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OES

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# From the President

***17 August 2011***

Congratulations to our newly elected six ADCOM members for 2012–2014 – Ross Chapman, Ferial El-Hawary, Kenneth G. Foote, William J. Kirkwood, Tamaki Ura, Joseph R. Vadus. We appreciate the interest of the four other OES members who were not elected. Our Society ADCOM elections are very competitive and we are pleased with the interest our members have in serving on the ADCOM.

OCEANS '11 IEEE, Santander Spain, was very successful, with an excellent student program. Our thanks to the LOC for all their hard work and we really enjoyed the Conference. If you have not been to Santander, I highly recommend a visit to a very beautiful area with very friendly people.

OCEANS '11 MTS/IEEE KONA will have an excellent technical program, having received a large number of abstracts with programs for teachers/students and registration is very high. Kona seems to be a very popular location. There will be a special track for the papers that were to be presented at our Underwater Technology Symposium that had to be canceled in Japan in April. The Technical Committee is to be congratulated for accommodating the UT papers. If you have not registered, do not miss out on this Conference.

This year has been very busy for us and we will soon be participating in the new Offshore Technology Conference in Brazil in October and will be a Technical Co-Sponsor for SYMPOL in India in November as part of our expansion into that area. We expect 2012 to be as busy with many opportunities for our members to volunteer. We are constantly striving to improve our Conferences and our products. We recently had an Off Site at Woods Hole to update the OCEANS Manual and to discuss ways to improve our Conferences.

Our JOURNAL OF OCEANIC ENGINEERING continues to be a high quality publication under the guidance of our Editor-in-Chief Bill Carey and we have launched a new OES Web Site which you should visit.

I have attached an OES Status Report to our ADCOM that summarizes our activities.

**Jerry Carroll**
**OES President**

# OES Status

***15 June 2011***


"OES is a relatively small society with only 1600 members but is very active for its size. In contrast to most societies, its membership has been gradually increasing over the last several years, with commendable global presence. The society is well managed with an ADCOM comprising a diversity of volunteers (affiliation, region, etc.). The society regularly provides officers for the Councils it is a member of. OES has an active program of technical activities, successful conferences and publications, and is financially sound."

This is the summary report from the society review committee for OES in March 2010. We have received similar comments from the Division Directors during their visit and the VP for TAB. The question was raised about the success of having two OCEANS Conferences each year and the workload on the ADCOM.

Beginning this century OES recognized the need to become a global society that was truly international following a similar strategy of the IEEE. The OCEANS Conferences in Europe during the odd years and in the Asia region during the even years was developed to better serve our global membership. We have had very successful OCEANS Conferences in Brest, Singapore, Aberdeen, Kobe, Bremen, Sydney and this year in Santander. We have a full schedule of OCEANS conferences the rest of this decade and locations in line to hold the conferences. Our leadership that saw the need for the Society to represent all our members and to be a global organization are to be commended.

In addition to our OCEANS conferences we have an excellent publication in our Journal and our conferences are known for their technical content. Our CMTC Workshop, AUV Workshop, Baltic Symposiums and South American Symposiums all are very successful. Our OES members make a very significant contribution to the OTC Conferences and the Human Powered Submarine races this June are organized by our OES members.

Based on the interest in Global Warming and the OCEANS, OES is an important part of the IEEE. The proposed new IEEE Membership model will include one Society membership and we expect to see an increase in our membership.

I consider our volunteers the most important part of OES. Our members are our volunteers and our volunteers are our members. We owe our volunteers a lot and do our best to recognize them.

I will be working with the Vice Presidents to better distribute the workload among our elected ADCOM in future months. We expect our ADCOM members to attend our ADCOM meetings and to make a significant contribution to the operation of the society.

**Jerry Carroll**
**OES President**

# Welcome New and Reinstated Members

| | | | |
|---|---|---|---|
| Nuno Abreu | Portugal | Eric Bayler | USA |
| Daniel Agbada-Olise | Nigeria | Robert Benton | USA |
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# Senior Members

The following OES members were recently elevated to the grade of Senior Member.

Frederick Chen
Brett J. Harker
Xiaofeng Li

The grade of Senior Member is the highest grade for which application may be made and requires experience reflecting professional maturity. For admission or transfer to the grade of Senior Member, a candidate must be an engineer, scientist, educator, technical executive, or originator in IEEE-designated fields for a total of 10 years and have demonstrated 5 years of significant performance.

To learn more about senior membership and how to apply, visit www.ieee.org/seniormember.

# Memorable Anecdotes and Personalities

### *Sandy Williams, OES Vice President for Technical Activities*

*[Editor's Note: This is a great article that is both interesting and informative. I think there may be many such articles that could be written about the people we have worked with over the years and I think there is value in sharing it, beyond the general interest because we can learn from their examples. I would like to share other stories like this one. Please send them to me at newsletter@oceanicengineering.org.]*

## Personal Anecdotes from My Acquaintance with Neil Brown

During my first year at Woods Hole Oceanographic Institution, the boss, Doug Webb, informed us that a noted engineer, Neil Brown, was joining us to develop a new instrument to measure salinity, temperature, pressure, and thus density. Space was made on the lab benches and an office was cleared for Neil who arrived in fall 1969 and sat quietly in his office designing for about six months. Then he gave short chalk talks about the precise measurement of temperature, stability in conductivity cells, noise in pressure transducers, and the 16-bit ac digitizer he had invented using integral turns-ratios in transformers to achieve the precision and stability required for oceanographic measurements. Construction started on conductivity cells almost immediately with a diamond saw, pieces of ceramic tube, platinum ribbon, Kovar glass frit, Kovar wire, and a muffle furnace with tanks of oxygen, nitrogen, and hydrogen for construction of the cells. Meanwhile an electronics technician started laying out circuit boards in our standard 6" D-shaped pattern established by Dick Koehler, one of our PhD electrical engineers, for the Vector Averaging Current Meter. I watched these two developments with great interest, learning about digital electronics since I was a physicist, not an electrical engineer. The Mark I CTD or Micro Profiler was ready for early testing in 1971 and went to sea with Nick Fofonoff and Bob Millard where it began to produce data of great resolution both spatially and in properties. But there were issues with the conductivity cell. A cell that was OK initially stopped working when subjected to several deep deployments on the logging cable at sea. While Neil's initial plan had been to build all three sensors – conductivity, temperature, and pressure – from ceramic for greatest stability, the problems with construction had led him to choose a slower but precise platinum resistance thermometer and a stainless steel commercial pressure sensor. But there were no microstructure-size conductivity cells and Neil continued to refine his

design with frits, processing, and finally exhaustive testing in our pressure test vessel. Three conductivity cells at a time fit inside the pressure vessel so when a batch had been constructed, they were placed inside the pressure vessel and pressurized to 10,000 psi and the pressure released back to 0 psi 100 times and then they were removed and tested for electrical leakage. Over and over they failed and a new design was tried.

My own research started in 1972 when I realized that the new Micro Profiler was just what I needed. I started construction on the third CTD, the first two being for Nick Fofonoff to take to sea and for Neil Brown to test in the lab. All went well until it was time for the conductivity cell. Neil said with great confidence that while version number 56 had failed, the new design, number 57, was free of the flaws that had afflicted the previous 56 designs. I learned how to build cells in ceramic and frit and how to fuse the materials in the muffle furnace, and by the end of the month, I had constructed 10 cells of design number 57. While I was building CTD number 3, John Jain from Scripps was building CTD numbers 4, 5, and 6 and had shipped them to Scripps where Arnold Bainbridge was getting ready to take them to sea for the start of GEOSECS, an early multiinstitutional research program to characterize the physical oceanographic properties of the world oceans. John said that he was flying to California the next day so if I didn't mind, could I test the conductivity cells I had constructed, which I did. When all three cells passed the first 100 pressurizations test, we all shouted Eureka and John took the three for his CTDs, saying I would have seven more for my own uses. In fact, only one of the seven also passed the test but I did have what I needed. Neil, ever optimistic said he knew what was wrong and design number 58 would solve the problem once and for all.

Neil, ever optimistic had a playful side. One Sunday morning, Al Morton who did some of Neil's electronics work, came into the lab and saw Neil snoozing at his desk with the Sunday newspaper in his lap. Al rolled a cherry bomb under Neil's chair and when it went off, Neil and newspaper flew. Neil vowed he would get back at Al but first he needed to practice. So a few days later a package was delivered to Bill Geoff who had been doing electronics work for me. When the cardboard box was opened, a firecracker went off showering Bill with confetti and Bill was so shaken he had to take the rest of the day off. But Neil had more subtlety and placed a brass cylinder wrapped to look like a fire cracker with a fuse on the bench of Carl, another tech. Since it was obviously a fake, Carl picked it up but his laughter was interrupted by the explosion in his drawer when moving the brass cylinder allowed light to go down the hole that Neil had bored in the bench under the brass cylinder exposing a photocell that triggered the firecracker. Then there were buzz bombs attached to the ignition in cars and other explosive devices and everyone was getting jumpy but Neil never worked out the perfect retaliation for Al Morton and they remained great friends but without further explosions.

My wife and I sailed to Maine on our boat and invited Neil to come along to stand watch with us on the offshore part of the voyage. As we sailed past Provincetown the first morning, Neil awoke and went in for a swim, the wind being light, and we trailed a knotted rope to pull him back to the boat. Izzie asked how the water was and Neil with a straight face said it was wonderful so she dove in too. The water was absolutely frigid and Neil just chuckled.

The CTD became at its time in the 1970s, the instrument that probably made the most oceanographic measurements ever made to that date. It sampled at 30 Hz producing three 16-bit digital words and it was lowered through most of the world oceans, permitting long term fluctuations in temperature and density to be documented, since its precision matched that of the most careful hydrographic measurements. Neil had come to the conclusion that a digital CTD was possible because desktop computers had only then become available so the computations could be done in a shipboard lab. But the precision in the measurement had to be matched by standards used for the computations. The conversion of conductivity to salinity depended on the conductivity ratio between diluted samples of standard seawater. In a set of careful dilutions by Brown and Allentoft, this relation was defined, but as Neil told me, almost a year's work was lost when he discovered that cleaning the glassware between dilutions with chromic acid or cleaning solution, was a mistake. The chromium ions exchanged with the sodium in the glass and later came out to increase the conductivity of the water used in the dilution. But Neil was always optimistic and just said, "Oh my gosh!" and carried on.

When it became clear that Neil could not meet the demand for the CTD at WHOI, he formed Neil Brown Instrument Systems and NBIS manufactured CTDs, by then Mark III CTDs. He also added an acoustic travel-time current meter to the NBIS line. He became an important technical employer on Cape Cod, and WHOI and NBIS traded technicians and engineers back and forth. Neil had talent as a business man as well as an ocean engineer but he found running the business kept him from developing instrumentation, something that he loved best. Under a hired business manager coupled with an economic downturn, NBIS ceased to exist although Falmouth Scientific, a replacement company under management of one of Neil's senior engineers, Al Fougere, soon formed. Neil returned to WHOI where he began development of a new conductivity cell that flushed better and this design is presently being produced by a company Ray Schmitt and Bob Petitt formed: Neil Brown Ocean Sensors, Inc. I do not know which number design this is but it is a success and is perfectly suited to gliders and AUVs where flushing and spatial response length is important. Although Neil is no longer with us (Ray Schmitt and I participated with Neil's family in another deployment from our sailboat in Buzzards Bay as he instructed his daughters he wanted) his designs and his spirit of optimism were an inspiration to many of us, as was his sense of mischievous fun.

# OCEANS 2011 Santander

### *Photos by Stan Chamberlain*


Santander was the location for this year's European OCEANS conference, held June 6–9, 2011. Santander is the capital city of Cantabria, a northern province of Spain located along the Atlantic coast. Co-chaired by Dr. Iñigo J. Losada and Dr. Juan Pérez-Oria, Oceans'11 was an excellent opportunity to showcase the vision of Santander and Cantabria, their historical ties to the Sea and the firm belief that a sustainable socio-economic development can be achieved through the use of renewable marine energy, guaranteeing the preservation of our world for future generations as is perfectly reflected in the conference slogan "Oceans of Energy for a Sustainable Future".

*The views overlooking Santander Bay were panoramic and inviting.*

The conference venue was the Santander Exhibition Center, a modern, well-equipped location conveniently located near hotels and restaurants as well as beaches, museums, and other areas of interest to conference attendees. The welcome reception was held at the Magdalena Palace, a structure built in 1912 by the local government of Santander as a seasonal residence for the royal family of Spain. It now serves as a conference and meeting hall and for special functions, such as the welcome reception. The mayor welcomed the conference to Santander on behalf of the city and emphasized the importance of the technology presented at the conference.

*Magdalena Palace provided a grand location for the welcome reception. The classic architecture and detailed craftsmanship were both beautiful and awe inspiring.*

*Harold Riisnaes and Trond Stromme.*

*Edoardo Bovio and John Potter.*

*Robin Newman and Sarah Watt.*

## Plenary Session

On Tuesday morning, the plenary session was held in the auditorium. After welcoming remarks from the conference co-chairs, two key-note speeches were delivered by special guests. First, Dr. Edoardo Bovio, the acting chief scientist at the NATO

*Dr. Edoardo Bovio addresses the plenary session.*



*Dr. Luis Valdés Santurio delivers his key-note address.*

Undersea Research Center (NURC) addressed the conference on the topic of "Autonomous persistent surveillance of the ocean for military and civilian applications." Next, Dr. Luis Valdés Santurio, Head of Ocean Sciences at the Intergovernmental Oceanographic Commission of UNESCO, addressed the conference on the topic of "Oceans in Focus: Science and Governance for Global Sustainability."

## Technical Program

Beginning on Tuesday afternoon the technical sessions that form the heart of the OCEANS conferences were held with papers being presented on a wide variety of relevant topics such as:

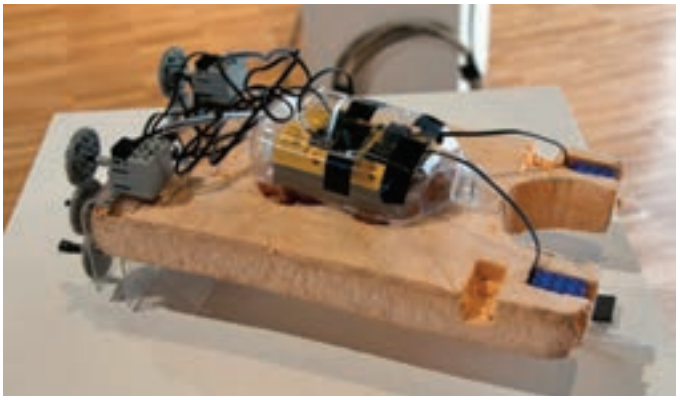
- Marine Renewable Energy
- Automatic Control
- Climate Change
- Sonar and Transducers
- Vehicle Design
- Sonar Signal Processing
- Pollution Monitoring and Oil Spills
- Offshore Structures
- Sound Propagation and Scattering
- Array Signal Processing, Array Design, and Vector Sensor Processing
- Buoy Technology and Cables and Connectors
- Hydrography
- Underwater Acoustics and Acoustical Oceanography
- Vehicle Performance
- Model-Based Signal Processing Techniques
- Ocean Dynamics: Wind, Surge, and Sea Level
- Ocean Data, Modeling, and Information Management
- Optics, Imaging, Vision and E-M Systems
- Vehicle Navigation
- Sonar Imaging, Synthetic Aperture, Classification and Pattern Recognition
- Coastal Hydrodynamics
- Coastal Engineering and Estuarine Systems
- Optical Sensors, Marine Optics Technology and Instrumentation
- Acoustic Telemetry and Communication
- Sonar Imaging, Synthetic Aperture, Classification and Pattern Recognition
- European Projects on Underwater Networks
- Oceanography: Physical, Chemical and Biological
- 3D Imaging and Holography
- Autonomous Underwater Vehicles
- Marine Law, Management and Safety
- Oceanographic Instrumentation, Sensors and Current Measurement Technology
- Marine Communications and Technology
- Coastal Radars and Passive Observing Sensors
- Systems and Observatories
- Airborne and Satellite Radar, SAR and Space Systems

## Junior Workshop

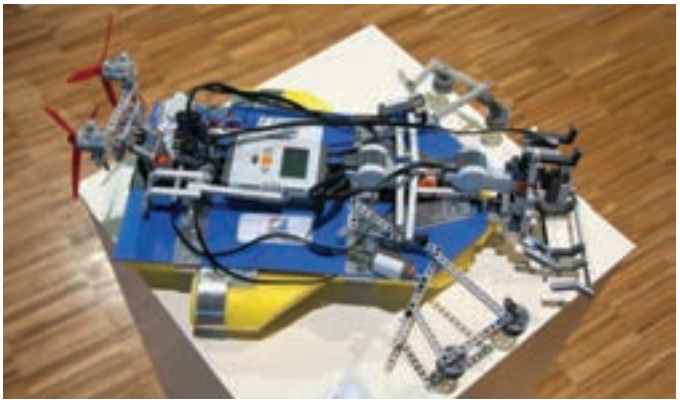
A workshop and competition in the design of autonomous devices was held the week before the Conference. Twelve

*Junior workshop participants.*


*Team Nautilus won first place with this robot.*



*Second place entry.*



*Third place entry.*

students from high schools in the towns of San Vicente de la Barquera and Colindres attended this workshop, forming three teams. Each team constructed a boat from LEGO sets that were IR controlled from a laptop computer. Two competitions were held, a race and a mock rescue on May 27th in Santander at the CEAR (Specialized Centre of High Performance) for sailing (RFEV, Royal Spanish Sailing Federation). In a small water storage pond each team completed a mission rescuing a boat with a personalized and programmed autonomous device.

Two retired professionals from shipyards showed the students how to build a small submarine (later displayed in the Conference venue at the Junior Workshop corner). The students learned principles of Archimedean forces and dynamic propulsion (they even showed how to build handmade propellers).

Then the group paid a visit to the nearby Naval installation and enjoyed looking at the facilities, especially all the submarines and ROVs. The workshop ended with a nice picnic on site for the students, tutors and parents.

There was wide media coverage, including newspapers and regional TV, specifically for the workshop. Awards for the best performances and originality of works were presented at the Conference and the boats built by the teams were displayed in the exhibit area.

## Exhibits

Exhibits were on display from several international vendors, research institutes, and technical societies. This area was also used for coffee breaks and an exhibitors reception. Lunches were served in the adjacent area of the exhibit hall. The exhibit hall provided an excellent venue for technical exchanges, professional networking, and forming new friendships.




## Organizing Committee

The conference was only possible because of the hard work and dedication of the local organizing committee. Many thanks are due to the following team of professionals:

| | |
|---|---|
| General Co-Chairs: | Iñigo J. Losada Rodriguez |
| | Juan Pérez-Oria |
| Assistant Chair: | Francisco J. Velasco |
| Finance Chair: | Pedro Diax Simal |
| Technical Program | Fernando Méndez |
| Chairs: | José R. Llata |
| Exhibit Chair: | José M. Zamanillo |
| Publicity Chair: | Carlos Pérez-Labajos |
| Arrangement Chair: | Laura Bravo |
| Tutorials Chair: | Alicia Lavin |
| Student Posters Chair: | José L. Arteche García |



*The local organizing committee for the conference*

## Gala Dinner

On Wednesday evening the conference gathered at the Gran Casino Sardinero for the Gala Dinner. The casino provided an elegant venue for a relaxing evening with a delicious dinner and conversation with friends. After dinner the General Co-chairs delivered their greetings and José Arteche, the Student Posters Chair, presented awards to the winning students.

*OES President Jerry Carroll presents a plaque of appreciation for an outstanding conference to Iñigo Losada and Juan Pérez-Oria who accepted it on behalf of the local organizing committee at the Gala Dinner.*

# Student Poster Contest

***Norman D. Miller, OES Student Activities Coordinator***

The 28th Student Poster Program of the OCEANS Conferences was held at OCEANS2011SANTANDER Spain June 6–9, 2011. Once again the program was technically very interesting and well appreciated by the student participants as well as those attending the Conference. The Student Poster Program was organized by Dr. Jose Luis Arteche, Senior Scientist, Spanish Meteorological Agency. He was assisted by Dr. Christophe Sintes, Telecom-Bretagne, France.

The program was supported by funding from ONR Global which enabled the students to attend the conference. The Conference provided the Student Participants with full registration for all events. Forty student poster abstracts were received and twenty students were invited to participate. Ten abstracts were received from the United States, ten from Asian countries, and twenty from European countries. Unfortunately only fourteen students were able to attend and present their posters.

The students were assembled on Monday afternoon for instructions and each of them introduced themselves and made a short presentation on the goals of their research and the background


*Dr. Christophe Sintes and Dr. Jose Luis Arteche coordinated the student poster competition.*

*The posters were displayed in a section of the Exhibition Hall and received a lot of attention during the breaks and at lunch time when the students were at their posters.*

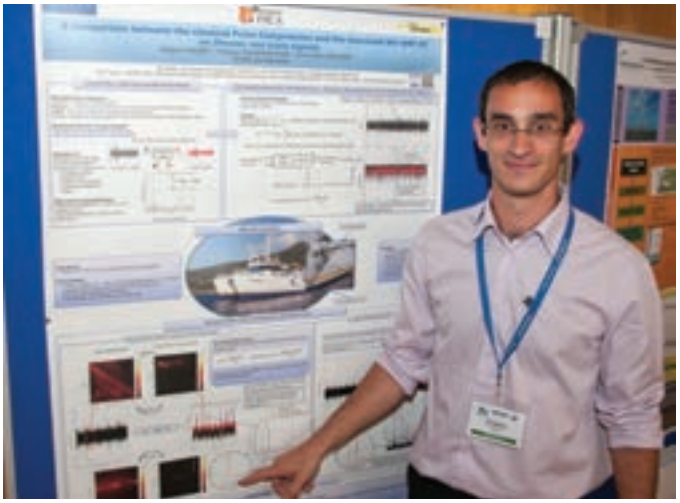
of their poster. Then before the ice breaker a short aperitif was organized for all the students to meet and mingle as a group throughout the conference. The posters were judged by a team of six judges who were very busy during the event. At the Gala Dinner all of the Student Poster participants were introduced. After a short introduction by Pr. Rene' Garello of Telecom Bretagne, the awards were announced. The awards were presented to the students by Dr. Ellen S. Livingston, Associate Director, Ocean and Underseas Science, U.S. Office of Naval Research Global, Dr. Jose Luis Arteche, Chair of the Student Poster Competition and Dr. Christophe Sintes. The winning students were:

**First Place:** Sarab Tay
**Second Place:** Isabel Caballero and Gregory Julien
**Third Place:** Yanira Guanache, Hector Fabian Guarnizo Mendez, and Frederico Traverso

Following the awards presentations the audience was asked to give the students a round of applause. The students were announced as members of the "OCEANS Student Poster Alumni Association" The audience was also invited to visit the posters and review the great work by all of the students. The students were all invited to receive a membership in the IEEE/OES.

The abstracts of the poster papers are reprinted below for each student. The full paper of the first place winner is reprinted in this issue of the newsletter.

**Gregory Julien**, Ifremer (French Research Institute for Exploration of the Sea)—*A Comparison Between the Classical Pulse Compression and the Improved WV-SMF-PC Ifremer Sea Trials Signals*



After studies in physics and electronics, Mr. Julien obtained his Master's degree in signal processing and trajectory determination. His Master's training course dealt with a blind source separation problem applied to the cancelation of reflections on photography. For the last two years, he has been a PhD student at Ifremer; his work, in collaboration with the IM2NP laboratory from the French National Center for Scientific Research, concerns the development of a new underwater acoustic positioning system based on an improvement of the pulse compression scheme using the Stochastic Matched Filter coupled to Time-Frequency techniques.

Abstract—In several domains of engineering technologies, such as telecommunications, sonar imaging, positioning systems, radar, medical imaging, the main problem is to identify a transmitted useful pulse in a noise-corrupted received signal. A solution to this problem consists in using a modulated pulse for emission and a matched filter for reception. Such a concept is known as pulse compression. Taking into account the main assumptions of the matched filter theory, a new algorithm has been proposed: the Wigner Ville - Stochastic Matched Filter - Pulse Compression (WV-SMF-PC). This one considers the random nature of the signal and the coloration of the noise, and is based on the jointly used of Time Frequency techniques and a stochastic extension of the Matched Filter notion: the Stochastic Matched Filter. However, some new sea trials have pointed out two main problems linked on the one hand, to the noise power estimation and on the other hand, to the real time compatibility. In this article, we propose and discuss a solution to these two problems exploiting information given by the time frequency domain and we propose a complementary technique to reach real time. Finally, some results obtained from real data are given.

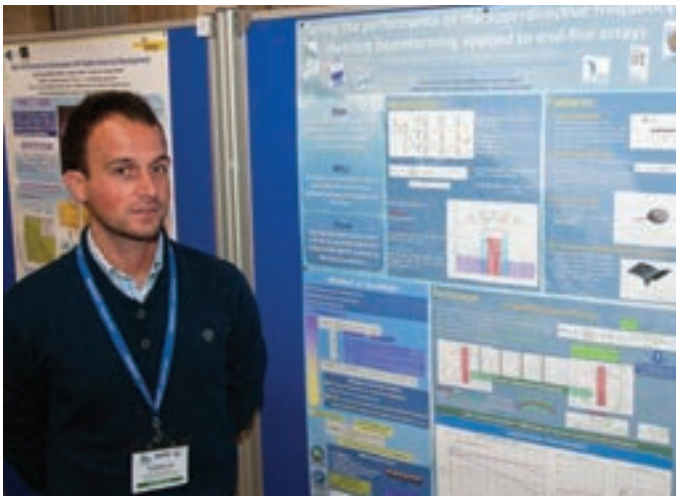
**Hector Fabian Guarnizo Mendez**, Telecom-Bretagne (France)—*High Performance Underwater UHF Radio Antenna Development*

Hector was born in 1975 in Ortega, Columbia. He obtained an undergraduate degree in electrical engineering from the "Universidad Nacional de Colombia" (National University of Colombia), in 2004, and in 2010 he earned a Masters degrees in engineering, electronics and computers from the university Los Andes, also in Colombia. He is currently enrolled in a Ph.D. program at Telecom-Bretagne in Brest (France). His current research is focused on underwater wireless communication.

Abstract—In the context of future scientific oceanic observatories, this work concerns the development of a UHF radio antenna compatible with deep underwater transmissions. It aims to allow rapid transmission of large size files and real-time video. The solution under development is based on a radiating excitation isolated from the sea water by a buffer. The system presents several advantages: lack of sensitivity to sea water variability, robustness to axial rotation and to alignment

between emitter and receiver, and ease of integration into classic underwater equipment. First measurements on a simple prototype present a bandwidth of 70 MHz around 2.4 GHz, appropriate for Wi-Fi communications.

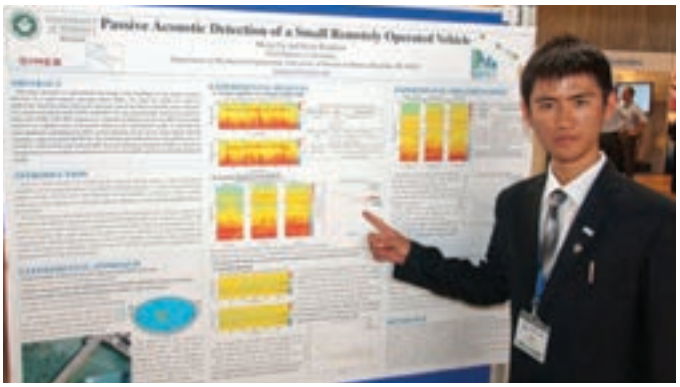
**Federico Traverso**, Department Of Biophisical And Electronic Engineering, University Of Genoa (Italy)—*Tuning the Performance of the Superdirective Frequency-Invariant Beamforming Applied To End-Fire Arrays*



Frederico was born in Genoa, Italy, in 1982. He received the Laurea degree (M .Sc) in Telecommunications Engineering from the University of Genoa, Italy (2007). He was employed by Saipem UK-ENI Group as a Subsea Control and Instrumentation Engineer (2007–2008), working on 3-D virtual reality system for real time operations and simulation. He is currently working toward the Dottorato di Ricerca degree (Ph.D.) in the course of Electronic Engineering and Computer Science at the Department of Biophysical and Electronic Engineering (DIBE) of the University of Genoa. He is involved in research activities with the Acoustic, Antennas Arrays, and Underwater Signals (A3US) Laboratory of the Signal Processing and Telecommunications (SP&T) Group at DIBE. His main research interests include array signal processing for advanced hearing aids and sonar system, underwater acoustic communications and underwater acoustic channel simulation

Abstract—In this paper, starting from a frequency-invariant filter-and-sum beamformer, we propose and assess a technique to tune the trade-off between the directivity and the robustness of the related beam pattern, without the need to modify the designed FIR filters. Our technique can be seen as a post-synthesis optimization that allows to choose a given system performance, after the investigation of a wide space of realistic possibilities. It can be applied only to end-fire array and will be referred to as oversteering. The idea is to steer the beam pattern past end-fire (i.e., to steer the beam pattern outside the visible region) in order to tune the beamformer performance without actually changing the main response axis of the array, which remains pointed to end-fire. The oversteering is obtained just by applying opportune delays to the signals received by the array transducers, and for each steering direction past end-fire a different balance between directivity and robustness occurs. By analyzing the results of the proposed technique it is possible to evaluate the effectiveness in producing frequency-invariant beam patterns with an end-fire looking direction and a number of interesting trade-offs between directivity and robustness.

**Meng Cai**, University of Hawaii at Monoa (USA)—*Passive Acoustic Detection of a Small Remotely Operated Vehicle*

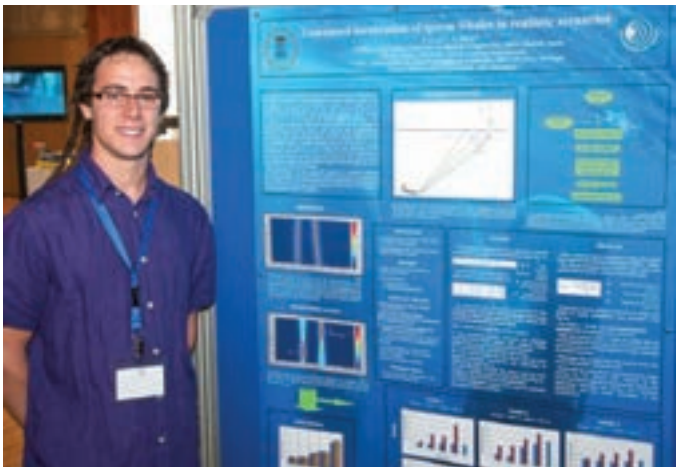


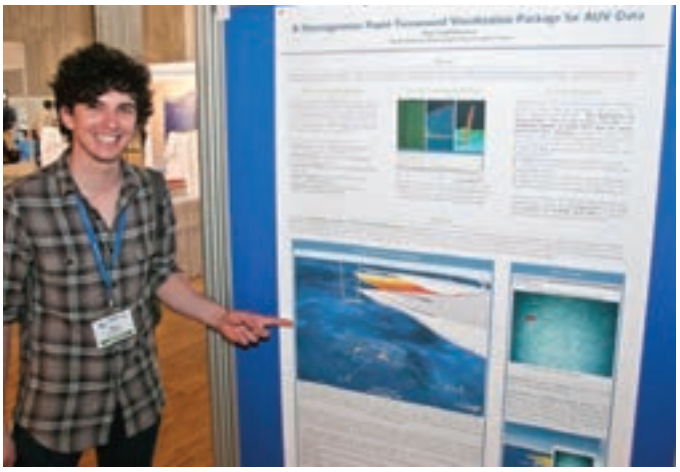
Meng Cai received his bachelor's degree in Electrical Engineering and Automation at China Jilang University, China, in 2009. He is currently a full-time student in a Masters program at the Department of Mechanical Engineering, University of Hawai'i at Mānoa, USA. He has been working as a Teaching Assistant and Research Assistant for Prof. Brian Bingham in the Field Robotics Laboratory. His research interest is acoustic detection, marine unmanned vehicles, dynamics and control systems. Meng is a student member of IEEE/OES, MTS, and IAENG and a graduate student affiliate in East-West Center. He has seven journal and conference publications as an author and a co-author on the stage of undergraduate and graduate studies. He will work as a summer intern at the Monterey Bay Aquarium Research Institute (MBARI). After summer session, he will graduate from Hawaii and pursue a Ph.D degree in the Department of Mechanical Engineering, University of California at Berkeley, USA, with major area in Ocean Engineering.

Abstract—This paper presents an experimental assessment of the feasibilities of the passive acoustic detection of a small remotely operated vehicle (ROV). We report the results of a series of underwater detection trials, both in the laboratory and in the field, to quantify passive detection of a commercial off-the-shelf (COTS) small ROV. We also measure the signal-to-noise ratio (SNR) of the ROV signature as a function of distance between the ROV and acoustic receivers in a shallow water environment. Based on the experimental results, we find that the most significant contributions for ROV acoustic detection are the electric motor signals with the frequency range of around 400–500 Hz. The maximum detectable distance with ambient noise at 116 dB re 1 uPa is 22 m away from the ROV in a noisy littoral environment. Finally, we present a comparison between predicted sound pressure levels of the ROV and the experimental measured results.

**Pablo Caro**, Universidad Politecnica De Madrid (Spain)—*Unmanned Localization of Sperm Whales in Realistic Scenarios*

In 2009/2010 Pablo developed his Bachelor thesis: *An acoustical detection and localization system for sperm whales*.





During 2011 he has been collaborating with the Signal Processing Laboratory, in the University of the Algarve (Portugal) in a project called "Unmanned localization of sperm whales in realistic scenarios". This project describes an autonomous localization system for the sperm whales, analyzing the advantages provided by the use of two hydrophone arrays and the beamforming technique in realistic scenarios with a real sperm whale click. Pablo has applied for admission to the Institute of Vibration Research, Southampton University, for the Engineering Acoustic program, one of the best ones in Europe. Pablo has shown a great interest on the acoustic field and he plans to work toward a Masters Degree in Engineering Acoustics.

Abstract—In this paper an unmanned sperm whale localization technique is presented. It focuses on the localization of sperm whales using a two-hydrophone array passive localization system. It is based on the beamforming technique and on the time delay between the direct and surface reflected wavefronts. The proposed method is based on that presented by E.K. Skarsoulis and it aims to develop a low computational complexity signal processing system which can operate autonomously in remote buoys with power and computational limitations. This study consists of the analysis of the improvements provided by using beamforming theory on the method proposed by Skarsoulis. The equipment used mainly consists of two hydrophone arrays deployed near the surface. It was found that the accuracy of this method depends on the array's location and can be improved by increasing the depth and the separation between the arrays and/or decreasing the angle formed by the line which crosses through the arrays with respect to the horizontal plane. The performance of the proposed method is evaluated through simulations using a real sperm whale signal in deep water, in presence of low and high SNR. The enhancements are proven in the extraction of the direct and surface-reflection arrival times as well as the arrival angle for each path under realistic conditions.

**Mark VanMiddlesworth**, Woods Hole Oceanographic Institution (USA)—*A Heterogeneous Rapid-Turnaround Visualization Package for AUV Data*

Mark grew up in Austin, Texas, and graduated from Harvard in 2011 with an A.B. in Computer Science. He will enter the MIT / Woods Hole Oceanographic Institution Joint Program in Applied Ocean Science and Engineering in the fall term of 2011. His research interests include autonomous vehicles, underwater acoustics, and multiagent systems.

Abstract—This paper presents a visualization package to address the growing quantity and diversity of AUV data, with an emphasis on rapid-turnaround scenarios such as dive planning. The package renders sensor data, photographs, and bathymetry from an AUV as a single scene in Google Earth. A Web-based photo viewer facilitates rapid browsing and annotation of photographs, and allows export to the Google Earth scene.

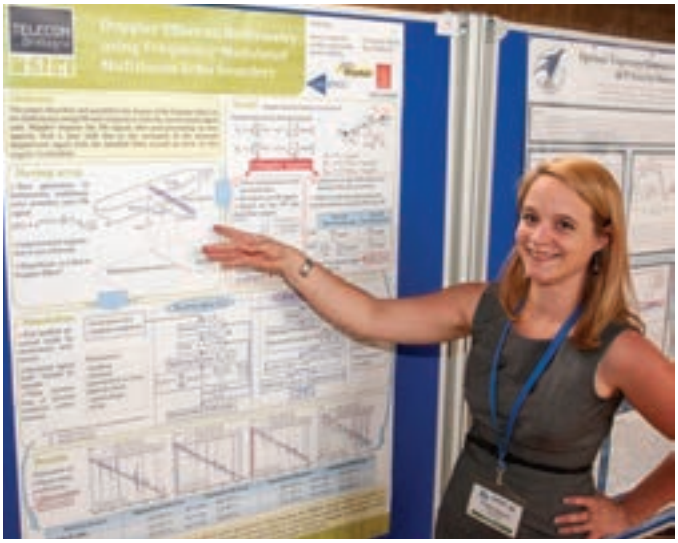
**Sarab Tay**, Telecom-Bretagne (France)—*Near Sea Surface Target tracking by Extended Kalman Filtering of the GPS Reflected Signals*


Sarab was born in Lebanon, in 1984. She received the Engineering degree in telecommunications and informatics from the Lebanese University, Faculty of Engineering, Beirut, Lebanon. She went on to earn a Master's degree in Signal Processing and Circuit Design from Telecom Bretagne, Brest, France in 2008. She is currently working towards her Ph.D. degree at Telecom Bretagne, with a special collaboration with ENSTA (Ecole Nationale Supérieure de Techniques Avancées) Bretagne, France. Her research interests include GNSS (Global Navigation

Satellite System) (GPS, Galileo…), signal processing, sea surface monitoring and remote sensing.

Abstract—This paper addresses the use of Global Navigation Satellite Systems (GNSS) as a remote sensing tool for oceanographic applications. In this paper we use the Global Positioning System (GPS) signals reflected off the sea surface along with a coastal receiver to perform detection and tracking of a near sea surface mobile target. Because these signals have a very low Signal to Noise Ratio (SNR) in a non stationary medium, a matched filter is required. A filter based on the Extended Kalman process is presented here.

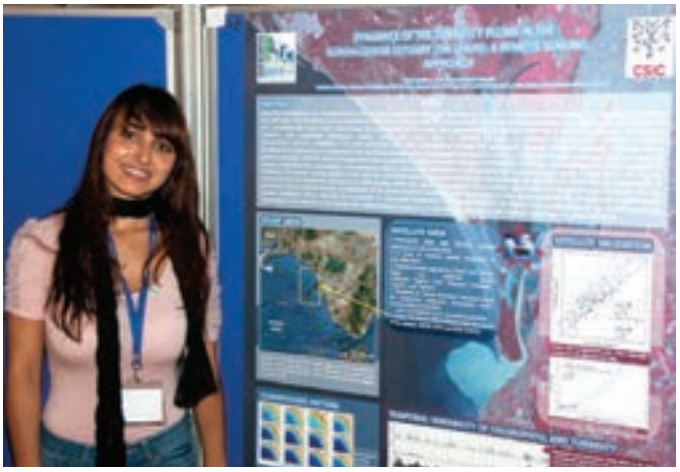
**Pauline Vincent**, Telecom-Bretagne (France)—*Doppler Effect on Bathymetry Using Frequency Modulated Multibeam Echo Sounders*



Pauline was born in Les Ulis (near Paris), France, in 1986. She graduated from Telecom Bretagne (Brest, France) with a Master's degree in Telecommunication engineering in 2009. Jointly, she obtained a "Master of Research" degree in signal and image processing from the University of Rennes I (France) with honors. She is currently specializing in Sonar signal processing; the field she has been working in as a Ph.D. student at Telecom Bretagne since 2010. Her research activities deal with modulated signals used in the latest bathymetric multibeam echo sounders.

Abstract—The latest generation of bathymetric multibeam echo sounders uses FM modulated signal with pulse compression in order to explore deeper seafloor while keeping a high resolution. Practically, the expected performances are not reached, and the first explanation made is this is due to the Doppler from the antenna motion which affects the FM signals processed with matched filtering. This paper describes and quantifies the impact of the Doppler effect on the bathymetry using FM and compares it with the narrow-band-signal case. Indeed, it is shown that Doppler impacts the FM signals after post-processing on two aspects: first a time shift due to the mismatch of the received dopplerized signal with the matched filter, second an error on the angular localisation.

**Isabel Caballero**, Andalusian Institute Of Marine Sciences (Spain)—*Dynamics of the Turbidity Plume in the Guadalquivir Estuary (SW Spain): A Remote Sensing Approach*

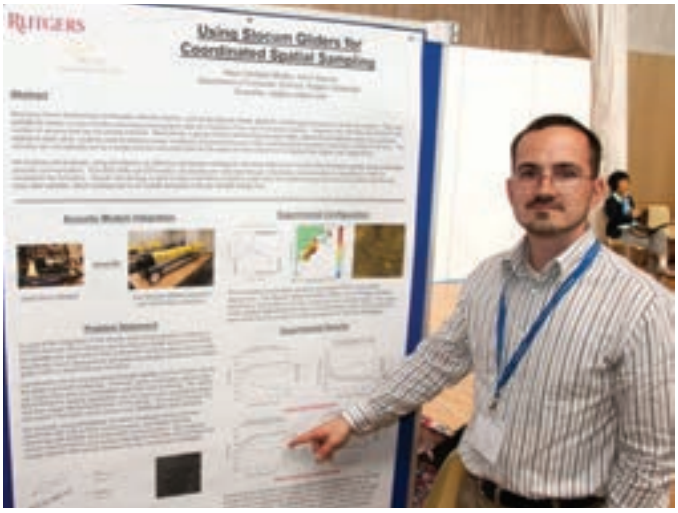


Isabel Caballero is a predoctoral Researcher in the Ecology and Coastal Management Group at the Andalusian Institute of Marine Sciences (ICMAN-CSIC) since September 2010. She received her BS in Marine Sciences from the University of Vigo, finishing her last year of studies performing the final project in the Geology Department at Aarhus University, Denmark. She earned a MS degree in Marine Engineering and Management in 2005 from the University of Santander-Cantabria (Spain) and also another Master of Science in Oceanography in 2007 from the University of Cadiz-Andalucía, Spain. She has worked in the department of Applied Physics at the University of Cadiz for the last 4 years (2006–2010) focused on coastal hydro-morphodynamics and oceanography. She is currently conducting her PhD in a cross disciplinary project that combines Engineering, Oceanography and Ecology & Environmental coastal processes over the Gulf of Cadiz region (SW Iberian Peninsula).

Abstract—Estuarine environments are characterized by very complex and varied morphodynamics and are one of the most critical coastal zones for the exchange of sediment and pollutants. The fertilization role of the continental shelf of the Gulf of Cadiz (SW Iberian Peninsula) in which the estuary of the Guadalquivir and other rivers play an influential role, is the major factor determining the productivity of the basin and is the main source of sediment for the adjacent coast. The work presented here was undertaken to analyze the spatial and temporal (seasonal-to-annual) variability of the turbidity plume in relation to the meteorological and oceanographic processes controlling the plume. To achieve this goal, we have processed Moderate Resolution Imaging Spectroradiometer (MODIS) level L2 images covering a period of 8 years (2003–2010). Validation of at-sensor retrieval against in situ data was performed and showed good correlation; this demonstrates the potential of satellite synoptic observations as a powerful tool for operational monitoring of water quality within the region. The first preliminary results confirm that the development of the estuarine plume is mostly associated with the increase in river discharge during the rainy seasons (negative North Atlantic Oscillation index), and

this, therefore, affects the seasonality of chlorophyll distribution. By the approach described here, turbidity patterns in the estuary have been successfully mapped; the incorporation of MODIS observations in the approach is recommended, since this should improve knowledge of both the physical oceanography and the marine biology aspects of the phenomenon studied. This approach has potential application to a wide variety of coastal research.

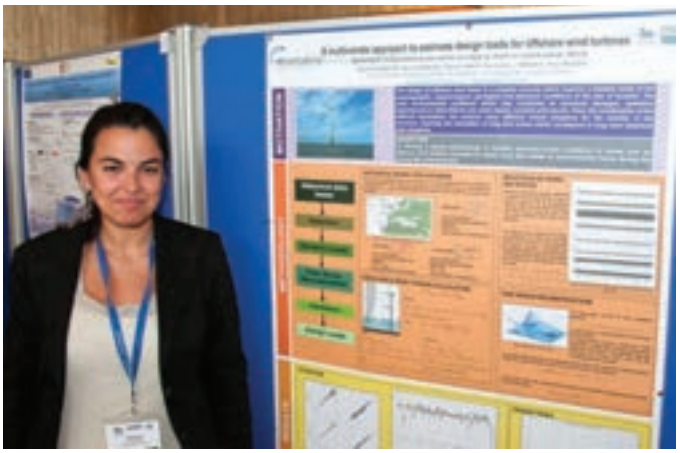
**Hans Christian Woithe**, Rutgers University (USA)—*Using Slocum Gliders for Coordinated Spatial Sampling*




Hans is a Ph.D. student at Rutgers University. He is currently funded by an NSF (National Science Foundation) award to investigate new hardware/software technologies to make autonomous underwater vehicles more effective research tools for marine scientists. In this poster paper "Using Slocum Gliders for Coordinated Spatial Sampling" he discusses different glider coordination schemes and their potential benefit and energy tradeoffs utilizing underwater and/or surface communication.

Abstract—Buoyancy driven Autonomous Underwater Vehicles (AUVs), such as the Slocum glider, allow for a prolonged presence to study the oceans. They can operate for weeks or even months recording oceanographic data for a fraction of the cost of research vessels. However, the vehicles are limited to the number of sensors that can be carried onboard. Alternatively, a group of AUVs performing formation flight, where AUVs maintain particular positions relative to each other, could be used to observe ocean conditions and phenomena at a high spatiotemporal resolution carrying a variety of sensors. The vehicles can conceptually act as a single science instrument that can be easier and less expensive to deploy than higher cost, large AUVs. In this paper we propose and evaluate, using simulations, an effective coordination strategy for formation flight which monitors the formation quality using underwater communication. If an AUV drifts out of formation, all vehicles are instructed through underwater communication to resurface in order to reestablish the formation. Overall, this strategy is able to keep a formation of gliders longer than the traditional approach and can gather significantly more data samples, which corresponds to an overall decrease in the per sample energy cost.

**Yanira Guanche**, Water And Environmental Sciences And Techniques Department. Cantabria University (Spain)—*A multivariate Approach to Estimate Design Loads for Offshore Wind Turbines*

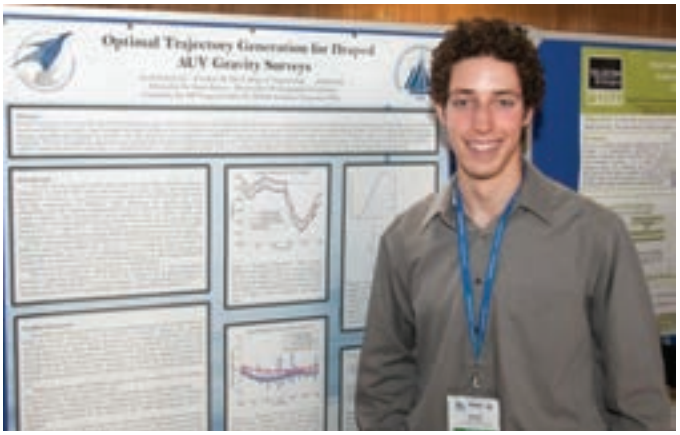


Yanira, born in 1984 in Los Realejos, Tenerife (Canary Islands), has a Civil Engineering Degree from the University of Cantabria, in Spain. She earned a Master's of Science degree from the Water and Environmental Sciences and Techniques Department, Universidad de Cantabria, Santander with a thesis entitled *New methodology on determination of extreme values for parameters used in maritime structures design*. Yanira is now enrolled in a Ph.D. program in the Water and Environmental Sciences and Techniques department, Universidad de Cantabria, Santander. Her PhD topic is about a 3D VOF (Volume of Fluid) numerical model of wave-structure interaction.

Abstract—The design of offshore wind farms is a complex process which requires a detailed study of the oceanographic, meteorological, geological and electrical conditions at the site of location. The main environmental conditions which may contribute to structural damages, operation disturbances or other failures are: wind, waves, currents and sea ice. Thus, the combination of the different parameters can produce many different critical situations for the stability of the structure, requiring the calculation of a long time series corresponding to long term historical data situations. The most accurate techniques available at the moment to estimate loads over a structure are the numerical and physical models, however they are very time consuming and the calculation of a long time series of data is unfeasible. Therefore, a hybrid methodology to transfer sea-wind-current conditions to forces over a structure is proposed. The methodology consists of a selection of a subset of representative cases of wave-wind-current climate at the structure location by a maximum dissimilarity algorithm, the estimation of loads over the structure for the selected cases and the reconstruction of loads corresponding to historical data using an interpolation technique based on radial basis function. In order to validate the proposed methodology, a current manual (IEC 61400-3 (2009)) has been applied to estimate the loads for the complete reanalysis time series of waves, winds and currents. The validation of the results confirms the ability of the developed methodology to reconstruct time series of forces over the structure. This methodology enables to apply the numerical and

physical models in the offshore wind farms design with a considerable reduction in the computational effort.

**Jacob Izraelevitz**, Franklin W. Olin College Of Engineering (USA)—*Optimal Trajectory Generation for Draped AUV Gravity Surveys*

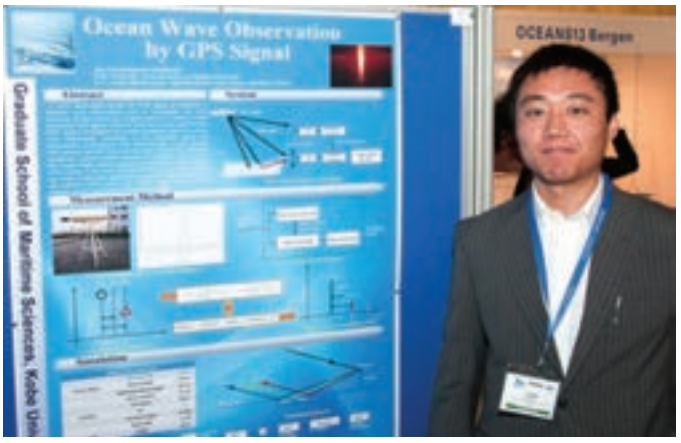



Jacob has just received his bachelor's degree this past May in mechanical engineering from Franklin W. Olin College of Engineering. His student paper is a compilation of his work in the Summer Science Fellowship at Woods Hole Oceanographic Institution under Dr. James Kinsey. Jacob will be attending MIT in the fall to complete a Master's degree, researching under Michael Triantafillou and Nicholas Patrikalakis on the CENSAM project for monitoring the coastal environment of Singapore.

Abstract—Gravity surveys provide crucial data about the subseafloor structure, and this information is used to both localize and characterize geophysical phenomena. Obtaining this gravity data from submersibles provides superior measurements, both in terms of signal strength and spatial resolution, than conventional survey platforms such as surface vessels and satellites. However, performing gravimetry an AUV requires specialized trajectory planning algorithms that minimize acceleration noise.We develop an AUV simulation as a testbed for creating these algorithms, designed to model the behavior of the Sentry AUV at the Woods Hole Oceanographic Institution. We then investigate the signal and noise characteristics of AUV gravimetry and propose a novel trajectory planner and state estimator that mitigates multiple noise sources. The resulting simulation predicts a .22mGal standard deviation of signal noise, at a spatial resolution of 10m, for a magma chamber with a 3.41 mGal gravity signature at depth, substantially better than other tested draped surveying techniques.

**Jian Cui**, Kobe University Graduate School of Maritime Sciences (Japan)—*Ocean Wave Observation by GPS Signal*

Jian graduated from Dalian Maritime University of China and received the Master's degree of Control Theory and Control Engineering in 2007. After that, He went to Kobe University of Japan as a graduate student under International Priority Graduate Program for further research on maritime sciences, and then received the Master's degree of Maritime Science and Technology in 2009. Now, he is in pursuit of a




Ph.D. His research field focuses on GPS measurements for ocean waves.

Abstract—A wave observation system by GPS signal is proposed to measure wave information, such as wavelength and wave direction. In this system an arrayed GPS antenna is used to receive multipath GPS signals reflected from sea surface and a software GPS receiver is designed to process composite signal to extract wave information. According to the composite signal, the indispensible performance and characteristics of the arrayed GPS antenna and RF front-end has been analyzed by computer simulation. Autocorrelation function and Teager-Kaiser energy operator are utilized as core functions of the software GPS receiver. The system has been verified that the arrayed GPS antenna can receive multipath signals from specified measurement area and the software GPS receiver can process signal very well and estimate relative time delays of multipath signals.

**Kyung Woon Lee**, Korea University Of Seoul (Republic of Korea)—*Implementation of Embededed System for Autonomous Buoy*

Kyung Woon received his undergraduate degree (B.S.) from the Department of Engineering, Sejong University, Seoul (Korea), in 2006. He earned a Master's of Science from the Department of Electrical and Computer Engineering, Korea University, Seoul, in 2008. Kyung Woon is currently enrolled in a Ph.D. program in the Korea University of Seoul. Professional interests include System engineering and Earth Environmental Sciences.

Abstract—We developed Autonomous Buoy, which is composed of embedded system, OPC (Optical Particle Counter) and CTD (Conductivity, Temperature, Depth) sensors, to observe underwater environment. The vehicle is an autonomous profiling float that uses a buoyancy engine to cycle horizontally while moving up and down. The autonomous buoy is controlled by embedded system composed of field-programmable gate array (FPGA) and high performance CPU, which is designated to perform image signal processing, data compression, power management and satellite communication. Embedded system acquires high-resolution particle image using linear-CCD for counting particle and CTD value and analyzes particle images in underwater environment. It reduces amount of particle image data using on-board processing that provides good performance when autonomous vehicle communicates with a satellite.

## Winning Student Poster Paper

# Near Sea Surface Target Tracking by Extended Kalman Filtering of the GPS Reflected Signals

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rene.garello@telecom-bretagne.eu

***Abstract*—This paper addresses the use of Global Navigation Satellite Systems (GNSS) as a remote sensing tool for oceanographic applications. In this paper we use the Global Positioning System (GPS) signals reflected off the sea surface along with a coastal receiver to perform detection and tracking of a near sea surface mobile target. Because these signals have a very low Signal to Noise Ratio (SNR) in a non stationary medium, a matched filter is required. A filter based on the Extended Kalman process is presented here.**

## I. Introduction

Monitoring the sea surface by using electromagnetic source of opportunity owes its success to the progress of Global Navigation Satellite Systems (GNSS). Typically, GPS signals are the most exploited. Thanks to the GPS signal properties, it is possible to find some parameters such as the ocean surface roughness, wind direction and speed, currents and surface altimetry [1], [2], [3] and [4], by studying the waveform shape of the reflected GPS signal correlated with a replica of its code. Therefore the GPS constitutes a relevant and inexpensive bistatic passive remote sensing tool. Space and airborne platforms, and radars often served as the receiver in this kind of observations. In the present, we use near sea surface observation systems for an accurate analysis of the diffusion and the scattering of GPS signals.

## II. Coastal monitoring

### A. Project MOPS

For an airborne receiver, the scattered GPS signal is extended to an area around a nominal specular point on the mean sea surface (glistening zone), which does not allow for observation of the elementary sea wave movement [3]. Therefore, to allow fine detection of the sea movement during very small time intervals, we consider a coastal receiver located dozens of meters above the sea surface that can record the scattered GPS signal (*MOPS*) [5].

Project MOPS studies the feasibility of passive systems in the vicinity of the sea surface for applications in oceanography. Due to the complexity of this objective, this project manages different scientific academic domains (electromagnetism, signal processing, oceanography, etc.), to develop an experimental testbed at a Brest coastal spot.

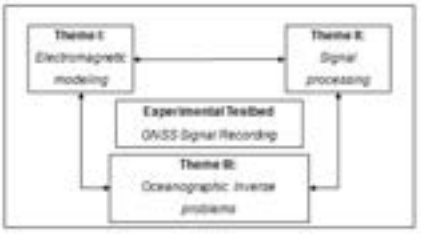


Fig. 1. Project MOPS

This project (Fig. 1) is composed of four main themes :

- Physical modeling: Numerical modeling of the electromagnetic field in the vicinity of scattered waves[6].
- Signal and raw data processing: Extraction of information from the Doppler Delay Map *DDM*[7].
- Inverse problem: inversion of the physical problem and identification of oceanographic information.
- Experimental platform: validation of the work with real measurements[8].

### B. Initilazing and modeling

For the very near sea surface configuration, we showed in [7] how the integration of the GPS signals scattered by some targets on sea surface can provide elementary information in order to detect them by extracting the reflected signal from the noise and sea clutter, where we presented the sea surface particles as mobile targets.

In this paper, the detection issue is extended to track the evolution of the target trajectory in an analogy with the problem of radar moving target tracking, in order to perform a close monitoring of the specular point itself.

- The target is a wave peak moving along the mean sea surface. The target has a uniform linear movement. The target speed depends on its position with respect to the receiver $x_0$, its wavelength and water depth $h_w$.
- The target is a buoy floating on the surface which oscillates in place, or a small boat located at a distance $x_0$ from the receiver. The movement is then vertical and sinusoidal (Fig. 2).

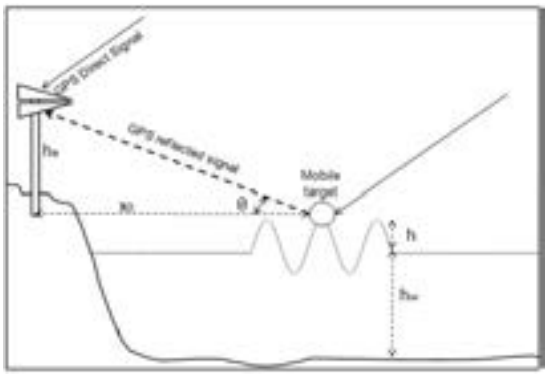


Fig. 2. GPS and Reflected signals on sea surface

The main objective is to estimate $(\delta_k, \tau_k)$ at every instant $t_k$ to be able to locate the target on the DDM.

Before proceeding to the EKF issue, let us recall some information about the GPS signal structure and the ambiguity function in order to explain the different hypothesis defined later to simulate and implement our filtering system.

### C. GPS Signal Structure

The GPS satellites emit their code on two carriers, with frequencies $L_1$ and $L_2$, defined by the fundamental frequency $F_0 = 10.23$MHz:

$$\begin{cases} L_1 &= 154 * F_0 \\ L_2 &= 120 * F_0 \end{cases} \quad (1)$$

$L_1$ wave is modulated by two codes: a civil code $C/A$ and a military one, $P(Y)$, whereas $L_2$ wave is modulated only by the code $P(Y)$. The signal spectrum is spread using a BPSK modulation. The $C/A$ code is composed of the Pseudo-Random Noise sequence (PRN) which is a sequence of $+1$ and $-1$ known and unique for each satellite. It has a length of 1023 chips, corresponding to a period of 1 ms [9]. By measuring the cross correlation product of the reflected GPS signal and the receiver generated replica PRN code, for a particular satellite, we show the peak corresponding to the direct signal emitted by the satellite and the secondary peaks corresponding to the reflection phenomena.

### D. Ambiguity function

The ambiguity function of a signal $x(t)$ is defined by:

$$A_x(\tau, f) = \int_{-\infty}^{+\infty} x(t)\bar{x}(t-\tau)e^{-j2\pi ft}dt \quad (2)$$

where $\bar{x}$ represents the conjugate of $x$.

for a PRN sequence, the ambiguity function is approximately [10]:

$$A_x(\tau, f) \approx e^{-j\pi T_{seq} f} sinc(T_{seq} f) R(\tau) \quad (3)$$

where $T_{seq}$ is the PRN sequence duration and $R(\tau)$ is the autocorrelation function ACF of this sequence.

1) Cut at zero Doppler : the ACF has a perfect triangular shape (Fig. 3)

$$R(\tau)_{/\{\delta=0\}} = \begin{cases} 1 - \left|\frac{\tau}{T_c}\right|, & \left|\frac{\tau}{T_c}\right| \leq 1 \\ 0, & elsewhere \end{cases} \quad (4)$$

where $T_c = \frac{1ms}{1023}$ is the duration of a chip. The trianglular ACF width is $2T_c$.

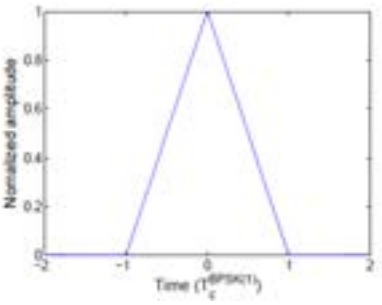


Fig. 3. The ambiguity function projection on $\tau$ direction

2) Cut at zero delay:

$$R(\delta)_{/\{\tau=0\}} = \alpha sinc(\pi f T_c) \quad (5)$$

In the Fig. 4, the main lobe is included in $\left[-\frac{1}{T}, \frac{1}{T}\right]$, where $T$ is the integration time.

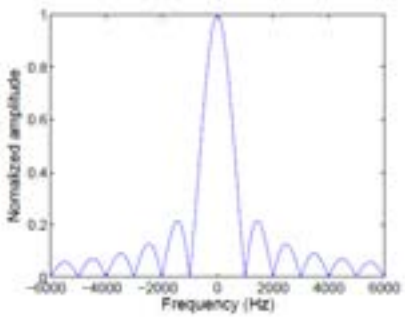


Fig. 4. The ambiguity function projection on $\delta$ direction

The standard deviation of the Doppler and the time delay, respectively $\sigma_\delta$ and $\sigma_\tau$, are found by computing the half of the width, respectively at the mid height of the triangular shape and the main lobe of the $sinc$ function.

## III. Matched filter: Extended Kalman Filter

### A. EKF: state model

The Kalman filter carries out recursive target state estimation given the target dynamic equation, sensor measurements, and the target originated measurements [11].

Let us define the state vector $s_k$ at time $t_k$;

$$s_k = \begin{bmatrix} \delta_k & \tau_k \end{bmatrix}^T. \quad (6)$$

and the state equations

$$s_{k+1} = f(s_k) + v_k \tag{7}$$

$$z_k = g(s_k, w_k) \tag{8}$$

Eq. 7 represents the dynamic evolution of the system where $f$ is a linear function and $v_k \sim \mathcal{N}(0, \sigma_v^2)$. While the sensor measurements $z_k$ are related to the target state via the function $g$ in the observation equation (8).

$w_k \sim \mathcal{N}(0, \sigma_w^2)$ theoretically.

The efficiency of the linear Kalman filtering used in [12] to track this target was limited, since the model used was relatively simplified and doesn't reveal exact information about the target. To have an optimal observation, we must choose measurements of the energy distribution of the signal which could be more representative of the model and more realistic.

### *B. EKF: Measurements Model and Simulator*

Actually the $z_k$ represents a series of *DDM* measured at time $t_k = k * 0.45s$. Therefore, as we can see in the Fig. 4, the ambiguity function representation at zero delay cut has important secondary lobes. To simplify and obtain a robust model, we choose to simulate this function with a gaussian form $g_k$.

As we do not have real measures for the moment, we will generate simulated observations using the target's motion equations Then, for every $(\delta_k, \tau_k)$ estimated at time $t_k$, we generate a noise-corrupted Power Spectral Density PSD $g_k$.

We suppose that our target has a sinusoidal motion as in the following

$$\begin{cases} x &= x_0 \\ z &= h \cdot \sin(2\pi f_m t) \end{cases} \tag{9}$$

Theoretically the originated measurements of the Doppler and the time delay can be obtained by the equations

$$\delta_k = -\frac{f_0}{c}\cos(\theta) \tag{10}$$

$$\tau_k = \frac{\sqrt{(x - x_0)^2 + (z - h_a)^2}}{c} \tag{11}$$

where $x_0 = 10m$, $h = 1m$, $f_m = 2Hz$ and $h_a = 22m$.

$$g_k = \left[ w_k + \frac{1}{2\pi\sigma_\delta\sigma_\tau} \cdot e^{\left( -\frac{(\delta_i - \delta_k)^2}{2\sigma_\delta^2} - \frac{(\tau_j - \tau_k)^2}{2\sigma_\tau^2} \right)} \right]^2 \tag{12}$$

$\delta_i = i\Delta_\delta + \delta_0$ and $\tau_j = j\Delta_\tau + \tau_0$ define the transitions of the DD cell in the DDM. $\Delta_\delta$ and $\Delta_\tau$ are the transition steps, and $\delta_0$ and $\tau_0$ the originated measurements.

*1) Statistical Properties:*

$$\begin{cases} \sigma_\tau &\approx \frac{2T_c}{4} \\ &\approx 0.5\mu s \end{cases} \tag{13}$$

If we suppose that the Doppler does not change during $T = 20ms$, then:

$$\begin{cases} lobe_{width} &= \frac{2}{T} \\ \sigma_\delta &\approx 22.8Hz \end{cases} \tag{14}$$

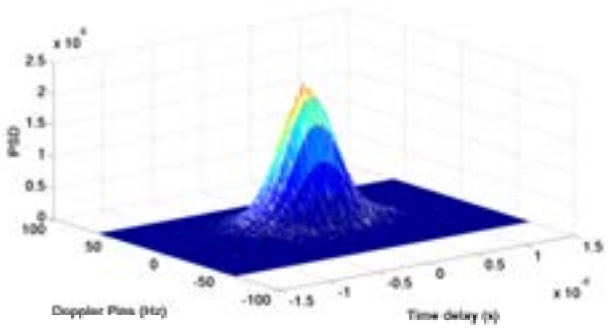


Fig. 5. Noise corrupted observation function

*2) Observation noise distribution $w_k$:* The noise in this distribution here has 2 dimensions.

At the receiver input, $w_0(t)$ represents a possibly correlated zero-mean Gaussian noise with estimated autocorrelation function $\Omega_0(t)$ [10].

- Fixed $f = f_\delta$:
  $A_x(\tau, f)$ in (2) will represent the output of a matched filter when the input signal has been Doppler-shifted by $f$. The output signal is then:
  $$y_f(t) = e^{-2j\pi f\tau} A_x(t - \tau, f - f_\delta) + w_f(t) \tag{15}$$
  $w_f(t)$ is a centered Gaussian noise, with : $\Omega_f(t) = \Omega_0(t) * ACF(x(t))$.
- Fixed $\tau = t_\tau$:
  The output noise is $\mathcal{E}(w_f) = \sigma_\delta^2 sinc(\pi f T)$ mean.

To simulate $w_f$ and use it in the observation equation, these parameters should be considered.

## IV. Results & Conclusion

In this paper, we have performed several simulations parameterized by wave height, distance from the target relative to the origin, distribution and level of observation noise. Then we have compared the theoretical target paths and those obtained at the output of the filter to analyze the performance and robustness of the extended Kalman filter for marine target tracking.

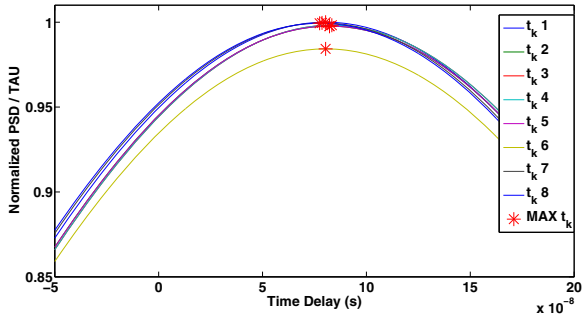


Fig. 6. The PSD projection on $\tau$ direction for $k = 8$ observations

In the Fig. 6, we can find the PSD projection on the $\tau$ direction for every observation of the $k = 8$ observations

separated by $0.45s$ set. We have estimated the time delay difference is so small ($\Delta_{\tau,max} - \Delta_{\tau,min} = 6.06ns$). In the same way and for these same observations, we have estimated the Doppler difference ($\Delta_{\delta,max} - \Delta_{\delta,min} = 120Hz$) (Fig. 7).

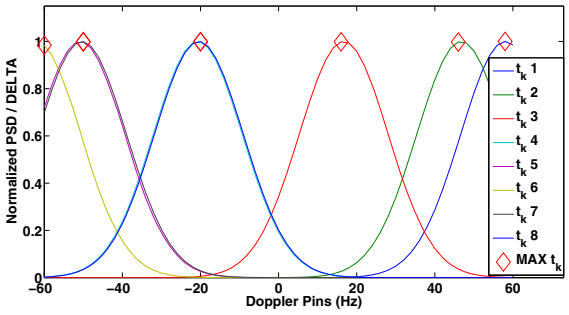


Fig. 7. The PSD projection on $\delta$ direction for $k = 8$ observations

We can see that the time delay difference is so small that it makes it hard to detect this tiny even with the sampling frequency $f_s = 8GHz$ used here. Anyway, we still have to work on this assumption else we may use only the Doppler shift for our tracking filter.

At the filter output, the target position in the DDM looks like in the Fig. 8.

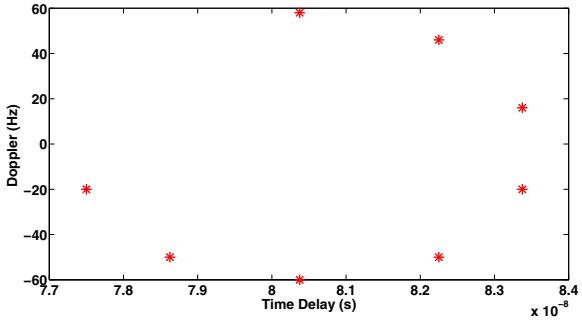


Fig. 8. Estimated target position through $k = 8$ observations

The encouraging results of this study allow us to predict multiple scientific extensions on several axes. We consider measures of the function of ambiguity, from a GPS signal simulator.

Depending on results and performance of our filtering system in the case of a single target, other hypotheses, such as the presence of another target or significant noise level, will also be discussed. Anlso, assuming a rather disturbed marine environment, we may need to develop a particle filter (or other) in the context of *Track - Before - Detect* .

Validation of our method with real measures is planned in the future, with a final objective of developing an experimental testbed for measurement and processing of scattered GPS signals.

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# AdCom Election Results

Every year we elect six members to serve on the Administrative Committee for a term a three years. This year we had ten well qualified candidates. The election was held by e-mail and the results were compiled by IEEE. The following newly elected members of the AdCom will serve from January 2012 through December 2014. Their statements and bio sketches are reprinted here. Congratulations to the AdCom class of 2012:

- Ross Chapman
- Ferial El-Hawary
- Kenneth G. Foote
- William J. Kirkwood
- Tamaki Ura
- Joseph R. Vadus

ROSS CHAPMAN (M'97-SM'03-F'10) is a Fellow of the IEEE. He received a Ph.D. in physics at the University of British Columbia in 1975, and subsequently joined the Defence Research Establishment Pacific (DREP) in Esquimalt BC as a defence scientist in the Ocean Acoustics group. He spent the next 20 years there in underwater acoustics research, and was Chief Scientist on over 20 sea trials. He left DREP in 1995 when he was appointed Professor and Senior Research Chair in Ocean Acoustics at the University of Victoria (UVic). The academic and research program in Ocean Acoustics that he established at UVic has graduated more than 25 Masters and Ph.D. students. Dr. Chapman is internationally recognized for his research on the interaction of sound with the ocean bottom. 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). He 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.

**Statement**: For the past dozen years I have been involved with the development of the NEPTUNE underwater cabled observatory in Victoria. I believe that the Ocean Engineering Society can play an effective role in promoting the international development of similar ocean observatories, through workshops to enable international collaboration and special sessions at Oceans Meetings. I would like to work from within the OES ADCOM to facilitate and enable this collaborative development. My career in ocean research has been greatly enhanced by the opportunity to publish research in the IEEE Journal of Oceanic Engineering, and I am currently an associate editor specializing in acoustic research. As an ADCOM member, I intend to work with the editorial team to ensure that the Journal continues to be the journal of choice for young scientists to publish their research in all aspects of ocean engineering, from ropes and cables to high-end software. I see also that there is an opportunity from within ADCOM to encourage the interaction with other IEEE societies with similar interests, for instance in geoscience and remote sensing.

It has been my privilege for the past 15 years to serve as a volunteer and Vice-chair of the OES chapter in Victoria in promoting the OES in the local marine R&D community, and providing student programs at UVic for career development. I ask for your support in providing the opportunity to serve a broader community at a higher level in the Society.

FERIAL EL-HAWARY (M'82-SM'85-F'99) received the B.Eng. degree from University of Alexandria, and the M. Sc. from the University of Alberta, Edmonton, Canada, in Electrical Engineering; and the Ph.D. in Oceans Engineering from Memorial University of Newfoundland, Canada. Dr. El-Hawary is President of BH Engineering Systems Ltd. She served on the Faculty of Engineering at Dalhousie University, where she established and directed the Modeling & Signal Analysis Laboratory. Sustained research contribution devoted to OCEANS Application with significant impact on defence, navigation and Oil & Gas exploration. She has published widely in IEEE Journals. She is Editor-in-Chief of The Ocean Engineering Handbook and served as Associate Editor of IEEE Oceanic Engineering Journal. With more than twenty-five years experience in teaching Electrical and Oceanic Engineering, she has made significant and sustainable contributions in promoting and developing continuing education programs. She is the founder of the Modeling and Signal Analysis Research Laboratory at the Faculty of Engineering at Dalhousie University, and founder of BH Engineering Systems Ltd., specializing in technology transfer and professional development courses, linking academic innovations to industrial needs of Engineering practitioners.

She is IEEE-Canada (Region-7) Director 2008–09, IEEE Conferences Services Committee Member, 2005–07, History Committee member, 2005–07, IEEE/Oceanic Engineering Society Administrative Committee Member, served as OES Vice-President International Activities, 1993–97; OES Membership Development Committee Chair 1990–92. Ferial is recognized for her leadership in establishing in the past OES Chapters in Halifax, France and Norway and recently a new joint OES Chapter in Quebec City, Canada. Ferial served as OCEANS'08 General Co-Chair, IEEE Section Congress'08 and OCEANS'11 Organizing Committee member.

She is the recipient of the Systems Man & Cybernetics Society (SMC) Outstanding Contribution Award, 2008, IEEE-Educational Activities Board (EAB) Meritorious Achievement Award in Continuing Education, 2007, Marine Technology Society (MTS) Ocean Engineering Compass International Award, 2005, the J.J. Archambault Eastern Canada Council Merit Award, 2002, IEEE Third Millennium Medal, 2000, RAB

Achievement Award, 1999 IEEE/OES Distinguished Service Award, 1997, Fellow of MTS, 1985, Fellow of the Engineering Institute of Canada (EIC),1997 and She is a Fellow of IEEE since1999.

**Statement:** My association with the IEEE-OES has been a rewarding experience developing excellent relationships with volunteers, and contributing to conferences and publications. The challenge for OES is finding the products and services that members globally truly value as well as to engage with volunteers so that they can more clearly see and leverage the benefits that the society brings to their efforts and aspirations.

Once elected I will continue to:

- Focus on OES Members needs and help Chapter Activities to grow our Membership worldwide
- Engage OES members in IEEE activities.
- Focus on strengthening Life Long Learning activities.
- Work with Society leaders from industry to foster additional areas of industrial applications
- Work at making the Society shift its perspectives to be even more global than it is today
- Promote efforts to make OES more attractive to new future members.
- Promote satellite Regional OES Conferences and Symposia.
- Work to increase the OES Visibility by sponsoring scholarships in our areas of interest and devote more time to increase Students membership.

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

KENNETH G. FOOTE (M'96-SM'11) is a Life Member of OES, Senior Member of IEEE (Member 1997–2010), Fellow of the Acoustical Society of America, and Member of the American Physical Society. He received a BS in electrical engineering from The George Washington University and PhD in physics from Brown University. He worked at Raytheon Company Submarine Signal Division 1968–74, spent a year at Loughborough University of Technology, then six years at the University of Bergen. In 1981 he became a Senior Scientist at the Institute of Marine Research, Bergen, and in 1999, a Senior Scientist at the Woods Hole Oceanographic Institution. Research interests include acoustic scattering by marine organisms, marine resource estimation, and sonar performance evaluation and calibration.

**Statement:** Two essential functions of the OES are organizing meetings, including OCEANS Conferences & Exhibitions and workshops, and publishing proceedings and an acclaimed journal. Both of these classes of activities present ongoing challenges and opportunities. As a regular participant in OES-organized and -sponsored meetings, and as Chair of the Technology Committee on Underwater Acoustics, I can attest to both. I have strong interests in other technical activities of OES too, participating in TC Chairs meetings, nominating Distinguished Lecturers, proposing improvements to the OCEANS Conference abstract reviewing system to assist authors and encourage JOE publication, and serving on the OES GEOSS committee. In seeking election to AdCom, I wish to promote the continued vitality of the Society through its technical activities. These are particularly effective for promoting ocean engineering, the enabling technology behind our growing knowledge of the oceans and their importance in everyday life.

WILLIAM J. KIRKWOOD (AM'08-M'09-SM'09) is currently Senior Research and Design Engineer for the Monterey Bay Aquarium Research Institute (MBARI). In this role Bill is focused on the applied research and development of next generation technologies for the advancement of ocean science. Creating technical solutions to ocean problems has been the core of his work for 20 years. Bill's primary expertise is in robotic vehicles and instrumentation. As project manager and mechanical designer Bill lead the development of the ROV Tiburon platform. Later, Bill was the MBARI project manager on the Dorado class AUV co-developed with Sea Grant at the Massachusetts Institute of Technology. Bluefin Robotics Inc., a small to medium sized underwater robotics company, spun out from MIT and commercialized the resulting vehicle system and is now a division of Battelle. Bill patented and licensed the distinctive ringtail used on the Bluefin 21 AUV's. Bill further developed AUVs as project manager and mechanical designer to deliver MBARI's mapping AUV which operates 7 acoustic devices simultaneously and is still in high demand as one of the premier mapping systems for science in the world. Bill's more recent work has centered on instrumentation for multidisciplinary biogeochemistry research. Bill's efforts have created a plug and play 4000 meter rated laser Raman instrument and precision positioning systems for in situ optical instruments. Currently Bill is Co-PI and project lead on the Free Ocean CO2 Enrichment experiments (FOCE) researching the impacts of ocean acidification (OA). The FOCE system is a combination robot and instrument to do in situ closed looped control of pH based on predictive models to study the potential impacts of OA. Several devices have been built at this point with regular operations at 900 meters in Monterey Bay and year long coral studies on the Great Barrier Reef.

Bill is a Senior Member of IEEE/OES with numerous publications and has published extensively in other journals as well. As an adjunct professor at Santa Clara University, Bill teaches upper division classes in ocean engineering as well as mentoring students on 3 ROVs, 1 autonomous surface craft, and has served as a coadvisor to graduate students on marine related projects. Bill was part of the original proposal team that created the Marine Advanced Technology Education (MATE) center located at the Monterey Peninsula College. The MATE program has been very successful and ultimately created the International ROV Competition. Bill has been involved with MATE since its inception and has contributed by first establishing competition rules and continuing to work as an advisor on rules, to student teams as well as judging. Bill provided content and served as a technical and editorial reviewer for the MATE textbook "Underwater Robotics: Science, Design & Fabrication" published in 2010. He is currently working on a chapter for a new textbook on the application of optical instruments

in the ocean. Additionally, Bill continues with his consulting firm TLR Inc. that has provided services for several aquaculture firms, holding a design patent for environmentally safe abalone farming. Bill has also provided design and fabrication services instrumentation for the International Ocean Drilling Program, NURP, and has served on the technical advisory committees for NOAA and the Ocean Observatory Initiative.

Bill graduated from UCLA in 1979 with a BSME, received his Masters in Computer Science in 2000 form UoP, completed the Lockheed Missiles and Space Corporation management program, and has completed years of extension graduate classes in technical innovation, management and negotiation at the Harvard Business and MIT Sloan School joint program.

**Statement:** I was hired by MBARI specifically for the task of applying myself to advancing ocean technology for science and industry. The challenge I accepted from Mr. Packard was to make a difference to society through technology and to reduce the barriers to access of technology for greater ocean community. I believe in the vision that with better technology comes better knowledge and with better knowledge we have a chance to better manage the resources hidden within 70% or so of the planet. To obtain the answers that will let us make informed policy decisions and better manage natural resources through conservation, protection, and the sustainable exploitation needed to meet societal demands. My desire to serve is a continuation of that challenge. By being proactive and involved in the ocean community through the ADCOM I believe I can make further contributions to our community and society overall. I've served IEEE/OES for almost a decade in a variety of roles by teaching tutorials, publishing, serving on panels, journal reviewer, co-chairing and chairing workshops (the latest being chair of AUV 2010 held in Monterey, CA.) and this year as guest editor for the IEEE/OES journal special issue Scientific Underwater Observations and Technologies of the New Millennium. I believe I can learn valuable lessons from the ADCOM and bring that to the next generation of potential IEEE/OES members while also providing fresh ideas as we look forward to the health and well being of our society.

TAMAKI URA (M'91-SM'02-F'07) is Director, Professor of Underwater Technology Research Center at the Institute of Industrial Science (IIS) of the University of Tokyo, and Director of the Tokyo University Ocean Alliance, since its establishment in 2007. He is one of the Top-leaders of development of Autonomous Underwater Vehicle in the world.

He has developed not only Autonomous Underwater Vehicles (AUVs) but also various related application technologies including navigation methods, a new sensing method using a chemical sensor, precise seafloor mapping methods, a precise seabed positioning system with a resolution of a few centimeters, a new sensing system of the thickness of cobalt-rich crust, etc. Finally, he exemplified using these technologies that AUVs are practicable and valuable tools for deep-sea exploration.

Dedicating himself to international societies' activities, establishing IEEE/OES Japan Chapter, he served it as its first chair from 1995 to 2000. He organized international symposium on underwater technology: UT'98, UT2000, UT'02, UT'07, UT'11 at Tokyo and UT'04 at Taipei and UT'09 at Wuxi with co-sponsor IEEE/OES and realized the international symposium on OCEANS/Techno-Ocean 2004, Kobe in November 2004, which is the first OCEANS conference held in Asia.

Not only for the academic fields but also for the public, he has been contributing to the Ocean related themes. He was a Commissioned Judge of the High Marine Accidents Inquiry Agency from 1984 to 2008, and he was the chairman of the Ocean Technology Committee of the Society of Naval Architects of Japan from 1998 to 2000 as well.

Based on these activities, he has received awards:

**2010:** IEEE Oceanic Engineering Society Distinguished Technical Achievement Award (USA)
**2007:** Nominated as IEEE Fellow, for contributions to autonomous underwater vehicle technologies. (USA)
**2006:** Distinguished Service Award from IEEE Japan Chapter (Japan)
**2000:** Award from Agency for science and technology (Japan)
**1999:** Award from the Japan Society of Mechanical Engineers (Japan)
**1998:** Award from High Automation Technology Association (Japan)
**1995 and 1997:** Awards on Invention from the Society of Naval Architects of Japan (Japan)
**1982:** Houkou Award on the significant contributions to safety of moored ship (Japan)
**1979:** Award from the Society of Naval Architects of Japan (Japan)

JOSEPH R. VADUS (M'57-SM'57-LS'94-LF'01) IEEE/OES Life-Fellow (1991); Vice President, IEEE/OES, Conference Development (2006–2009). Vice President, International Activities (2002–2005); Vice President, Technical Activities (1997–2002).

IEEE Engineering R&D Policy Committee (1992–2006); IEEE Centennial Medal (1984) & IEEE Millennium Medal (2000); IEEE/OES Distinguished Service Award (1985).

General Chairman, OCEANS 1976 Bicentennial Year in Washington; Program Chairman, OCEANS 1991 in Hawaii; Liaison and Advisor to OCEANS 2001 & 2002. Advisor to more than 10 OCEANS Conferences.

Organized the First OCEANS/TECHNO-OCEAN MTS/IEEE 2004 Conference in Kobe, Japan. Received The First Techno-Ocean Award by the Consortium of Japanese Organizations—for leadership in ocean science and technology, and for US-Japan collaboration.

Chaired three Underwater Technology Symposia ('98-'00-'02) in Tokyo; Chaired Workshop in Taiwan (2002).

US Chairman, US/EU-Baltic International Symposium 2004 for Marine Research, and Advanced Technologies; and in 2006 for Integrated Ocean Observation Systems; US Chairman, Baltic Symposium held in Tallinn, Estonia, in 2008; US Chairman for Chile-US Workshop in Valparaiso, Chile in 2008. Helped organize Argentina-US Symposium in Buenos Aires (2010).

Selected as contributing author to IEEE's book celebrating the new millennium, "Engineering Tomorrow: Opportunities and Challenges in the 21st Century".

Marine Technology Society: Fellow, Member Emeritus; Vice President for Technical Activities for nine years (1979–1988), and Directed 32 Professional Committees; received the Compass Distinguished Technical Achievement Award and Rolex (1990) & Special Commendation signed by nine MTS Presidents (1989) for leadership as VP Technical Activities. Received the 2006 Lockheed Martin Award for Achievement in Ocean Science & Engineering.

B.S. Electrical Engineering, Penn State University; M.S. in Ocean Engineering from Long Island University (1967); served in the Graduate Division as Adjunct Professor for a two semester course in Ocean Engineering (1967–72).

Retired from NOAA in 1996 as Senior Technology Advisor, National Ocean Service ;Director Technology, NOAA's Office of Manned Undersea Science and Technology; Office of Coastal Environment, Office of Ocean Engineering, and the Ocean Energy Program Office.

Senior Staff Associate at the National Science Foundation and Director for Ocean Engineering Research (1988–91).

Sperry Rand Corporation: Engineering management positions in major ocean R & D programs; headed the R & D Program (1968–71) for the U.S. Navy's NR-1 Nuclear Submarine; and other deep submergence R & D projects: Trieste II,DSRV,USS Dolphin (1969–72).

Has 11 patents (6 awarded, 5 pending):

No. 3072002 V-Beam Radar System

No. 3078459 Height Indicating System

No. 3080555 Function Generator

No. 3155939 Counter Checking Ckt.

No. 3168655 Pulse Averaging Device

No. 31518 (Navy Dept.) Automatic Range Gating

Patents Pending based on final development:

Sperry Rand Docket 13396 Personnel IFF

SR Docket 16424 Radar Communications

SR Docket 18523 Radar Beam Dwell Tech.

Docket (Navy Dept.) Surface Search Radar for USS Dolphin Sub

Docket (Navy Dept.) Submersible Amphibious Vehicle

Over 90 technical publications and many major keynote and plenary addresses at International Conferences. Chaired more than 10 technical sessions.

U.S. Chairman (15 yrs.) for Marine Technology R&D in the U.S.-Japan Bilateral Program (1980–1995); Reviewed 200 R&D facilities in US & Japan and exchanged over 500 technical papers. Japan Government Awards received for Leadership in 1986 and 1992. State Dept. Distinguished Service Award (1992) for sustained performance as U.S. Chairman.

U.S. Chairman (15yrs.) for Marine Technology R & D for the U.S.-France Cooperation in Oceanography (1980–1995), managing an average of 6 cooperative U.S.-France R&D projects each year. One project, in 1985, resulted in finding the RMS "TITANIC", during the U.S.-France Project for evaluation of Deep Ocean survey systems. For 20 years service, in 1999, the President of France selected him for the award of "Chevalier de l'Ordre National du Merite" the French Order of Merit. Member, American Society of the French Legion of Merit.

The Mexican Academy of Science presented their Distinguished Technical Achievement Award for Coastal and Ocean Engineering, and designated him Corresponding Member (1991).

Fellow in the UK Society for Underwater Technology, (1996).

Served in the US Marine Corps and is a Member of the First Marine Division Association. Sperry Rand Corp presented letters of commendation (1965) for development of Marine Corps Radar, used in Vietnam.

**Statement:**

- Very interested in helping upcoming engineers to take on leadership responsibilities in the OES.
- Helping young engineers to apply for chairs of technical committees, or to take a leadership role in an OCEANS Conference, Symposium or Workshop.
- I can show you how to prepare a winning technical proposal in response to Navy. NOAA, or NSF technical requirements. I succeeded in getting 8 technical grants.
- I would like to see more young people get opportunities to travel to international conferences.
- Gained considerable experience and knowledge serving OES, and now I would like to offer a helping hand. Semper Fi.

# José del Río Sainz, Poet of the Sea

José del Río Sainz was born in Santander in 1884 and affectionately known as "Pick." He was a sailor, journalist and poet. He studied seamanship and was a sailor until 1936. He then concentrated on journalism as both a columnist and a correspondent. A statue in his honor stands near the sea in Santander. His popular poem Las tres hijas del capitán is presented below both in its original Spanish and in an English translation. "Pick" died in Madrid in 1964.

***Las tres hijas del capitán***

*Era muy viejo el capitán y viudo*
*y tres hijas guapísimas tenía;*
*tres silbatos, a modo de saludo,*
*les mandaba el vapor cuando salía.*
*Desde el balcón que sobre el muelle daba*
*trazaban sus pañuelos mil adioses,*
*y el viejo capitán disimulaba*
*su emoción entre gritos y entre toses.*
*El capitán murió... Tierra extranjera*
*cayó sobre su carne aventurera,*
*festín de las voraces sabandijas...*
*Y yo sentí un amargo desconsuelo*
*al pensar que ya nunca las tres hijas*
*nos dirían adiós con el pañuelo...*

*It was a very old captain and widowed*
*and three so beautiful daughters he had;*
*three whistles, as a farewell,*
*always sent the steamboat as it left.*
*From the balcony over the dock*
*her handkerchiefs traced a thousand goodbyes,*
*and the old captain hid*
*His emotions within shouts and coughs.*
*The captain died...A Foreign land*
*fell on his adventuous flesh*
*A feast of the voracious bugs...*
*And I felt a bitter grief*
*when I thought that never again the three daughters*
*would say goodbye with the handkerchief...*


*Photo and English translation (Courtesy of Luis Sainz de Rozas).*

*Photo by Stan Chamberlain.*


# Oceans of Opportunity: International Cooperation & Partnerships across the Pacific


## Important Dates

Final Submission of Papers: 15 July
Early Bird Rooms & Registration: 01 Aug
NELHA Tours sign-up: 15 Aug
Education Symposium sign-up: 26 Aug
Conference dates: 19-22 Sept 2011
www.oceans11mtsieeekona.org

## Will you be there?

**Keynote Speakers**

Dr. Marcia McNutt, Director, U.S. Geological Survey
Mr. Mike Utsler, COO, Gulf Coast Restoration Organization (GCRO), BP
Dr. Eddie Bernard, Director, NOAA PMEL [Retired]

**Technical Program** - OCEANS '11 MTS/IEEE Kona will have a very strong technical program. A record 750+ abstracts were received with substantial international representation and a broad range of topics, including Ocean Vehicles, Ocean Observations, and Sonar Signal/Image Processing & Communication. In addition to the Kona Special Topics, there will be a track to accommodate the canceled UT'11 Tokyo Symposium.

**Exhibits** - Over 100 national and international exhibitors from government, academia, and industry have already committed. Please contact our Exhibits team at exhibit@oceans11mtsieeekona.org for further details and to reserve your space. A few limited booths remain in the HI, WA and the BC (Canada) groupings.

**Tutorials** - Nine offerings for full- and half-day sessions on a wide variety of technical topics ranging from imaging technologies, autonomous vehicles, ocean energy and modeling, as well as a business-oriented topic for companies seeking to improve on strategies for engagement with government customers in DoD and other federal agencies. Tutorial participants may earn formal credits through IACET.

**Education Symposium** - Sat Sept 17, 2011, Hilton Waikoloa Village - Free full- & half-day professional development offerings for elementary to high school educators focusing on Pacific Coral Reefs and Climate Change, Discovery of Sound in the Sea, and Exploration in the Mariana Trench Marine National Monument.

**Exclusive Tours** - A tour of the Natural Energy Laboratory of Hawai'i Authority (NELHA) will be offered. Don't miss this chance to visit and learn about the state's most unique and innovative ocean science and technology development park, where NELHA is growing sustainable industries for the 21st century.

**Patron Opportunities** - There are a number of remaining opportunities for exhibitors who want to enhance their market presence at OCEANS and companies/organizations that are looking for an alternative strategy to raise their visibility with this highly qualified target audience!

MTS www.oceans11mtsieeekona.org
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