when the long trick’s over.

Trade Winds

IN the harbor, in the island, in the Spanish Seas,
Are the tiny white houses and the orange trees,
And day-long, night-long, the cool and pleasant breeze
Of the steady Trade Winds blowing.

There is the red wine, the nutty Spanish ale,
The shuffle of the dancers, the old salt’s tale,
The squeaking fiddle, and the souging in the sail
Of the steady Trade Winds blowing.

And o’ nights there’s fire-flies and the yellow moon,
And in the ghostly palm-trees the sleepy tune
Of the quiet voice calling me, the long low croon
Of the steady Trade Winds blowing.



2009 IEEE Fellows

The grade of Fellow recognizes unusual distinction in the profession and is conferred only by invitation of the Board of Directors upon a person of outstanding and extraordinary qualifications and experience in IEEE designated fields (including electrical engineering, electronics, computer engineering and computer sciences, and the allied branches of engineering and related arts and sciences), who has made important individual contributions to one or more of these fields, that have been reflected in an improved quality of life for society.

The IEEE Bylaws limit the number of members who can be advanced to Fellow grade in any one year to one-tenth of one percent of the total Institute membership, exclusive of Students and Associates, on record as of December 31 of the year preceding. Nominations are evaluated by the Technical Society/Council engaged in the technical field in which the candidate is active.

Candidates must be an IEEE Senior Member at the time of nomination and have been an IEEE Member for at least 5 years. Any person, including those who are not members of the IEEE, may nominate a candidate. The exceptions are IEEE Officers involved in Fellow evaluations and IEEE Staff.

This year three OES members were selected to receive the designation of IEEE Fellow. Congratulations to all of these highly qualified members.



Ross Chapman studied physics as an undergraduate student at McMaster University in Hamilton Ontario (B.Sc., 1968), and continued graduate research in physics at the University of British Columbia where he received a Ph.D. in 1975. His introduction to the world of ocean science came afterwards, at the Defence Research Establishment Pacific (DREP) in the navy dockyard in Esquimalt BC. Dr. Chapman joined the Canadian defence laboratory in 1976 as a defence scientist in the Ocean Acoustics group, and spent the next 20 years in underwater acoustics research. DREP was a uniquely well-equipped laboratory for ocean science, with its own research vessel, CFAV ENDEAVOUR, in the dockyard. He was Chief Scientist on over 20 sea trials on the ENDEAVOUR from 1976–1995. These included the Pacific Echo experiments in collaboration with the Naval Research Laboratory to demonstrate the concept of matched field source localization at sea, and the Heard Island Feasibility Test on ocean acoustic thermometry in 1991. From 1986–1988, he spent two years as an exchange scientist at the Defence Scientific Establishment in Auckland, New Zealand studying ambient noise processes in the ocean. Dr. Chapman left DREP in 1995 when he was appointed Senior Research Chair in Ocean Acoustics at the School of Earth and Ocean Sciences at the University of Victoria (UVic). The academic and research program in Ocean Acoustics that he has established at UVic with Dr. Stan Dosso is unique in Canada. He and his colleague Dr. Stan Dosso have graduated more than 20 Masters and Ph.D. students who have gone into research and development positions at industrial and government laboratories.

Dr. Chapman is internationally recognized for his research on the interaction of sound with the ocean bottom. His work has fundamental importance in understanding the physics of sound propagation in marine sediments, and in applications for acoustic characterization of sea bottom materials and sonar performance prediction. Acousticians describe the interaction of sound with the ocean bottom by geoacoustic models, profiles of the variation with depth of the physical properties of sea bed materials, such as sound speed, density and attenuation. Estimates of these parameters are used as inputs to numerical calculations of the acoustic field. Dr. Chapman's research in the development and application of methods for estimating parameters of geoacoustic models from experimental data has stimulated work in this research field in naval, academic and applied research laboratories nationally and internationally. He has published over 90 refereed papers on ocean acoustic propagation and geoacoustic inversion, mostly in the IEEE Journal of Oceanic Engineering and the Journal of the Acoustical Society of America, and has presented over 125 papers at conferences (~30 invited). His research at UVic has expanded to include geoacoustic characterization of marine gas hydrates and applications of acoustic sea bed classification for marine habitat assessment, in collaboration with the local marine R&D industry, Quester Tangent Corporation in Sidney, British Columbia. Dr. Chapman is an active member of the Victoria Chapter of the IEEE Ocean Engineering Society, and is an associate editor of the IEEE Journal of Oceanic Engineering. He is also a Fellow of the Acoustical Society of America (ASA), and from 2004–2007 was the Chair of the ASA Technical Committee on Acoustical Oceanography.



Milica Stojanovic graduated from the University of Belgrade, Serbia, in 1988, and received the M.S. and Ph.D. degrees in electrical engineering from Northeastern University, Boston, MA, in 1991 and 1993. After a number of years with the Massachusetts Institute of Technology, where she was a Principal Scientist, she joined the faculty of Electrical and Computer Engineering Department at Northeastern University in 2008. She is also a Guest Investigator at the Woods Hole Oceanographic Institution, and a Visiting Scientist at MIT. Her research interests include digital communications theory, statistical signal processing and wireless networks, and their applications to underwater acoustic communication systems. Milica is an Associate Editor for the IEEE Journal of Oceanic Engineering and the IEEE Transactions on Signal processing.



Professor John Vesecky grew up in Dallas, Texas and studied Electrical Engineering at Rice University before attending graduate school at Stanford. His career in science, engineering and university education spans X-ray astronomy to remote sensing with HF radar and microwaves. After a Research Fellowship in Astronomy he taught astronomy

at the University of Leicester (UK) and went on to do teaching and research at Stanford, Michigan and now the University of California at Santa Cruz. In the 1970's he was selected for the Jason study group and has participated in Jason Summer Studies on nationally important topics ever since, including climate change and applications of ultra-precise clocks. In the 1990's Prof. Vesecky was selected as Sensor Team Leader for Vice-President Gore's Environmental Task Force that identified classified data of environmental value and argued successfully for declassification. In 1999 he was selected as Founding Chairman of the Electrical Engineering Department in the new Jack Baskin Engineering School at UC Santa Cruz. He has served as Chair or Associate Chair ever since, guiding the department to successful accreditation and growth.

Examples of his research interests and accomplishments are his work in applying HF (decimeter) ground wave radar and microwave synthetic aperture radar to ocean measurements. He has worked in HF radar since the 1980's and led a team at Michigan, Stanford and the Environmental Research Institute of Michigan (ERIM) to design, develop, construct and deploy the only extant four-frequency HF radar system (MCR), allowing surface current measurements at multiple depths. Prof. Vesecky and his group showed that currents near the surface in Monterey Bay exhibit a definitive Ekman spiral behavior. MCR radars near the mouth of Chesapeake Bay led to calibration of the relationship between the effective depth of the HF radar currents and in-situ measurements. MCR deployments on Lake Michigan led to the first time histories of the surface current patterns; both observed (by HF radar) and predicted using lake circulation models. This showed that the difficulties of HF radar on fresh water lakes could be overcome using appropriate frequencies. More recently MCRs on Monterey Bay were

used to measure the properties of the vector, surface wind field, including wind field eddies and the first measurements of the friction velocity in the air and water using HF radar. A second example is microwave remote sensing applications of synthetic aperture radar (SAR) to ocean winds and sea ice. In the 1980's Dr. Vesecky and graduate student Steve Durden developed an ocean wavenumber spectrum model that responds at high wavenumbers to ocean surface winds. This "Durden-Vesecky" spectrum has had lasting impact in ocean surface scattering models, both active and passive. His research at Stanford made sea ice tracking more accurate and efficient, showing the use of object-oriented feature tracking and the extraction of lead and ridge features from SAR images. He worked with graduate student Qian Lin to develop new methods for image registration and phase unwrapping and applied these to terrain elevation recovery from interferometric SAR. The review by Vesecky and Stewart was a landmark paper, showing opportunities for ocean surface sensing by SAR, based on the SeaSat instrument. It was important in arguing for the deployment of space based SAR, e.g. ERS, RadarSat, Envisat and the Shuttle SAR. Professor Vesecky has been active in IEEE activities since it was the IRE and AIEE, including the Ocean Engineering Society, the Geoscience and Remote Sensing Society and the Antennas and Propagation Society.

He has a lifelong interest in amateur radio and holds an amateur extra class FCC license, AE6TL. In his community he provides leadership and labor in the Calvary Food Pantry that distributes food regularly, providing about 50,000 meals each year to the hungry in downtown Santa Cruz. At home he enjoys his family of wife Cynthia, son Stephen, daughter Holly and son in law Josh as well as playing the ukulele and the guitar and singing at family events.

Visit the OES online, link to the IEEE homepage:

<http://www.ieeeoes.org>

10th International Submarine Races

In June 2009 the 10th International Submarine Races (ISR) were held at the Naval Surface Warfare Center, Carderock Division near Washington, DC. The races are managed by the ISR Organization, a group of volunteers who have dedicated their personal talents and abilities to maintaining the continuity of this unique technology competition. The ISR Organization is led by individuals whose main concern and interest is to encourage engineering and technology students, as well as entrepreneurs of all types, in the development and evaluation of engineering designs of human-powered submarines and to expand the educational experience engendered by the underwater event.



The mission of the ISR is:

- To inspire students of the various engineering disciplines to delve into broad areas of underwater technology advancement and to provide them an educational experience that translates their theoretical knowledge into reality.
- To foster advances in subsea vehicle hydrodynamic, propulsion and life support systems.
- To increase public awareness of the challenges people face in working in and exploring the ocean depths.

The rationale for the ISR is that there is a continuing need to improve the efficiency of hydrodynamics, propulsion and life support systems for small, subsea vehicles. Profound lessons may be learned through the process of designing, building and operating an “optimized design.” The rules of this competition restrict the vehicle’s power to human power, thus focusing attention on maximizing the vehicle’s design and life support system.

Teams from a variety of educational institutions and other organizations design and build a one or two-person, human-powered submersible on an underwater course. The course is a 100 meter long straight run in a 22 foot deep water tank at the David Taylor Model Basin.

The participating teams were:

- | | |
|--|----------------|
| 1) U of California San Diego | Odin’s Rage |
| 2) Sussex County Technical School | Umptysquatch-4 |
| 3) U of California San Diego | Stanley |
| 4) U of British Columbia, Canada | SUBC |
| 5) Wheaton Submarine Works | SCUBA DO II |
| 8) U. of Florida | Swamp Thing II |
| 11) Texas A&M | Maroon Harpoon |
| 12) Virginia Tech | Phantom 5 |
| 13) Scuba Sub Team | Sparky’s Sub |
| 14) U. of Maryland | Terpedo II |
| 15) U. of Michigan | Mercury |
| 16) U. of Maine | Lobstar 1 |
| 17) Universidad Veracruzana | Halcon Marvin |
| 18) Ecole de Technologie Superieure | OMER 6 |
| 19) Ecole de Technologie Superieure | OMER 7 |
| 20) Team Sublime Hernando City School | Sublime |
| 21) Team Sea Wolf Hernando City School | Sea Wolf |
| 22) Archimede | Archimede 5 |
| 25) UW Human Powered Sub Team | Canis Maris |
| 28) HPS Universidad Simon Bolivar | PICUA |
| 29) U.S. Merchants Marine Academy | TBD |
| 30) Florida Atlantic University | Talon 1 |
| 31) U. of Bath, England | SULIS |



The David Taylor Model Basin is the perfect facility for this competition.



The winning teams in various categories were:

Overall Performance:

- First place: “Sublime”, Trophy and \$1,000
- Second place: “Talon-1”, \$500
- Third place: “OMER 7”, \$250

Innovation:

- First place: “OMER 7”, Trophy and \$750
- Second place: “Swamp Thing”, \$500
- Third place (tie): “Beluga”, \$250, and “Phantom 5”, \$250

Best Use of Composites:

“Beluga”, Trophy and \$750

Absolute Speed:

- First place: “Talon-1”, 6,298 knots, Trophy and \$750
- Second place: “Sublime”, 5,975 knots, \$500
- Third place: “Maroon Harpoon”, 5,445 knots, \$250

Best Design Outline: “Umptyscratch-4”

Best Spirit of the Races: “Umptyscratch-4”

Smooth Operator Award: “Team OMER-6,7”

Judges Award for Persistence and Resourcefulness: “Picua”

The ISR Organization operates on a virtual basis, with support from corporate sponsors, government and academic officials, and a host of private individuals. Their involvement and spirit carry on the vision of H. A. “Hap” Perry, who conceived and founded the race in 1989 in collaboration with the Ocean Engineering Department of Florida Atlantic University and sustained it through 1993.

To remain abreast of the activities of the ISR Organization and FURE, access their web site at <http://www.isrsubrace.org/>.



Team “Picua” from Universidad Simón Bolívar.



Team “Sublime” from Hernando City School won first place in Overall Performance.



Team “Sulis” from the University of Bath demonstrated an innovative propulsion design featuring both propellers and oscillating fins that could be switched while underway.



“Battlin’ Pete” from the United States Merchant Marine Academy used oscillating fins for propulsion.



Team “OMER 7” from the University of Quebec’s École de Technologie Supérieure.

OES Administrative Committee (AdCom) Meeting Report Summary

Stephen Holt, OES Secretary

This article is a summary of the IEEE Oceanic Engineering Society (OES) Administrative Committee (ADCOM) Meeting, held in Biloxi, Mississippi, USA on 26 October 2009. Only the highlights are presented here.

The IEEE OES ADCOM Meeting commenced at 8:30 AM at the Beau Rivage Hotel in Biloxi, MS. The meeting began with a Call to Order, Roll Call, and an official welcome from Jerry Carroll, the IEEE OES President.

Jerry Carroll introduced Hal Fletcher from Nuclear and Plasma Society who is the VP Technical of TAB addressed questions about IEEE. Hal gave a presentation on IEEE activities.

Jerry Carroll gave his presentation as OES President. He stated that:

- He recommended that we raise our dues by \$3.00 to be voted upon in Sydney at the OCEANS'10 Conference there.
- We are supporting our Chapter in India through technical co-sponsorship in India with SYMPOL, with Sandy Williams and Jim Collins participating. Sandy and Jim also reviewed the papers for this conference.
- There is another conference in China that they are requesting technical co-sponsorship with and they have moved it to July 2010. We want the models used for the UT conferences to be applied to India.
- Our website has been updated by Todd Morrison, Barbara Fletcher, Matthew Gelis, and Milica Stojanovic.
- The student program reimbursements are on track here in Biloxi.
- There were hitches in Bremen because the university could not accept the ONRG money and it had to be redirected to OES from which it went to the students.
- The Argentina 2010 Symposium is on track and may need a \$10,000 loan.
- The Baltic 2010 Symposium will be held in June with the meals purchased in the cafeteria at the university without conference cost. There are costs only for the ice breaker if we have money. However, the cost is expected to be very low.
- The hope is to get all expense cost issues resolved with these conferences before Sydney.

Jim Barbera, the Junior Past President, conducted the elections. There were four positions for election. After a call



Jerry Carroll, OES President.

for nominees from the floor all nominees were unopposed. Therefore, a motion was made for each in turn to be elected by acclamation. The motions passed in each case. The results were: For VP Professional - Liz Creed; for VP Conference Development – Bob Wernli; for Treasurer – Diane DiMassa; and for JOE Editor-Elect – Bill Carey.

Jerry Carroll gave a presentation of the ICEO task that has been requested of us:

- It is not fully understood what work is to be done.
- It was decided that Stan Chamberlain will meet with Zdenka Willis (NOAA IOOS Director) to find out more.

Diane DiMassa, the OES Treasurer, gave her presentation on our finances. Diane stated that:

- The OES is presently in the black financially.
- IEEE has requested that OES raise its dues. In response, the EXCOM and ADCOM should consider raising the dues by \$3 from \$19 to \$22. This is to be discussed in Sydney.
- She was concerned about costs for travel/expenses for “Old Salts”.
- Get items for a wish list that can be funded out of surplus as soon as possible, like GOLD members and students (to fund their travel/expenses for conferences).”

Steve Holt provided his Secretary’s Report. He reported that:

- He wrote three EXCOM and ADCOM Meeting Reports so far in 2009.





- Maintained list of outstanding action items and motions.
- Continued organizing arrangements for conference meetings.
- Worked on arranging Integrated Ocean Observing System (IOOS) sessions for the Biloxi, MS conference.
- Continued work with several OES officers preparing 2009 IEEE OES Society Review Report.
- Worked a limited amount on IEEE ISWG Standards Registry.
- Wrote article for Earthzine magazine (Posted electronically on 21 May, 2009): <http://www.earthzine.org/2009/05/21/ieee-committee-on-earth-observation-standards-working-group-iswg-is-recruiting-volunteers-to-build-geoss> and was entitled: "IEEE Committee on Earth Observation Standards Working Group (ISWG) is recruiting volunteers to build GEOSS."

Note: There were no outstanding action items to address.

Tamaki Ura gave a presentation on the proposed 2011 IEEE/OES 7th International Symposium on Underwater Technology (UT), to be held from April 4–8, 2011.

Marinna Martini wanted to take the "Lost Instruments" site off the web. She pointed out that "Linked In" and Facebook have replaced this. The proposal is to use the OES logo on Linked In the OES group. It should be kept open for non-members as well as members. Also, job postings should not be put there.

Claude Brancart distributed the International Submarine Races (ISR) 10 DVD. There is a compendium as well.

Sandy Williams, the Vice President for Technical Activities, gave his presentation on his recent efforts. Sandy stated that:

- Several TCC slots needed to be filled. Three motions to approve TCCs were approved.

- He will present a proposal for Distinguished Lecturer candidates from each of the 18 TC areas in the OES. As it presently reads, there could be 18×18 candidates.
- Session chairs needed to be selected more carefully and it has been proposed that authors be asked if they are willing to be a session chair and also who is attending and who will be present. These are to be added to the web based abstract site.
- He gave a presentation on his thoughts on the Distinguished Speaker program. He will give a presentation in Sydney for a formal program to be incorporated into the OES Policy and Procedures Manual.

Bob Wernli gave a presentation on his RECON activities. Bob reported on the status of potential future OCEANS sites that include the following candidates: Taipei in 2014, Baltimore/Washington DC in 2014, Genoa in 2015, Monterey/Bay Area in 2015, Shanghai in 2016, and possibly St. John's in 2016.

Todd Morrison proposed a change to the IEEE OES Bylaws. The future status of several proposed appointments were addressed by three motions. Todd noted that the new Editor for the Newsletter (James Gant), the Editor for the electronic Newsletter (Marinna Martini), and the OES WebMaster (Barbera Fletcher) presently need to be elected members of ADCOM according to the OES Bylaws. Todd proposed that we have to change this language because Jim Gant presently isn't an elected member of ADCOM. For this reason alone, plus for other potential situations, these three positions needed to have this language in the Bylaws changed.

Jim Gant presented his Newsletter report. The July issue is out and the next is nearly done. But there needs to be something



Sandy Williams, VP for Technical Activities.





Barbara Fletcher, Webmaster and Bob Wernli, VP for Conference Development.



Reneé Garello, VP for Conference Operations.

in it about Sydney. The next issue deadline is December 31, 2009.

Jim Collins, the Vice President for Professional Activities, gave his report on Professional Activities noting that the eNewsletter and Newsletter Editors had already covered their topics. He would do the Chapter Activities report and the Website, Membership Development, and Student Activities would be reported by those Chairs respectively. The Norway Chapter has been officially approved as of October 19th, 2009. The India Chapter has been active in the past year. The India Chapter Chair, M. A. Atmanand, has just been promoted to Director of the National Institute of Ocean Technology. The New South Wales Chapter is a Joint Chapter Chaired by Brian Ferguson. At present the UK/RI Chapter is the only one without a Chair.

Christian de Moustier, the OES Journal of Oceanic Engineering (JOE) Editor, gave a presentation on his activities:

- The Journal went through a five year review in June, and a final report was submitted to IEEE in September 2009.
- The review committee noted what it considered “best practices” for the Journal:
 - Reader survey to assess the publication needs of the membership.
 - Prescreening of manuscripts submitted for publication in the Journal for content and form. Manuscripts that do not meet the expected quality standards are returned to the authors without review and with instructions on what needs to be done before the manuscript may be considered for review.
 - Yearly recognition of excellent reviewers, with publication of their picture and nomination in the April issue of the Journal.
- Involvement of Associate Editors is critical to the quality of the Journal and we need more Associate Editors outside the US. However proficiency in English limits the pool of prospective editors.

The review committee recommended that Associate Editors have term limits. Currently editors serve three years terms, renewable indefinitely.

Rene Garello, the Vice President of Conference Operations, gave a presentation on his activities. His full presentation is included in Attachment D. Rene stated that:

- Recording the plenary sessions since the Oceans’07 conference in Aberdeen. There is also a promotional video under production. Also there is a tutorial on the web tools.
- A question arose should the IEEE Committee on Earth Observation (ICEO) meeting be on Sunday before the Oceans’10 conference in Seattle, or should the ADCOM be on Sunday and have the ICEO on Monday? Jerry Carroll suggested that the ICEO conference be part of Oceans as a track. The problem is that the GEO/ICEO conference is by invitation and the papers should not have to go through the abstract review process.

Norm Miller gave a presentation on his Student Poster activities. Norm stated that:

- The Student Poster Competition process needs to be revised. There is still a need for the conference judging to be revised.
- Norm reported that the student poster program started in 1989 and Franz Hover was the first winner. In 1990 there was no student program but in 1991 there was another student poster program in Hawaii. Since then the student program got woven into the OCEANS conferences. Norm said that he has been involved in every student program since.

Glen Williams reported on the IEEE OES “Old Salts” Initiative. Glen stated that:

- The IEE OES “Old Salts” Committee consists of past presidents and appointees.
- They can act where they have experience or where their experience is requested.
- One member of the committee should attend the EXCOM and ADCOM meetings, plus, they should meet among themselves at least once a year.

In summary, there were eleven new motions and no new action items created. The meeting was then adjourned at 5:15 PM on 26 October 2009.

SYMPOL-2009 Report

Held at Cochin, India, 18–20 November 2009

Dr. P.R. Saseendran Pillai

Introduction



Realizing the need for initiating research and development activities in the area of Ocean Electronics and Exploration, which are going to be the major international issues of the 21st Century, the Department of Electronics of the Cochin University had started research and manpower development programmes with the active support from the Ministry of

Human Resources Development (Government of India), University Grants Commission, Department of Ocean Development/Ministry of Earth Sciences, Naval Research Board, Department of Information Technology, etc.. The Symposium on Ocean Electronics is a biennial event, started in 1991 to mark the occasion of the formal opening of the Centre for Ocean Electronics in the Department of Electronics of Cochin University. SYMPOL 2009 is the tenth symposium of this series and was organized as an International Venture. This Symposium is intended to provide a forum for the Scientists / Engineers working in this field to assemble and interact with each other and present their innovative ideas and research findings.

Background of SYMPOL

The tenth Symposium on Ocean Electronics (SYMPOL-2009) was organized as an International Conference addressing the Global Oceans, Systems and Technologies during 18–20 November, 2009 in The Hotel International, Cochin. The first Symposium of this series (SYMPOL-91) was organized during 18–20 December 1991, to mark the occasion of the formal opening of the Center for Ocean Electronics established in the Department of Electronics of the Cochin University of Science And Technology as a joint venture of the Ministry of Human Resource Development (Government of India) and the University Grants Commission (UGC), New Delhi. A Technical Panel of SYMPOL-91 suggested that the Symposium on Ocean Electronics should be organized periodically, at least once in two years. In line with this recommendation, SYMPOL is being organized as a biennial event. The Technical Panel of SYMPOL-2005 organized during 15–16 December, 2005 suggested that SYMPOL should be organized as an international venture and its international visibility should be enhanced by giving wider publicity and hence SYMPOL-2007 was organized as an international conference. The enthusiasm, cooperation and support extended by the IEEE-OES particularly by Dr. James S. Collins led to the culmination of the technical cosponsoring of the SYMPOL-2009 by IEEE-OES.

Series of SYMPOLS

The Center for Ocean Electronics (CUCENTOL) of the Department of Electronics, Cochin University of Science and Technology has organized the following SYMPOLS

- National Symposium on Ocean Electronics (SYMPOL-91) during 18–20 December, 1991.
- National Symposium on Ocean Electronics (SYMPOL-93) during 15–17 December, 1993
- National Symposium on Ocean Electronics (SYMPOL-95) during 18–20 December, 1995
- National Symposium on Ocean Electronics (SYMPOL-97) during 16–17 December, 1997
- National Symposium on Ocean Electronics (SYMPOL-99) during 16–17 December, 1999
- National Symposium on Ocean Electronics (SYMPOL-2001) during 18–19 December, 2001
- National Symposium on Ocean Electronics (SYMPOL-2003) during 16–17 December, 2003
- National Symposium on Ocean Electronics (SYMPOL-2005) during 15–16 December, 2005
- International Symposium on Ocean Electronics (SYMPOL-2007) during 11–14 Dec., 2007
- International Symposium on Ocean Electronics (SYMPOL-2009) during 18–20 Nov., 2009

Publicity Support for SYMPOL By OES

SYMPOL has received boundless support and cooperation from many enthusiastic groups of professionals and professional bodies across the globe. The enthusiasm, cooperation and support extended by the IEEE-OES particularly by Dr. James S. Collins, resulted in getting a wider publicity for SYMPOL, as the SYMPOL-2005 and SYMPOL-2007 announcements were advertised in the OES Newsletters. This association the SYMPOL had with OES led to the technical cosponsoring of SYMPOL-2009 by IEEE-OES and the Acoustical Society of America (ASA).

OES Technical Cosponsorship for SYMPOL-2009

The SYMPOL-2009 has bagged the technical cosponsorship from IEEE-OES. To further enhance the international visibility and standard of the technical program of SYMPOL 2009, all the papers received were reviewed by a technical panel of reviewers identified by IEEE-OES. The technical panel consisted of Dr. James S. Collins (University of Victoria), Dr. Kenneth G. Foote (Woods Hole Oceanographic Institution), Dr. Tim Duda (Woods Hole Oceanographic Institution), Dr. George Frisk (Florida Atlantic University), Dr. Jim Candy (University of California), Dr. Ananya Sen Gupta (Woods Hole Oceanographic Institution) and Dr. Albert J. Williams III (Woods Hole Oceanographic Institution), who officiated as the chairman of the technical panel. Efforts are being made for publishing the papers presented in SYMPOL-2009 in the IEEE Xplore. Moreover to further strengthen the ties of technical cosponsorship of SYMPOL by IEEE-OES, OES has nominated

Dr. James S. Collins (Vice President- Professional Activities) and Dr. Albert J. Williams III (Vice President- Technical Activities) as their representatives in SYMPOL-2009.

Details of Venue and Participants

The venue of the International Symposium on Ocean Electronics (SYMPOL-2009) was The Hotel International, Cochin, located at the heart of the city. Tucked away strategically between the two main roads of Ernakulam (M.G. Road and Chittoor Road), the International Hotel has its obvious advantages. The mellowed old world charm, the soothing quiet and the all pervading nostalgia evoked by its decor are a welcome departure from the cliched and synthetic feel of many a star hotel. Precisely for this reason the International Hotel is rightly remembered as the transit lounge of the revisiting clientele.

Unlike many symposia/conferences organized by professional bodies/organizations, for SYMPOL, starting from its inception in 1991, CUSAT insists for the submission of full papers rather than extended abstracts. One of the unique features of the proceedings of SYMPOL is that all the papers accepted for SYMPOL used to be presented in the symposium. However, for SYMPOL-2009 one of the papers in the Research Session IV on Underwater Sensors and Applications entitled 'Single and Multibeam Echosounder Delineate Tsunami Wave Impacted Depressions off Chellanum, Kerala' could not be presented due to unforeseen situations, as the authors were held up in a one month cruise which got unduly delayed. The authors were very much apologetic in not having been able to present their paper in SYMPOL 2009.

The Delegates and Resource Persons of SYMPOL 2009 constituted a wider cross section representing the National Laboratories, Defense Research Laboratories, Universities, Indian Institute of Technologies, Indian Institute of Science, etc from India and University of Rhode Island, Naval Research Laboratory, University of Victoria, Woods Hole Oceanographic Institution, etc. from the United States as well as ONR Global, Japan, etc..

The Inaugural Function

The International Symposium on Ocean Electronics (SYMPOL-2009) was inaugurated by Dr. M.A. Atmanand, Director National Institute of Ocean Technology, Chennai at 10.00 am



National Institute of Ocean Technology Director M. A. Atmanand inaugurating the the International Symposium on Ocean Electronics (SYMPOL 2009). K. Vasudevan, James S. Collins, Godfrey Louis, S. Anantha Narayan, P. R. S. Pillai and Supriya M. H. are also seen.

on 18th November, 2009 in a function presided over by Dr. Godfrey Louis, Pro-Vice-Chancellor, Cochin University of Science and Technology. Delivering the inaugural address, Dr. Atmanand stressed the importance of promoting Ocean Research for the well being of the humanity. He also stressed the importance of Global Warming quoting the statement made by the UN Secretary-General, Ban Ki-moon, "Human-induced global warming poses as much danger as war". The Secretary General also urged the United States to take the lead in the fight against global warming. Dr. Atmanand also indicated the importance of ocean observation system, ocean energy and renewable energies during his inaugural address.

Technical Program

The technical program of SYMPOL-2009 commenced with a keynote address on Exploring the Ocean: Challenges and Emerging Trends by Dr. M.A Atmanand, Director National Institute of Ocean Technology, Chennai. Delivering the keynote address, he enumerated the various challenges faced by the ocean scientists, while attempting to validate the various ground truths at different locations. He also indicated the various opportunities for the enthusiastic Ocean Researchers. He gave a vivid account of various inertial navigation systems for underwater exploration applications as well as various techniques for measuring wave, tide and currents. He further elucidated the use of floating stations which can go down



M. A. Atmanand, Director, NIOT, Chennai, delivering the keynote address in SYMPOL 2009.



S. Anantha Narayanan, Director, NPOL, Kochi.



V. Chander, President, Ocean Society of India.



G. V. Anand, Indian Institute of Science, Bangalore.



D. D. Ebenezer, NPOL, Kochi.



Bishwajit Chakraborty, NIO, Goa.



Albert J. Williams III, WHOI, USA.



James S. Collins, University of Victoria, Canada.

underwater, gather the oceanographic data and come up to the surface and transmit the data collected to the earth station through the ARGO satellite. He also indicated that NIOT is actively working on a project to develop manned submersibles to study the ocean floor.

The following state-of-the-art invited talks on emerging topics in Ocean Electronics were delivered by eminent working engineers/scientists:

- Challenges in Dunking Sonar System Design by Shri S. Anantha Narayanan, Director Naval Physical & Oceanographic Laboratory, Cochin.
- Underwater Scramble by Shri V. Chander, Former Director NPOL, Cochin and President, Ocean Society of India.
- Sonar Projectors by Dr. D. D. Ebenezer, Naval Physical & Oceanographic Laboratory, Cochin
- Acoustic Vector Sensor Array Processing by Prof. G. V. Anand, Indian Institute of Science, Bangalore.

- Current, Wave and Turbulence Measurements in Coastal Waters and the Deep Sea by Dr. Albert J. Williams III, Woods Hole Oceanographic Institution, USA.
- Seafloor Classification using High Frequency Sonar: An Appraisal of the Activities carried out in Indian Ocean Region by Dr. Bishwajit Chakraborty, National Institute of Oceanography, Goa.
- Development of Underwater Measuring Systems: Challenges by Dr. V.G. Idichandy, Department of Ocean Engineering, Indian Institute of Technology, Chennai.
- The Olympics, the IEEE and the Development of Oceanic Engineering by Dr. James S. Collins, University of Victoria, Canada.

Apart from these, original research papers in the areas such as Navigational Aids and Instrumentation, Ocean Acoustics, Signal Processing & Underwater Sensors and Applications were also presented by working engineers/scientists from



V. G. Idichandy, Indian Institute of Technology, Chennai.

various Laboratories, Institutions, Universities, etc. from India and abroad in this symposium.

Recommendations of the Technical Panel of SYMPOL 2009

The organizers of SYMPOL 2009 have convened a panel discussion on 19th November 2009. The panelists comprised of the Session Chairpersons, Invited Speakers and the representatives from OES, ONR and Government Agencies/Departments. While welcoming the panelists for the meeting, Dr. P.R.S Pillai, Chairman, SYMPOL-2009 presented a brief agenda for the meeting and requested Dr. D. Sreenivasan to conduct the Proceedings of the panel meeting. After an elaborate, critical, in depth deliberations and discussions, the Chairman of the technical panel, Dr. Sreenivasan consolidated the recommendations of the panel as follows.

- The quality of the papers presented and published in the Proceedings of SYMPOL-2009 were better than those in the earlier SYMPOLs.
- He expressed the gratitude and acknowledgements of the technical panel of SYMPOL-2009 to the IEEE-OES and Acoustical Society of America for their technical cosponsorship and also to IEEE-OES for rendering all sorts of technical support for conducting the expert review of the papers of SYMPOL-2009.
- He also opined that the two level review process of the technical papers of the SYMPOL-2009 and the fact that all the papers presented in SYMPOL-2009 will be published in the IEEE Xplore as well should have been widely publicized.
- He suggested that industrial participation in SYMPOL should be encouraged to the extent possible. He also indicated that the seismic division of ONGC (Oil and Natural Gas Commission) should be specifically invited for the next SYMPOL. Efforts should also be made for encouraging the participation from Indian Navy, Port Trusts, Shipyard, Center for Earth Science Studies (CESS), etc..
- Regarding the issue of shifting the venue of the next SYMPOL to Goa, Dr. P.R.S. Pillai expressed his deep concerns in managing the SYMPOL, if it is organized in Goa. He also emphasized the fact that the eleventh SYMPOL (SYMPOL-2011) has already been announced with Cochin as the venue. On the light of these, Dr. Sreenivasan suggested the organizers to examine the possibilities of shift-

ing the venue of one of the SYMPOLs to other places as suggested by the representatives of IEEE-OES and Acoustical Society of America.

- He also suggested that in line with the opinions expressed by most of the panelists, SYMPOL-2011 should have a pre-conference tutorial and a student poster session.
- He further opined, on the light of the deliberations, that for SYMPOL-2011 we should stick on to the usual practice of inviting full papers rather than extended abstracts, for conducting the two level review process.
- The announcement of SYMPOL-2011 scheduled to be held during 16–18 November, 2011 has been accepted, as it does not clash with either the OCEANS-2011 or the ASA meeting.
- In his concluding remarks, Dr. Sreenivasan indicated that SYMPOL-2009 has been organized in a better way and the hospitality arrangements were extremely good. He expressed his gratitude and sincere thanks to all the enthusiastic groups of CUSAT for making SYMPOL-2009 a grand success.

Best Paper Awards

The Organizing Committee of SYMPOL-2009 has instituted a Best Paper Award for the best paper presented and published in the Proceedings of SYMPOL-2009. All the papers presented and published in the Proceedings of SYMPOL-2009 were considered for the award by the Award Committee with Dr. Albert J. Williams III, as the Chairman. The Committee was unanimous in selecting the winner paper entitled, Characteristics of Broadband Underwater Transducers Integrated with Tuning Coils and Cables co-authored by R. Ramesh, Sreejith S. Pillai, Pushpa Abraham and D. D. Ebenezer from the Naval



Dr. D. D. Ebenezer receiving the Best Paper Award for SYMPOL 2009 from Dr. Godfrey Louis, Pro-Vice-Chancellor, CUSAT, during the award presentation ceremony held on 31st December 2009.



Dr. R. Ramesh receiving the Best Paper Award for SYMPOL 2009 from Dr. Godfrey Louis, Pro-Vice-Chancellor, CUSAT, during the award presentation ceremony held on 31st December 2009.



Sreejith S. Pillai receiving the Best Paper Award for SYMPOL 2009 from Dr. Godfrey Louis, Pro-Vice-Chancellor, CUSAT, during the award presentation ceremony held on 31st December 2009.



Pushpa Abraham receiving the Best Paper Award for SYMPOL 2009 from Dr. Godfrey Louis, Pro-Vice-Chancellor, CUSAT, during the award presentation ceremony held on 31st December 2009.

Physical & Oceanographic Laboratory, Cochin. The best paper was formally announced by the Chairman of the Award Committee during the valedictory function of SYMPOL-2009 held at 4.00 p.m. on 20th November, 2009. The Best Paper Award, consisting of a Citation, Plaque and Certificate for each of the four co-authors have been presented to the winners on 31st December, 2009 in a function presided over by Dr. Godfrey Louis, Pro-Vice-Chancellor, Cochin University of Science and Technology. Photographs from the Best Paper Award presentation ceremony are shown below.

Sponsorship

SYMPOL-2009 had the technical/financial cosponsorship from the following Government Agencies/Departments and Professional Bodies.

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

Cultural Evening

To provide a glimpse of the social, cultural and traditional art forms of the State of Kerala, a Cultural Program was organized on the 18th evening. The traditional art forms such as Thiru-



Thiruvathirakali is an extremely popular folk dance performed by the maidens of Kerala.



Panchavadyam is basically a temple art form evolved in Kerala.



Kalaripayattu is a Dravidian martial art from Kerala.

vathirakali, Kalaripayattu and Panchavadyam were presented to the distinguished invited guests and delegates of SYMPOL-2009. Some of the photographs of these traditional art forms presented to the SYMPOL delegates are shown below.

Announcement of SYMPOL-2011

The eleventh biennial Symposium on Ocean Electronics (SYMPOL-2011) is scheduled to be held in Cochin during 16-18 November, 2011. The website of SYMPOL-2011 will be uploaded in a couple of months.

Conclusion

The salient highlights of the Proceedings of the International Symposium on Ocean Electronics (SYMPOL-2009) have been presented in this Activity Report. The SYMPOL Organizers are very keen in sustaining the technical collaboration the SYMPOL has had with the IEEE-OES as well as the Acoustical Society of America. The Organizing Committee of SYMPOL is exploring the possibility of incorporating special sessions on selected areas for SYMPOL-2011.



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- Advances in Understanding of the Southern Ocean
- Advances in Exploration and Recovery for the Offshore Oil & Gas Industry
- Advances in Understanding of the Impact of Climate Change on the Oceans
- Advances in Understanding of Marine Environments in the Western Pacific

General OCEANS Topics

- Underwater acoustics and acoustical oceanography
- Sonar signal / image processing and communication
- Ocean observing platforms, systems, and instrumentation
- Remote sensing
- Ocean data visualisation, modelling, and information management
- Marine environment, oceanography, and meteorology
- Optics, imaging, vision, and EM systems
- Marine law, policy, management, and education
- Offshore structures and technology
- Ocean vehicles and floating structures

Critical Dates

Abstract submission opens	15 November 2009
Abstract submission closes	15 January 2010
Notification to authors	21 February 2010
Final paper submission	21 March 2010

For further information about conference topics, abstract submission, exhibition and registration, please visit our website

www.oceans10ieeesydney.org

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