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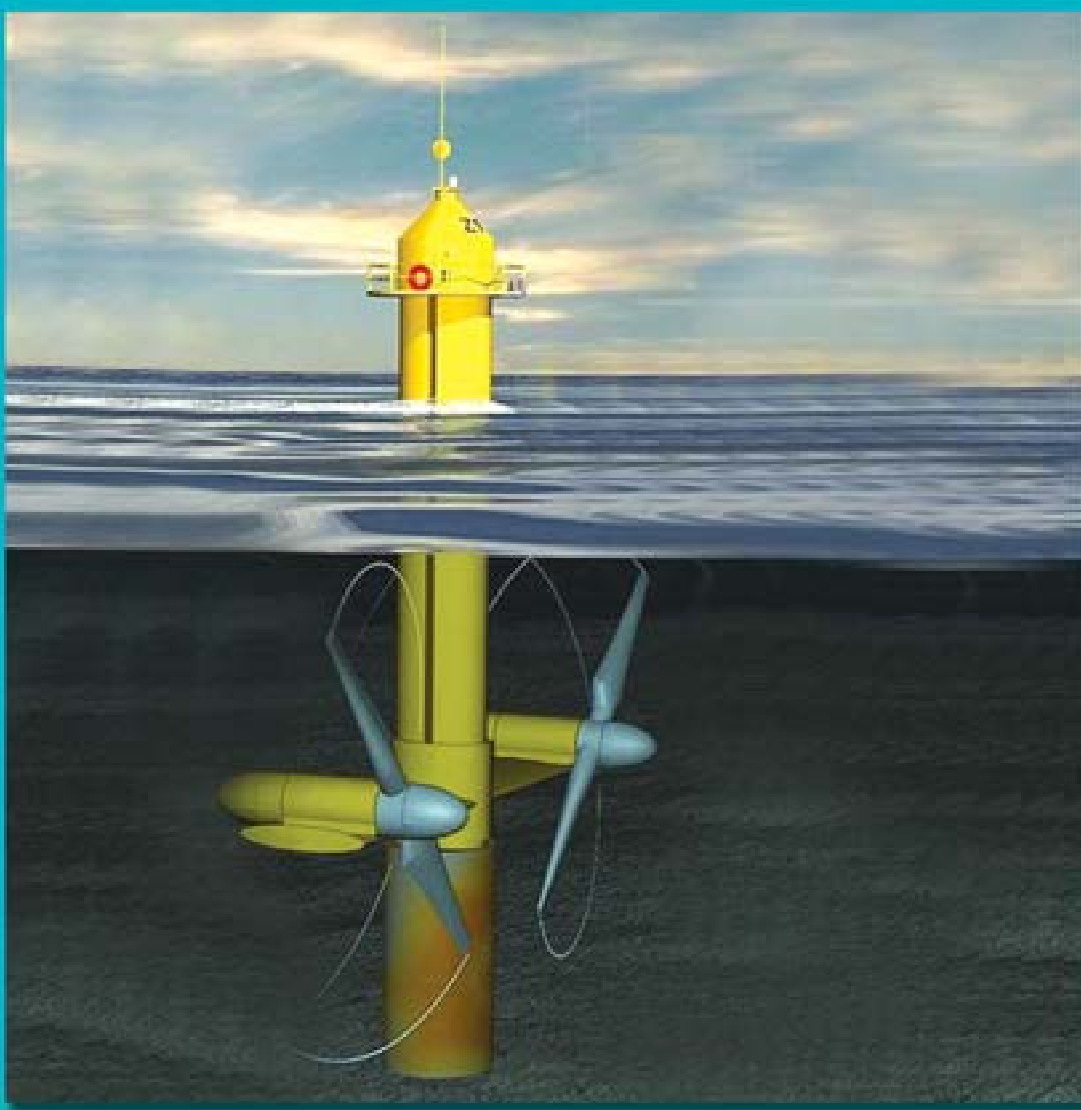

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President's Message

Norman Miller

After many years of service, Norman Miller is stepping down as our Vice President for Professional Activities. Norm has been the foundation of many of our programs and I thank him for his support and his energetic labors for the Oceanic Engineering Society. Norm will not be leaving us. Rather he will take on some projects near and dear to his heart.

Thomas F. Wiener

Norm has been the energy and guiding spirit behind our Student Poster Contest. OCEANS '03 marked the 14th time the Society sponsored the contest. Norm himself presented the prizes at Sea World to the accompaniment of applause from Shamu. Norm will continue as the Student Affairs Coordinator and will oversee the Student Poster Contest at each OCEANS Conference.

Please thank Norm when next you see him. You might even look him up on the web (www.oceanicengineering.org) and email him (n.miller@ieee.org).

OCEANS '03 MTS/IEEE

September's OCEANS Conference in San Diego was a roaring success. We had over participants and exhibitors. BZ to Bob Wernli and his team. And, speak it softly, there was a little BXing going on as well in a well-deserved celebration.

OCEANS/Techno-Oceans '04 MTS/IEEE

Next year we will be in Kobe, Japan. Our OCEANS Conference couples with the very successful Techno-Oceans Conference held every two years in Kobe. The organizing committee is hard at work. You may have already seen the Call For Papers.

Please plan to come to Kobe 8-11 November 2004. It's a great opportunity to meet Asian colleagues that we don't get to see very often. It will also be an unparalleled opportunity to hear about technology issues peculiar to Asia and Asian countries. In addition, touring Kobe (and indulging in the noted beef) and Osaka and the rest of Japan is not to be missed.

IEEE/OES As The Primary Source Of Oceanographic Information

Let's Get Famous!

As I was preparing my President's Report to the Administrative Committee for the San Diego meeting, it became even clearer to me that we have too long hid our light under a bushel. As I said last summer, our work as individuals and as a Society is a valuable asset for the profession, for our governments, and for the world. The problem is that we are not nearly as well known as we should be, given the resource that we represent. One of the important directions we are taking is to make the IEEE OES better known. We should be the source of choice whenever someone needs information about marine electro-technology.

One example of such identification is putting IEEE/OES on your business cards. For those of you who are Fellows or Senior Members, I encourage signing yourself in accordance with the following example.

Thomas Freud Wiener, Sc.D., LSMIEEE/OES
President, IEEE Oceanic Engineering Society

E-Notes

We have decided to institute A program of email notices to members. We plan to use this to alert members to opportunities in a timely manner. We will publish these notes irregularly. They will contain links to web pages. Todd Morrison and Diane Di Massa will be the moving force behind these communications. Please let them know your thoughts.

Elections

Congratulations to Jim Collins who was elected Vice President for Professional Activities at the Administrative Committee meeting in San Diego. He will serve in the post for 2004 and 2004. In addition to his other claims to fame, Jim has been Membership Committee Chair for the past several years, working hard to spread the IEEE/OES message. He was also the recipient of the 2002 Outstanding Service Award. Please congratulate Jim (j.s.Collins@ieee.org) on his new responsibility and offer to help.

New Membership Chair

Ken Ferer (kferer@esrthlink.net) has been appointed Membership Chair. He is taking over that post from Jim Collins. He is already on the job, having been active at the Homeland Security Technology Workshop extolling the benefits of IEEE and OES to the participants. Several new applications are in hand. Welcome, Ken! Keep up the good work.

IEEE/OES Homeland Security Technology Workshop

I have just experienced an amazing workshop. In an very shot time, Pam Hurst and Bob Bannon put together a two-day workshop dealing with technologies that support security of an individual country, with emphasis on port and coastal protection. It was a roaring success, drawing almost 400 participants and three dozen exhibitors. Among the keynote speakers were The Hon. Curt Weldin (R-PA), the Hon James Langevin (D-RI), the Hon Rob Simmons (R-CT), and Dr. David Bolka, Director, HS ARPA. The five track technical sessions were uniformly outstanding. As a former boss of mine used to say, it was eye-watering. Look for a more detailed report in the next newsletter.

The IEEE/OES Ed Early Student Poster Contest

At the San Diego Administrative Committee meeting, we decided to honor Ed Early's contribution to the Society by naming the Student Poster Contest for him. As I noted above, this year the awards were made by Vice President Norm Miller with much fanfare and ceremony, and Ed's name was prominently mentioned.

2004 Conferences

Several conferences of note will be held in 2004 including the newly initiated Baltic Symposium on Marine Environmental Research being organized by Joe Vadus and Jim Barbera and a group of people from Europe, and AUV '04 being organized by Claude Brancart. As I noted above, OCEANS/Techno-Oceans '04 MTS/IEEE will be held in Kobe, Japan with Tamaki Ura as General Chair. (See above..) We are also participating in the International Geodesy and Remote Sensing Symposium '04, which will be held in Anchorage, Alaska in September. Finally, IEEE SENSORS 2004 will be in Vienna, Austria, in October.

OCEANS 2003 Conference, San Diego, California - Opening & Plenary

Thomas F. Wiener

John Orcutt

Don Walsh

Cortis Cooper

Robert L. Wernli
(Conference Co-Chair)

Charles Kennel (Conference Co-Chair) at podium. Seated are Robert Gagosian and Leon Panetta (Thursday Keynote Speakers)

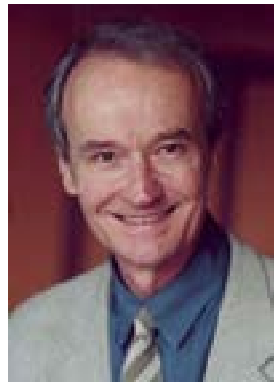
Oceanic Engineering Society

Distinguished Technical Achievement Award

1975 Robert Frosch
1976 Werner Kroebel
1977 Howard A. Wilcox
1978 Richard K. Moore
1979 David W. Hyde
1980 Neil Brown
1981 No Award
1982 Ira Dyer
1983 Alan Berman
1984 John B. Hersey
1985 William N. Nierenberg
1986 Robert J. Urick
1987 James R. McFarlane
1988 Chester M. McKinney
1989 Victor C. Anderson
1990 Robert C. Spindel
1991 Henry Cox
1992 Arthur B. Baggeroer
1993 William J. Plant
1994 Edmund J. Sullivan
1995 Mack O'Brien
1996 Frederick H. Fisher
1997 Newell Booth
1998 Burton G. Hurdle
1999 William M. Carey
2000 Albert J. Williams
2001 Werner Alpers
2002 James Candy

Distinguished Technical Achievement Award

Oceanic Engineering Society
OCEANS 2003
Georges Bienvenu



Georges Bienvenu

Georges Bienvenu graduated from Ecole Supérieure d'Electricité (Paris, 1964) and received the Docteur Ingénieur Degree from the Faculté des Sciences d'Orsay in 1973 (Thesis on Adaptive Beamforming, supervisor: Pr. B. Picinbono).

He joined the Underwater Acoustics Department of CSF in 1966, currently Thales Underwater Systems (TUS). He became the Director of the Signal Processing Laboratory, and was made the General Sonar Studies Director of TUS in 2000. (This division of Thales works in medium modelling, signal and data processing, classification, and sonar performance predictions).

He contributed to several technical application domains, including underwater communications, near field measurements of radiated noise, and data fusion, but his main contribution is in the Array Processing domain for passive sonar.

He began his research on passive adaptive beamforming in 1968. His results were published in a NATO ASI Conference in 1972, with initial at-sea tests in 1974.

In 1974, he also undertook research on so-called High Resolution Methods. He discovered the noise subspace (or orthogonal subspace) method, which he published in April 1979. Based on a noise field structure composed of point sources and background noise with a known spatial correlation (a reliable hypothesis in most sonar situations), this method shows a resolving power, which increases with the observation time, unlike conventional and adaptive beamforming. He published the statistical foundations of the method (1983), its application at the output of conventional beams or sub-arrays (1984), a method to decrease the influence of a noise spatial coherence mismatch (1980) and the coherent wideband extension using homothetic arrays obtained by interpolation (1989). This research has had an important impact on sonar performance due to the gain against self-noise and jamming signals, and in resolution power.

Georges Bienvenu has produced more than 60 papers. He has been presented two French awards: ''Grand Prix de l'Electronique du Général Férié'' (1985) and ''Prix Science et Défense'' (1988). He was elevated to an IEEE Fellow in 1991. He was General Chairman of OCEANS'98 in Nice, France, and he has served as a member of Juries of several student theses and a reviewer for several technical Journals.

Distinguished Service Award

Oceanic Engineering Society
OCEANS 2003
Joseph Czika

Joseph Czika

Joe has been a member of the IEEE Oceanic Engineering Society for nearly 20 years. Soon after joining in 1984, he was appointed Secretary, which he held for 4 years. He was elected to Vice President (1992-1994) and President for a three year term from 1994 through 1996. In other activities of the OES, he served as the Technical Committee Co-chairman for OCEANS'88, and Treasurer for OCEANS'90.

Joe's involvement with things oceanic began in 1972 when he joined NOAA's National Weather Service. In 1974 he joined SAIC and worked in the areas of submarine acoustic detection and communication, propagation modeling, and LRAP. His career then turned non-acoustic, working with NSWC's Linear Chair program to quiet magnetic and electric signatures of submarines, airborne Magnetic Anomaly Detection (MAD), and constructing signature detectability assessment models for submerged and airborne sensors. He broadened his scope by supported the Navy's SSBN Security Program in the detailed study of the detectability of submarine signatures by current and future sensor technology. He lead a team on in-depth studies of: magnetic and ELF signatures, synthetic aperture radar, hydrodynamic turbulent wakes and internal waves, laser imaging, and a variety of submarine, ship and airborne passive and active sonar systems detecting broadband and tonal signatures.

In 1983 he joined TASC, now part of Northrop Grumman Information Systems, as a program manager of support to an assessment of the foreign non-acoustic technology threat to U.S. submarines.

Joe received his Ph.D. in Physics in 1971 from Case Western Reserve University, his M.S. in Information Systems in 1996 from The American University, and his B.S. in Physics in 1962 from Case Institute of Technology. His has also enjoyed occasional teaching assignments at the University of Maryland, and The American University.

Joe was selected as one of three IEEE Congressional Fellows for the calendar year 2003. During his Fellowship, he is serving on the Committee on Science of the U.S. House of Representatives. His primary accounts are the Columbia shuttle accident investigation and homeland security technology, although he spends some time on DOE nuclear energy topics and NOAA oceans topics.

Oceanic Engineering Society

Distinguished Service Award

1975 Arthur S. Westneat
1976 Frank Snodgrass
1977 Calvin T. Swift
1978 Edward W. Early
1979 Richard M. Emberson
1980 Donald M. Bolle
1981 Loyd Z. Maudlin
1982 Arthur S. Westneat
1983 Elmer P. Wheaton
1984 John C. Redmond
1985 Joseph R. Vadus
1986 Stanley G. Chamberlain
1987 Stanley L. Ehrlich
1988 Harold A. Sabbagh
1989 Eric Herz
1990 Anthony I. Eller
1991 Frederick H. Fisher
1992 Gordon Raisbeck
1993 Edward W. Early
1994 Daniel Alspach
1995 David Weissman
1996 Glen Williams
1997 Ferial El-Hawary
1998 Norman D. Miller
1999 Pierre Sabathé
2000 Frederick H. Maltz
2001 Claude Brancart
2002 James Collins

OCEANS 2003 Shines in San Diego

It was one for the record books. Oceans 2003, the latest edition of the annual MTS/IEEE joint conference, convened in San Diego, September 22-26, 2003, drawing more than 5,000 people from 46 countries. A number of special events were open to the general public, including the San Diego Underwater Film Festival, making the conference a community event as well as international meeting. Those attendance figures, plus over 800 technical presentations, 17 tutorials, and a record 301 exhibit spaces sold, made it the largest event in the 29 year history of combined Oceans conferences. The conference produced more than 300 new members for IEEE-OES and MTS. "It was easily the best Oceans conference I ever attended," said Jim Teague, Sales Manager for Emerson-Cuming Composite Materials, (Canton, MA), echoing most speakers, attendees, and exhibitors.

Joining IEEE-OES and the MTS, were another 17 co-participating ocean and marine societies and organizations invited to create their own customized sessions. They included the American Geophysical Union-Ocean Sciences Div (AGU-OS), American Society of Limnology and Oceanography (ASLO), Acoustical Society of America (ASA), American Meteorological Society (AMETS), American Society of Mechanical Engineers (ASME), The Oceanography Society (TOS), the Association of Diving Contractors (ADC) and Alliance for Remote Marine Sensing (AMRS).

The societies were drawn together because Oceans2003 was scheduled to coincide with the 100th anniversary of the founding of the Scripps Institution of Oceanography. A large number of the Institution's friends, colleagues, and alumni came to join in a theme honoring the Scripps Centennial. Conference attendees were invited to participate in many of the celebrations, including the actual 100th birthday event on the campus of Scripps Institution on Friday, September 26, which ended with a magnificent fireworks display launched from their pier.

Oceans 2003 Chairman Bob Wernli and his veteran team complied a list of conference firsts including a mini-CD-ROM Advance Program, Interim and Final Programs updated online, the first all-digital San Diego Underwater Film Festival, the global webcast of both Plenary and Keynote sessions, and a searchable DVD containing the Scientific and Technical Proceedings, plus 3 hours of underwater video features. Organizers were also pleased with the performance of their conference website, which provided one-stop registration for attendees, exhibitors, and authors to sign-up for conference sessions, tutorials, hotel accommodations, and other conference events. The on-line payment system was developed through IEEE headquarters and their Conference Management Services. "Exhibitors even had the ability to order booth furnishings on-line from the exhibits contractor, GES," according to Exhibits Chairman Brock Rosenthal. The website drew an average of 30,000 daily website hits from a total of 117 countries, with a high of 85,000 in one day.

"Thanks to my team and a lot of hard work, Oceans2003 went off without a problem," declared Wernli. Wernli's core team of 38 volunteers was supplemented by another 80 student volunteers who pitched in during the conference itself.

"Each member of this committee," added Wernli, "was delighted to be a part of this fine gathering of scientists, technologists, students, and businessmen engaged in the common pursuit of mastering the oceans for the betterment of mankind."

The diverse and rich scientific and technical program, with supplemental sessions on ocean policy, marine education, and nautical history, was constructed by Technical Program Chair, Jack Jaeger, a familiar face to the ocean community since Oceans'75. "One big difference since 1975," said Jaeger, "is the popularity of PowerPoint as the preferred medium for speakers. We had Cat 5 Ethernet connections to all rooms, which let us use a central Authors' Ready Room to preload each speaker's presentation. We had few overheads, and virtually no slides."

The four-day technical program featured 2500 co-authors representing over 40 countries, directed by 200 session co-chairs.

The conference opened with a Plenary Session chaired by Dr. John Orcutt, Scripps Institution's Deputy Director, examining "Ocean Science at 100: Historical Precedents and Future Directions," Dr. Don Walsh discussing "Exploration: Has Everything Been Discovered?," and Dr. Cortis Cooper, ChevronTexaco, examining "Offshore Oil Industry Cooperation in Oceanography: Past and Future."

The Keynote session, "Ocean Science and Technology in the 21st Century," was co-moderated by Scripps Director and Oceans 2003 Co-Chairman Charles Kennel and WHOI Director Robert Gagosian. Speakers included representatives of the President's Commission on Ocean Policy, the Pew Oceans Commission Report, the President's Office of Science and Technology Policy (OSTP), NSF, NOAA, NASA, IOC, Scripps Institution of Oceanography, Woods Hole Oceanographic Institution, and numerous other national and international institutions, governments, and corporations.

Many social events enriched the conference experience, including a golf tournament at the championship Torrey Pines Golf Course, a special OCEANS-only Night at Sea World, and an exhibitor hosted cocktail and food reception. Other special events include an earlybird reception, MTS and IEEE award luncheons, plus concurrent meetings of the International Explorer's Club, the Passionfish Sustainable Fisheries advocacy group, and presentation of the Scripps William A. Nierenberg Prize for Science in the Public Interest. Invited exhibit hall displays included a Sand Sculpture, Human Powered Subs, and student built AUVs.

Sets of the CD/DVD Proceedings are available for $80 from IEEE-OES headquarters. The CD contains the Full Proceedings of 750 abstracts and manuscripts, a total of 650 Mb of material. The DVD also includes the full conference proceedings, plus Oceans2003 conference exhibitor profiles and product information, and 25 Scripps Exploration videos totaling 3 hours. The videos highlight Scripps Institution of Oceanography's international research projects as well as a look back at the first century of American oceanography, a total of 3 Gb of bonus material. To order your set, contact IEEE Service Center, 445 Hoes Lane, POB 1331, Piscataway, NJ 08854-1331 1-800-701-4333.

Organizing committees met to advance plans for OCEANS 2004, Kobe, Japan, November 9-12, 2004, and OCEANS 2005, Washington, D.C., September 19-23, 2005.

Oceans 2003 was a milestone event created to draw the international marine community of industry, academic institutions, government agencies, and professional societies together for the benefit of all attendees. It was great to "See you in San Diego!"

IEEE Fellow: Robert T. Bannon

Mr. Bannon is the founder and president of Bannon International Consulting LLC (1998), and S4 Intelligence LLC (2002). He is a recognized technical leader in Homeland Security, Infrastructure Protection, ITAR, and Underwater Telecommunications. He has over 35 years of design engineering, operations and maintenance program management experience in global telecommunications, underwater fiber optic systems, new sensor technologies for detecting, locating and tracking subsea cables, and development and integration of commercial ROV's for survey, repair, burial and post lay inspection/burial operations. Mr. Bannon provides expertise to the underwater and terrestrial telecommunications industry, and the oil and gas industries.

Robert T. Bannon

Bob was with AT&T and Bell Labs for 31 years. He was instrumental in the development of special underwater protection, maintenance and repair techniques for AT&T and other Trans-Atlantic and Trans-Pacific Telecommunications Companies. He was responsible for designing 18 special application ROVs, spanning five generations of underwater Remotely Operated Vehicles (ROV's), Autonomous Underwater Vehicles (AUV's), and towed devices for AT&T, Consortium and commercial applications. He directed the development of the Enhanced Bottom Sonar System (EBSS) for detection, classification and tracking of subsea commercial cables. He was the lead scientist and Senior Systems Engineer of Digital Signal Processing of sensor data for real time detection and identification for the U.S. Navy and other government agency applications. Bob made significant contributions to the use of DSP technology for underwater sonar applications. He has also integrated non-conventional sensor suites into pressure vessels for underwater applications for related special programs, and has contributed significantly to submarine battery design and telemetry systems.

In addition, Mr. Bannon is a lead scientist for several major defense contractors for special sensor technologies associated with "classified" underwater programs. Mr. Bannon develops transformational Undersea Warfare initiatives at the invitation of the U.S. Navy, and he is a National Defense Industry Association (NDIA) Blue Ribbon Panelist on "Restoring Cueing in the Contested Littorals". Bob is also a speaker and consultant on homeland security and harbor defense, as well as a 'Contributing Author' - Undersea Vehicles and National Needs (Marine Board National Academy of Science, National Research Council Commission on Engineering and Technical Systems). Mr. Bannon has been a 'Guest Lecturer' at the Armed Forces Industrial College - Future Computer Directions / Advanced Sensor Technologies and the U.S. Naval Academy - Computer Graphics. Bob is Member of the Naval Submarine League (NSL), and he is a Member of the National Defense Industry Association (NDIA).

Bob holds a BSEE, MS, and multiple MBA's from Pennsylvania State University, Wharton School - University of Pennsylvania, George Washington University, and Harvard Graduate School of Design.

Ice Breaker and Exhibits

Scripps Celebration

Scripps celebrated its 100th anniversary on September 26, 2003. A huge party was held on the newly developed Pawka Green with some 2,500 people in attendance.

The past 100 years have been exciting and eventful for Scripps, from development of the La Jolla campus to innovative ocean exploration to visits from presidents and royalty. The Scripps Timeline gives a glimpse into this colorful history.

L to R: J. Carroll, R. Wernli, P. Hurst, J. Vadus

L to R: J. Vadus, F. Spiess, A. Rechnitzer

L to R: R. Bannon, H. Narita, P. Hurst, H. Maeda, R. Wernli

L to R: T. Ura and R. Wernli admiring headgear fashioned at Scripps

Awards Luncheon

Robert T. Bannon receiving IEEE Fellow Award

Georges Bienvenu receiving Technical Achievement Award

Joseph Czika receiving Distinguished Service Award

OES Administrative Committee

Student Poster Session

Micaela Pilotto at poster.

Megan Hendry-Brogan at poster.

Norman Miller, Christina Carollo, Ed Crenshaw, Temitope Ojo, and Chris Fellows.

David Palandro, Norman Miller, Ed Crenshaw, and Megan Hendry-Brigan.

Norman Miller, Micaela Pilotto, and Ed Crenshaw.

OCEANS 2003 MTS/IEEE - Student Poster Session

Once again the student poster session at the annual OCEANS conference was a highly successful one. We received 124 student poster abstracts from students worldwide. We were able to invite 27 students to come and present their posters. Twenty Five students attended the Conference and presented their posters. The quality of the posters was very high, due in large part to modern computer graphics capability. However, the work that was presented was also of high quality and represented a lot of original research. The posters that were presented are:

A New Ocean SAR Imaging Process Simulator - Morgan Lamy, ENST Gretagne, Brest France

Large Events In The Ocean Currents - Christina Carollo, University of Reading, Reading, UK

The Systematic Optimization of the Propulsion Efficiency of Inservice Autonomous Underwater Vehicles - Chris D. Fallows, Environmental Systems Science Centre, University of Southampton, Southampton, UK

The Design and Construction of a Model Small Waterplane Area Twin Hull Vessel with Dynamic Control System -

Sheila Saraglou, Massachusetts Institute of Technology, Cambridge, MA

Main Lobe Shaping in Wide-Band Linear Arrays - Simone Curletto, Department of Biophysical and Electronic Engineering, University of Genoa, Genoa, Italy

Multi-Parameter Instrument Array and Control System (MPIACS): A Software Interface Implementation of Real-time Data Acquisition and Visualization for Environmental Monitoring - Temitope O. Ojo, Environmental and Water Resources Division, Texas A&M University, College Station, TX

Simulation and Control of an Autonomous Surface Vehicle - Tannen Van Zweiten, Department of Ocean Engineering, Florida Atlantic University, Dania Beach, FL

Design of an Inexpensive Waterproof Housing - Jeff Harrington, Engineering Department, Lake Superior State University, Sault Ste Marie, MI

Dynamic Buoyancy Control of an ROV Using a Variable Ballast Tank - Kathryn Wasserman, Massachusetts Institute of Technology, Cambridge, MA

Tension Leg Platform Design Optimization for Vortex Induced Vibration - Megan Hendry-Brogan, Massachusetts Institute of Technology, Cambridge, MA

Time-Frequency Representations For Wideband Acoustic Signals in Shallow Water - Chuen-Song Chen, University of Rhode Island. Kingston, RI

Non-Linear Dynamic Analysis With Deterministic And Random Seas: The Case Of Minimum Platforms - Micaela Pilotto, Massachusetts Institute of Technology, Cambridge, MA

Comparison of Benthic Cover Trend Between Satellite and In-Situ Datasets (1996-2002) for Reef Ecosystems of the Florida Keys National Marine Sanctuary - David Palandro, College of Marine Science, University of South Florida, St. Petersburg, FL

Tidal Modulation of Nocturnal Vertical Migration from the Benthos: A High- Resolution Acoustic Analysis - Leslie E. Taylor, University of South Florida, Tampa, FL

137Cs Distribution and Geochemistry in Savannah (Georgia) Riverine, Estuarine and Marsh Environments - Ursula Wilborn, College of Marine Science, University of South Florida, Tampa, FL

Drag Reduction of an Elastic Fish Model - Karl-Magnus Weidmann McLetchie, Massachusetts Institute of Technology, Cambridge, MA

Investigation the Doppler Effect on Measured Travel Times using Acoustic Data - Kathleen A. Philllips, University of California San Diego, San Diego, CA

Molecular Recognition of Cyanotoxin and Toxic Cyanobacteria Specific Peptides Using T7 Phage Display - Ricardo D. Burgos, University of Puerto Rica Mayaguez Campus, Mayaguez, PR

Preliminary Determination of Microbial Diversity in Several Soils in Puerto Rico by Using Molecular Analysis and Metagenomic Ligaries Generation - Ramon E. Martinez, University of Puerto Rico Mayaguez Campus, Mayaguez, PR

The Role of Eddies in a Laboratory Study of the Antarctic Circumpolar Current - David Sutherland, Massachusetts Institute of Technology, Cambridge, MA

The Collapse of Jamaican Coral Reefs: A Case Study in the Lessons of History - Marah J. H. Newman, University of California San Diego, San Diego, CA

Calls of North Pacific Right Whales Recorded in the Southeast Bering Sea - Lisa M. Munger, University of California San Diego, San Diego, CA

Rip Current - Beach Cusp Coupled Systems: Waves Currents, Sediments and Tides Self-Organized to form a Geometrical Coastal Geomorphology - Francis J. Smith, University of California, Berkley, Berkley, CA

Decimeter-level Positioning of a UUV Using GPS and Acoustic Measurements - Marine Physics Laboratory, University of California San Diego, San Diego, CA

Numerical Modeling of Tidal and Wind-Driven Circulation in the Meso-American Barrier Reef Lagoon, Western Caribbean - D.V. Thattai, Department of Geological Sciences, University of South Carolina, Columbia, SC

The Awards Ceremony for the Student Prize Winners was held Wednesday evening at Sea World, just prior to the Shamu show. The awardees were invited to come forward and received large replica checks to denote their winnings. The awards were presented by Norman D. Miller, IEEE/OES Student Activities Coordinator and Edward Crenshaw, Conference Student Poster Session Chair. Six awards were presented to six poster presenters as well as five honorable mentions:

1st Place - Micaela Pilotto
2nd Place - Megan Hendry-Brogan
2nd Place - David Palandro
3rd Place - Christina Carollo
3rd Place - Temitope Ojo
3rd Place - Chris Fellows

Honorable Mention -

Neil Kussat
Sheila Saroglou
Ricardo Burgos
Tannen Van Zweiten
Mara Newman

The Poster Judging Team included Prof. Rene Garello, Dr. Dan Alspach, Scott Jenkins, Dr. Christian deMoustier, Kim McCoy, Dr. Richard Crout, Bret Castillo, Prof Jeff Ota and Norman D. Miller. The Student Poster Session continues to grow and we are getting many more abstracts from which to make our selections. This is particularly rewarding as we are getting increased participation from students outside of the USA. The Students and Judges were all pleased with the OCEANS 2003 Poster Session.

Upcoming Conferences

ASLO/TOS 2004 Oceans Research Conference
February 15-20, 2004
Honolulu, Hawaii
Helen Schneider Lemay
254-776-3550 or email
helens@sgmeet.com

Advances in Technology for Underwater Vehicles
March 16, 17, 2004
London, England
www.imarest.org

UT '04 IEEE International Symposium on Underwater Technology
April 20-23, 2004
Taipei, Taiwan, R.O.C.
http://ut.na.nfu.edu.tw/ut04

Offshore Technology Conference
May 3-6, 2004
Houston, Texas
www.otcnet.org

U.S.- Baltic International Symposium
June 15-17, 2004
Klaipeda, Lithuania
www.oceanicengineering.org

IGARSS 2004
September 20-24, 2004
Anchorage, Alaska
www.igrss04.org

Oceans/Techno-Oceans 2004
November 9-12, 2004
Kobe, Japan
www.oceans-technoocean2004.com

Non-linear Dynamic Analysis with Deterministic and Random Seas: the Case of Minimum Platforms

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Abstract - Minimum facilities platforms have a very simple configuration and are largely used in shallow water environments. Since their natural period is several times smaller than the design wave period, the design is usually carried out via a quasi-static analysis amplified “a posteriori” by a dynamic amplification factor. In this paper, we investigate the limitations of this approach by comparing quasi-static and dynamic results of a non-linear, time domain, finite element analysis. Three different configurations of minimum platforms are considered: one freestanding caisson and two braced monopods. We begin by investigating the response under deterministic seas, using the Stream Function formulation. We then extend the analysis to random seas, using the JONSWAP spectrum with parameters measured from the North West Shelf of Australia. The first important result is the existence of a considerable dynamic amplification under both deterministic and random seas. Interestingly, braced configurations are dynamically more sensitive than the unbraced monopod, even if the latter exhibits the largest top displacements. This can be inferred in the deterministic case from the higher values of the dynamic amplification factor. Under random waves this is further confirmed by the fact that the dynamic response of braced monopods exhibits resonant phenomena, and in particular is very sensitive to ringing. Ringing is characterized by sudden, large responses lasting for relatively short periods of time. It is shown that, among the several formulations for the dynamic amplification factor (DAF) in random seas, only the one based on most probable maximum values takes ringing into account. Since so far ringing has been described mainly qualitatively in

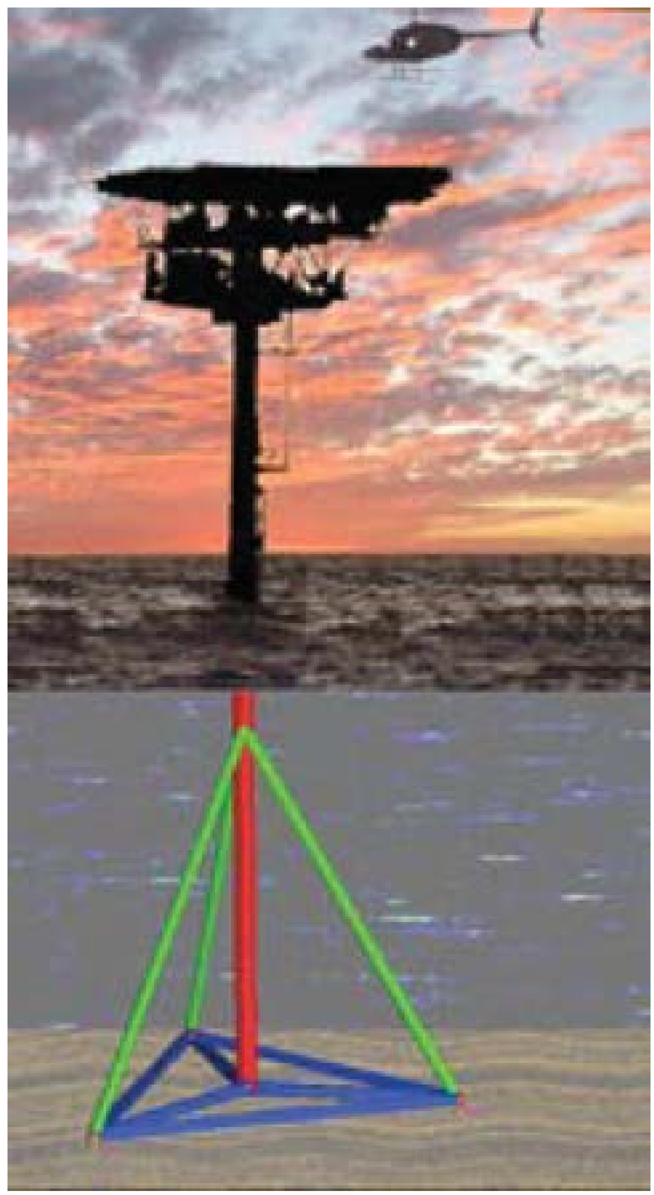

Fig. 1. A braced minimum facilities platform

the literature, we suggest an innovative, quantitative indicator of ringing based on a careful assessment of its phenomenological properties. We are therefore in a position to quantitatively compare the ringing behavior of different structures. This analysis confirmed that braced monopods are particularly sensitive to ringing. In conclusion, we show that for design purposes the use of deterministic versus random seas as a simulation tool for the real ocean is conservative, yielding higher values of the dynamic response for all configurations. However, particular resonant phenomena, such as ringing, are not detected by a deterministic simulation.

I. INTRODUCTION

Minimum platforms (e.g. Fig. 1) are becoming an increasingly popular solution for the development of marginal offshore oil and gas fields because of their low fabrication cost and the possibility of standardizing the design [1]. Typical structural designs for minimum platforms include free standing and braced caissons. Low levels of redundancy and greater flexibility compared with traditional offshore platforms characterize these structures. Platform dynamics may play a crucial role in the design of these structures. The natural period of minimum platforms (typically 1.5 – 2.5 sec) is usually much smaller than the period of the design wave (typically 12 – 13 sec for North Sea and Australia's North West Shelf), and this generally implies an insignificant dynamic amplification. Therefore, structural analysis is conventionally carried out using deterministic wave approach (Stokes or Stream Function, [2]) to calculate the forcing. Results from a quasi-static analysis are amplified "a posteriori" via a dynamic amplification factor, typically calculated from a single degree of freedom model. However, the nature of the hydrodynamic loading (which is drag dominated), the nonlinear motion of the free surface, and the slenderness of the structures can make minimum structures extremely sensitive to loads associated with higher harmonics of the forcing wave, and therefore dynamically excitable even under waves of periods four to five times larger than the natural period of the structure. Furthermore, the dynamic amplification factor of a single degree of freedom system is smaller by up to a factor of 2.5 compared with that computed from a full dynamic analysis of these structures.

II. NUMERICAL MODELS

Three different models are considered in order to compare a range of minimum structures (Fig. 2). The models have been kept simple on purpose to highlight some trends in monopod behavior. Model 1 is the most commonly analyzed single vertical cylinder, restrained at the mud-line. Model 2 is also a vertical cylinder, restrained at the height of the apex, the point where the braced substructure starts. This is to simulate a case with substantial stiff bracing below the apex. Model 3 is a simple braced monopod with the apex in the same position as Model 2. All models have the same caisson cross-section with a diameter of 1.8 m and the same material characteristics and damping ratio (ξ =1.5%). We have chosen to impose the fundamental natural period (T_n = 2.5 s) to be the same for all the models by varying the lumped mass at the top of the structure (Table I) in order to consistently compare their dynamic behavior. For a justification of the selection of these models refer to Pilotto et al. [3].

TABLE I
MASS OF THE MODELS

	Top mass [t]	Structure mass [t]
Model 1	7.95	86.5
Model 2	220.6	43.2
Model 3	121.5	189.7

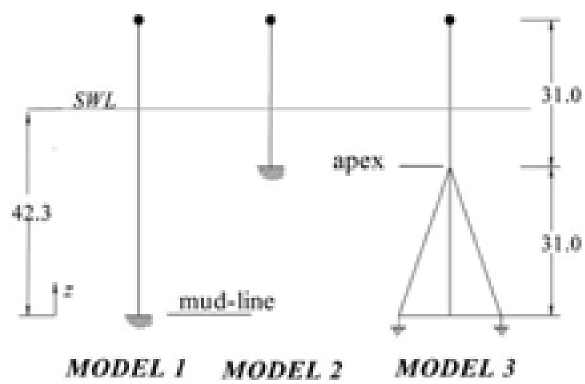

Fig. 2. Geometric characteristics of the three models.

III. ANALYSIS IN DETERMINISTIC SEAS

We analyzed the behavior of minimum platforms under deterministic seas using the Stream function [2] of eighth order to simulate the sea state. The characteristics of the wave are given in Table II for the Wandoo location in Australia's North West Shelf [4]. Under these conditions the problem is non-linear. The non-linearity is due to three factors: to the wave theory (Stream function), to the quadratic relation between velocity and drag-force (the u|u| term in Morison's formula, where *u* is the horizontal particle velocity) and to the shallow water environment (large H_w / d, where H_w is the wave height and d is the water depth). The main effects of these non-linearities are to spread the energy provided by the wave forcing over higher harmonics, therefore making these structures dynamically excitable.

A. Dynamic Amplification factor

In deterministic seas the dynamic amplification factor is defined as the ratio between the maximum dynamic response versus the maximum quasi-static one. Two main features are observed. First, the *DAF* increases up the water column (Fig. 3). Second, the different slopes of the three lines indicate that the dynamic sensitivity increases considerably faster up the water column for Models 2 and 3, as compared to Model 1. This is due to three reasons. The first is the stronger non-linear behavior of Models 2 and 3, best explained in terms of energy distribution (see next section). The second reason depends on the different magnitude of displacements for the three models. Since Model 1 exhibits larger displacements, and therefore velocities (the natural period being the same) than Models 2 and 3, damping plays a stronger role in the dynamic response of Model 1. The third reason is related to the different masses at the top of each structure, with the *DAF* increasing more rapidly for larger masses [3].

TABLE II
WAVE CHARACTERISTICS OF THE WANDOO LOCATION (NORTH WEST SHELF) FOR A 100 YEAR RETURN PERIOD [4]

H_w (m)	T_w (s)	d (m)
20.9	12.5	42.3

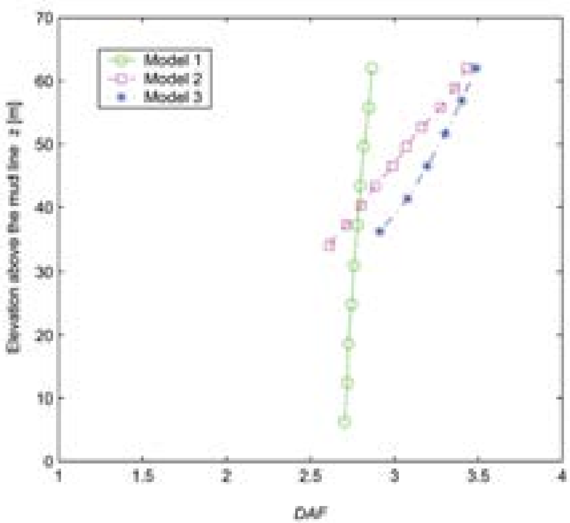

Fig. 3. Dynamic amplification factor along the water column for displacements in deterministic seas.

B. Power Spectral Density

The dynamic response of each configuration is compared in terms of the power spectral density of the response. We found that braced monopods (Models 2 and 3) experience greater excitation than the more common analytical model of a vertical cylinder. This is explained by the fact that the power spectral density of the static response shows that Models 2 and 3 have more energy at higher frequencies than Model 1 (Fig. 4). This means that they can be dynamically excited by a wave with a period four or five times their natural period more easily than Model 1. This fact can be observed in Fig. 4. Here an energy ratio *R* has been computed as follows. For each model the power spectral density of the top static displacements has been normalized by its maximum static displacement. Then, for each model, *R* is computed as the ratio between the normalized power spectral density of the model and that of Model 1. Therefore $R = 1$ for Model 1. This allows us to properly compare the energy of the three models for each harmonic of the fundamental forcing frequency. It is clear from Fig. 4 that Models 2 and 3, while having less energy than Model 1 at the fundamental forcing frequency, experience stronger forcing at higher harmonics. Thus, a dynamic analysis is essential for these structures even if the wave frequency is very different from the first natural frequency and even if the dynamic amplification factor for the equivalent single degree of freedom structure is only marginally larger than unity.

IV. RANDOM SEAS

The behavior of the same three structural configurations has also been studied under random seas. The JONSWAP spectrum with the parameters given in Table III corresponds to deterministic wave in Table II. The results show that in random seas braced monopods can develop a peculiar resonant response known as ringing (Figs. 6 and 7). We also observe that for drag-dominated structures ringing is not only due to the non-linearity in the forcing, as reported in the literature [5], but also to the stiffness of the caisson and to the presence of a substructure, which concentrates the dynamic response in the wave zone.

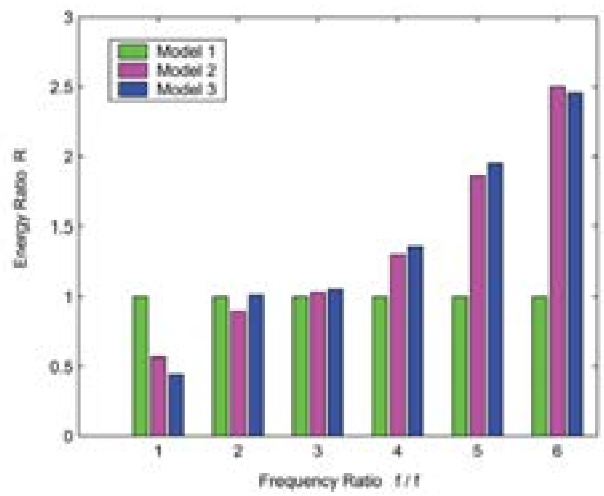

Fig. 4. Energy ratio of the three models for top static displacements. F is the natural frequency, f_W is the wave frequency.

TABLE III
PARAMETERS OF JONSWAP SPECTRUM FOR THE NORTH WEST SHELF FOR A 100 YEAR RETURN PERIOD [4]

H_s (m)	T_p (s)	χ	σ_a	σ_b
12.2	14.7	2	0.082	0.098

A. Dynamic Amplification factors

In order to obtain a practical measure of the dynamic amplification we compared two definitions of the dynamic amplification factor given in *SNAME* [6]. The first (DAF_1) is defined as the ratio between the standard deviation of the responses, dynamic versus quasi-static:

$$DAF_1 = \frac{\sigma_{dyn}}{\sigma_{sta}} \quad (4.1)$$

The second (DAF_2) is given in terms of the most probable maximum extremes (*MPME*) of the response, again dynamic versus quasi-static:

$$DAF_2 = \frac{MPME_{dyn}}{MPME_{sta}} \quad (4.2)$$

The *MPME* is defined as the mode value, or the highest point on the probability density function with 63% chance of exceedance. In practice this corresponds to a 1/1000 probability in a 3-hour storm. For Gaussian processes the MPME can be determined analytically. In the case of nonlinear, non-Gaussian processes, such as the response of minimum facilities platforms (Table IV), approximate methods are required to generate the probability density function of the process. The method proposed by Winterstein [7] and further refined by Jensen [8] fits a Hermite polynomial of Gaussian processes to transform the non-linear, non-Gaussian process into a mathematically tractable probability density function [6]. We used the method of Winterstein and Jensen, as suggested also by Yan Lu et al. [9], because it is believed to be the most efficient.

In Fig. 5 DAF_1 and DAF_2 are presented for all three models as a function of the position along the water column. As observed in the deterministic case, both *DAF*s increase up the water column, showing that the dynamic response is enhanced in the wave zone, particularly for Models 2 and 3. In both deterministic and random seas the unbraced model (Model 1) exhibits the weakest dynamic amplification: the dynamic amplification factor is the smallest of the three models and does not increase significantly up the water column. Models 2 and 3, on the other hand, are shown in both cases to be dynamically sensitive. The values of both *DAF*s are smaller than those in the deterministic case for both displacements and bending moments. This is because the deterministic analysis is intrinsically more conservative, in the sense that velocities and accelerations calculated for the deterministic case are larger than those measured in the field and therefore the loads on the structure and the structural response are larger.

Interestingly, while in the deterministic case Model 3 has the largest DAF, in random seas Model 2 exhibits the largest value. This is because in random seas the resonant behavior is enhanced, with ringing phenomena lasting for a long time, in the orders of minutes (Fig. 6). This behavior is not noticed in deterministic seas and greatly influences the magnitude of the dynamic amplification factor. Another feature that can be observed from Fig. 5 is that the values of DAF_2 are larger than those of DAF_1, particularly for Model 3. Taking average values over the water column, for Model 1 DAF_2 is larger than DAF_1 by about 10%, for Model 2 by 13% and for Model 3 by about 30 %. This difference can be attributed to ringing decay. This can be explained by the fact that ringing is a transient event lasting for short periods of time and does therefore not significantly influence the standard deviation of the response and thus DAF_1. On the other hand, DAF_2 is more sensitive to extreme values, because it is defined in terms of *MPME* values, and is thus more able to detect ringing. Therefore, in random seas the two *DAF*s, which could be at first considered apparently equivalent (since both capture the increase in the dynamic over the quasi-static response), are in fact different in the case that transient events, such as ringing, occur.

On the other hand, while DAF_2 can detect the dynamic amplification produced by short, temporally localized resonant events, it does not give any indication about the kind of amplification occurring. For example it cannot distinguish between springing, ringing or other resonant effects. This prompted us to define some indicators in order to specifically identify ringing events, as described in the next section.

A. Ringing

Ringing was first identified in the early 1980's in Hutton's tension leg platform model tests [10]. This resonant phenomenon is associated with large, steep waves and it has been observed to contribute significantly to the response of large-volume fixed and floating platforms [11]. Therefore, studies have focused so far mainly on large-volume structures, which are dominated by inertia and are minimally affected by drag forces ([12], [13]). However, tests performed by Sterndorff and Thesbjerg [14] showed that monopods, with a natural period ranging between 2 and 4 s, also respond dynamically to wave loading and, under certain conditions (transient, very steep waves), exhibit ringing. Moreover Nedergaard et al. [5] observed ringing in a braced monopod, suggested the higher harmonics in the wave loading to be the cause. The effects of ringing on drag-dominated structures have never been thoroughly investigated [15], despite the potential importance of ringing from the structural point of view, in particular with respect to increased loads and fatigue [16]. Furthermore, the fact that the bending moments on the upper part of the caisson are amplified by ringing, is of interest in view of the fact that the failure of the Campbell monopod [17] occurred in the wave zone. Our approach will be twofold. First, we will define three ringing indicators, in order to be able to compare the effect of ringing on the three models. Second, we will reinterpret their quasi-static and dynamic response in light of those indicators.

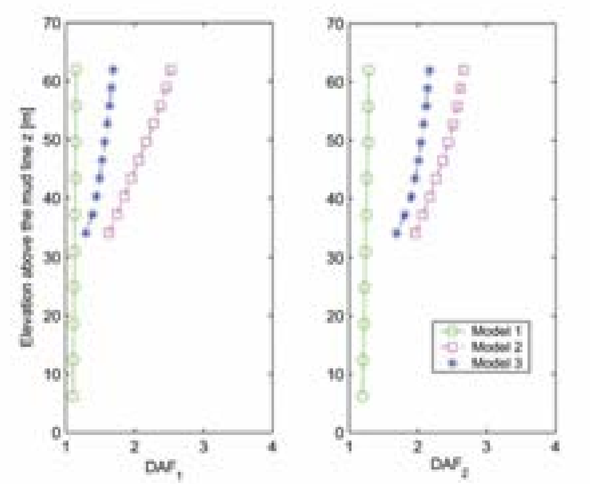

Fig. 5. Dynamic amplification factors (DAF_1 and DAF_2) in random seas for the top displacements of the three models up the water column.

1) Phenomenological Characteristics of Ringing

A Gaussian distribution is the frequency distribution of many natural phenomena and its graph is the well known bell-shaped curve. This curve is symmetric with respect to the mean and has skewness equal to zero and kurtosis equal to three. It is also known that ocean waves can be modeled as a linear random superposition of sinusoidal waves, which are entirely described by the wave spectrum. The statistics of the underlying random process are Gaussian. On the other hand, the free surface effects together with the fact that drag forces introduce nonlinearities to the wave kinematics, make the hydrodynamic forcing always non-linear. As a result, the random excitation is non-Gaussian and the response of the drag-dominated structures is therefore also non-Gaussian. This can be seen from the parameters given in Table IV for the top displacements of the three models. In particular skewness and kurtosis have very high values. However, these parameters by themselves do not capture the presence of ringing, as suggested by [12] among others. Indeed, Models 1 and 3 have the largest values of skewness and kurtosis, but it is Models 2 and 3 that exhibit ringing, while Model 1 does not. Clearly another way of quantifying ringing must then be found.

Ringing is usually characterized by a sudden, strong amplification in the response. The initial peak, much larger than the previous oscillations, is then followed by a number of slowly decaying peaks. A typical event can be seen in Fig. 7, bottom panel. We can quantify this by saying that there is a ringing event when all three of the following criteria are verified:

TABLE IV
STATISTICAL PARAMETERS OF THE DYNAMIC RESPONSE OF THE TOP DISPLACEMENTS FOR THE THREE MODELS. THE SECOND COLUMN INDICATES THE RANGE OF VALUES ASSUMED BY THE PARAMETERS IF THE RESPONSE WERE GAUSSIAN. CLEARLY ALL THREE MODELS BEHAVE IN A NON-GAUSSIAN FASHION.

Parameters	Gaussian response	Model 1	Model 2	Model 3
μ (mean)	0	0.0323	0.0018	0.0044
σ (std. dev.)	$0.25H_s \pm 1\%$	0.2630	0.0180	0.0255
α_3 (skewness)	$-0.03 \div 0.03$	1.94	0.68	2.23
α_4 (kurtosis)	$2.9 \div 3.1$	14.79	6.81	21.08

1. The first peak is much larger than the average magnitude of all peaks. The latter can be taken to be proportional to the standard deviation of the response, with a proportionality factor K. This reflects the fact that ringing is indeed characterized by a strong amplification of the response. With this criterion we consider as ringing phenomena only those peak responses that are considerably larger than an average response.
2. When a peak obeys criterion one, the following peaks must be smaller than the first one and they must be of large enough number (N_{foll}). This criterion captures the slow logarithmic decay after the first, large peak which is typical of ringing.
3. A certain number of peaks (N_{prec}) preceding the first one must be considerably smaller than the first peak, in order to have the sudden start which is characteristic of ringing. In particular, we chose to require those N_{prec} peaks to have less than half the amplitude of the first one. This criterion reflects the suddenness of initiation of ringing.

The values of these parameters (K, N_{foll}, N_{prec}) need to be chosen. We have taken $K = 4$, $N_{foll} = 6$, $N_{prec} = 5$. A MATLAB routine has been written in order to automatically detect ringing events for a given time series (Figs. 6 and 7). While there is admittedly a certain degree of freedom, and therefore subjectivity, in our choice of the parameters, there is no doubt that once a set of parameters has been picked, comparison among different ringing events becomes quantitative and objective. Furthermore, the above values were carefully chosen after a prolonged tuning exercise so as to identify as ringing events those and only those events which most naturally appear as such by visual inspection of the time series. The difference with several previous qualitative descriptions of ringing resides in the fact that we have been able to translate the phenomenological characteristics of ringing into simple and yet objective criteria, allowing quantitative prediction of the ringing behavior for different models and different conditions.

2) Ringing Indicators

The criteria introduced in the previous section allow us to detect ringing events in a time series. To extract quantitative information from this result, some further parameters must be computed. Three indicators have been identified as important in characterizing a ringing response: the first is simply the number (N_R) of ringing events that occur in a time series. The second (m_R) is a measure of the average amplification that occurs during a ringing event. This is defined as the average of the maximum value of each event divided by the standard deviation of the whole time series. The third (M_R) captures the maximum value of the amplification exhibited by the structure. It is calculated as the ratio of the maximum ringing peak to the standard deviation of the entire response. In Table V the values of these three parameters are given for the three models for both apex bending moments (BM) and top displacements (TD). It can be seen that the indicators reflect the behavior of the models, which we previously described only in a qualitative fashion. In fact, ringing is almost absent for Model 1. In this case, with only one event characterized as ringing for the bending moments (N_R = 1) and none for the top displacements, the values of m_R and M_R are not representative. On the other hand, Models 2 and 3 are comparable. They have approximately the same number of ringing events for both top displacements and apex bending moments. However, Model 3 has larger values of m_R and M_R than Model 2. This is interesting because, as we have seen in the previous section, the dynamic amplification factors attained by Model 2 are larger. However, Model 3 experiences stronger and more sudden ringing, as indicated by m_R and M_R.

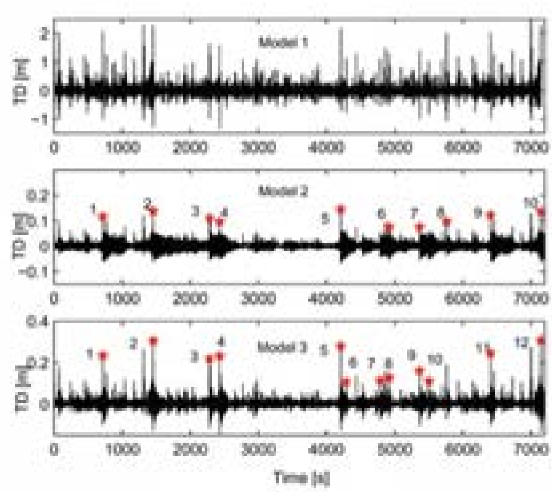

Fig. 6. Ringing in the top dynamic displacements (TD) for a two-hour simulation. The stars characterize the start of a ringing event as defined in the text and ringing events are numbered progressively. Models 2 and 3 exhibit ringing, Model 1 does not, despite its larger amplitudes (note the

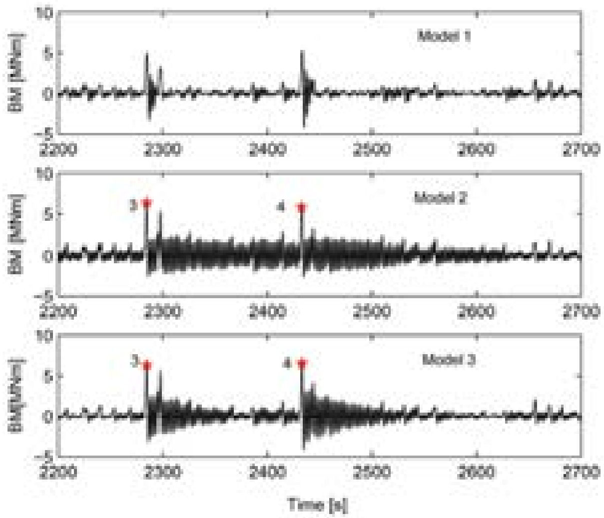

Fig. 7. Ringing in the bending moments at z=31 m (BM) for a two-hour simulation. The stars characterize the start of a ringing event as defined in the text and ringing events are numbered progressively. A close up on events 3 and 4 is shown.

TABLE V
RINGING INDICATORS FOR APEX BENDING MOMENTS (BM) AND TOP DISPLACEMENTS (TD) FOR THE THREE MODELS DURING A TWO-HOUR SIMULATION.

	Model 1		Model 2		Model 3	
	BM	TD	BM	TD	BM	TD
N_R	1	0	9	10	11	12
m_R	11.2	0	7.4	6.2	8.4	8.0
M_R	11.2	0	9.2	8.0	12.2	12.1

B. Power Spectral Density

In order to explore how the dynamic response influences the energy of the monopods, we computed the power spectral density of the dynamic response. In Fig. 8 the power spectral density of the dynamic top displacements is compared among the three models. Also included in the comparison is the spectrum of the wave elevation. Model 1 has a larger amount of energy because it exhibits the largest top displacements. The largest peak is at the same frequency (0.07 Hz) as the peak frequency of the wave elevation and it is due to direct wave forcing. Models 2 and 3 have less energy (smaller top displacements) but at the frequency of 0.4 Hz (first natural mode) they exhibit a sharp increase in the power spectral density, which reaches values close to those of Model 1. This is again due to ringing, which amplifies the response at the natural frequency and therefore increases significantly the energy density at 0.4 Hz.

A closer look at the peaks at 0.4 Hz shows that Model 2, which overall has less energy than Model 3, overcomes the energy of Model 3 at the natural frequency. This is due to the fact that Model 2, being stiffer, overall exhibits smaller displacements than Model 3, but when ringing occurs the amplification is longer lived than that of Model 3. In order to compare the overall energy of the three models, the integral of the power spectral density, representing the total energy in the response, has been calculated for the quasi-static and dynamic cases. The ratio of the total dynamic and the total quasi-static energies can be considered as another index of the dynamic amplification, whose physical meaning is close to that of the dynamic amplification factor. In Fig. 9 this energy ratio is plotted for each node of the structures along the water column. The behavior of the total energy ratio is remarkably similar to that of the dynamic amplification factors seen previously (Fig. 5). Like the dynamic amplification factor, the total energy for Model 1 is smallest and increases only slightly up the water column. Model 2, on the other hand, has the largest total energy, strongly increasing up the water column, due to its resonant behavior and its large stiffness. Model 3 shows an intermediate behavior, as it did in terms of the dynamic amplification factors.

In order to further investigate how the power spectral density varies along the water column and how the two main peaks contribute to the total energy in the upper part of the structure, the power spectral density for the displacements of Model 3 has been plotted in Fig. 10 as a function of the vertical position along the water column starting from the apex up. It can be seen that the strength of the peak at 0.4 Hz increases up the water column (larger values of z), showing even more clearly that the dynamic response is enhanced in the upper part of the structure. Fig. 11 shows the same plot, but for the bending moments. In this case, looking more closely at the low frequencies, it can be observed that the first peak (the one at 0.07 Hz), due directly to wave forcing, decreases dramatically going up the water column. This is best seen in Fig. 12, where the first peak (at 0.07 Hz) and the second peak (at 0.4 Hz) are plotted along the water column. The fact that the energy decreases up the water column is consistent with the general behavior of the bending moments, which are greater at the apex for Model 3 and decrease upwards. However, up in the water column the "ringing" peak at 0.4 Hz still retains a considerable amount of energy, comparable with the energy at the apex.

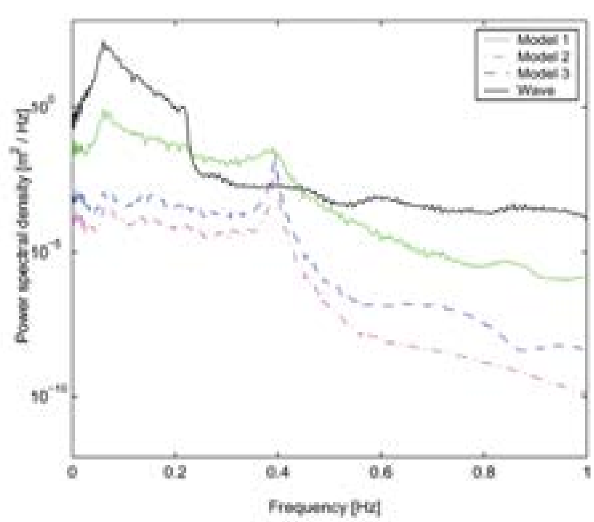

Fig. 8. Power spectral density of the dynamic top displacements for the three models. Also shown is the power spectral density of the wave elevation.

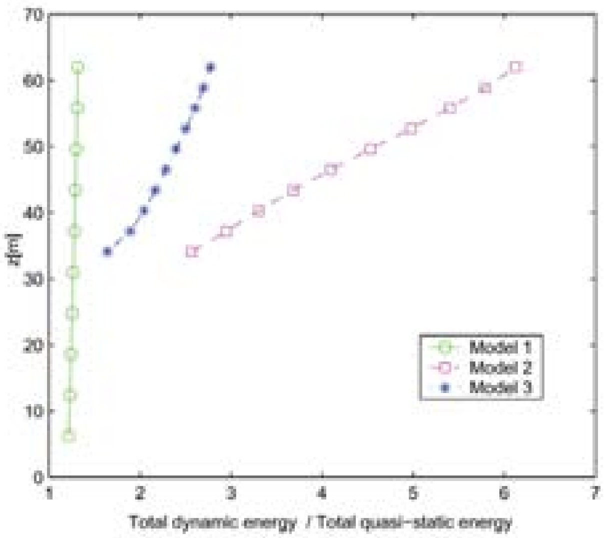

Fig. 9. Ratio of the total dynamic energy and the total quasi-static energy along the water column for the three models. Both energies are calculated as the integral of the power spectral density from Fig. 8. Compare with the dynamic amplification factors in Fig. 5.

V. COMPARISON OF BENDING MOMENTS

Since the design of monopod structures is generally governed by bending moments, it is interesting to compare the dynamic bending moments under random seas, and in particular their most probable maximum values, with the quasi-static deterministic moments amplified by the dynamic amplification factor of a single degree of freedom model ($DAF_{SDOF} = 1.05$), which is used in design practice. In Fig. 13 these values are compared. As expected, the design moments (deterministic quasi-static amplified by DAF_{SDOF}) are larger than those found with the random seas dynamic analysis. This indicates that, in general, the design is conservative. However, while the ratio between deterministic quasi-static and random dynamic moments is large at the base (Model 1) or at the apex (Models 2 and 3), higher up in the water column this value becomes smaller, thereby decreasing the safety margin in the wave zone.

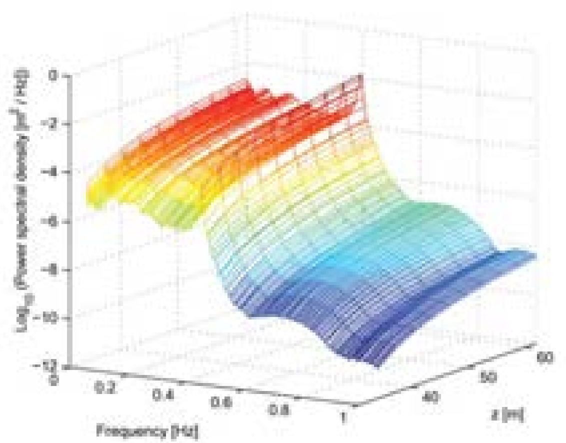

Fig. 10. Power spectral density of the displacements of Model 3 for each node along the water column.

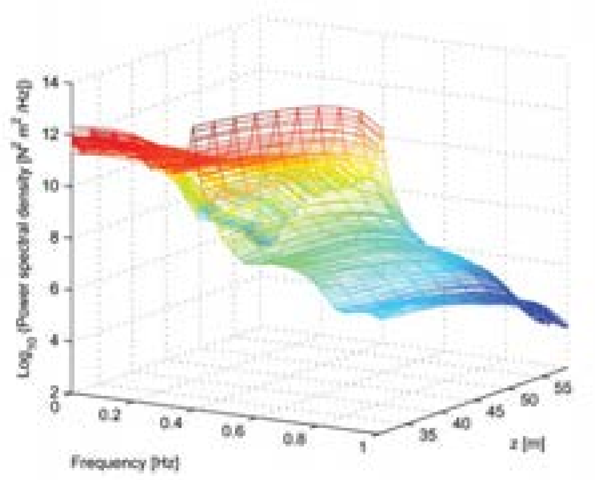

Fig. 11. Power spectral density of the bending moments of Model 3 for each node along the water column.

This is clearly shown in Fig. 14, where the ratio of the bending moments presented in Fig. 13 is plotted. It can be noted that, while the ratio increases up the water column for Model 1 reaching values of seven or more, for the braced configurations (Models 2 and 3) the ratio decreases rapidly to values as low as 1.5. Since in design practice other factors intervene, namely the presence of internal conductors and risers and installation requirements, usually the caisson's diameter is constant along the water column for economical and practical reasons and is able to withstand the upper bending moments.

Therefore, the fact that bending moments under random seas decrease more slowly up the water column than design values should not in general be a concern for safety. However, a more optimized design would suggest taking advantage from two facts. First, that bending moments are actually smaller than those predicted with a deterministic quasi-static analysis. Second that their decrease along the water column is by no means as fast as predicted in the quasi-static determinis-

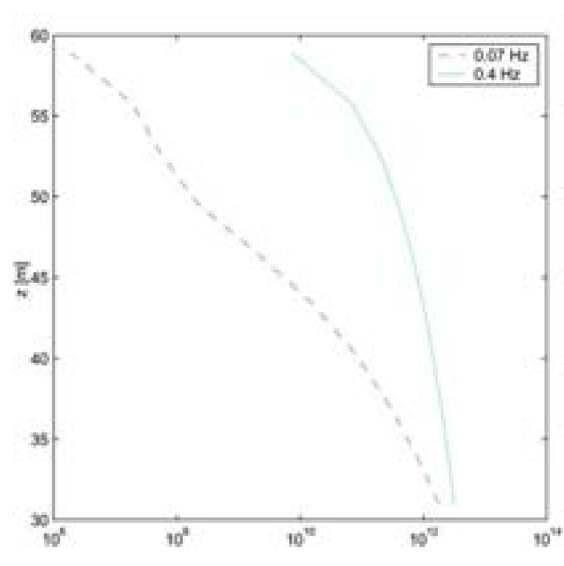

Fig. 12. Power spectral density of the bending moments for Model 3 along the water column for the first peak (at 0.07 Hz) and the second peak (at 0.4 Hz).

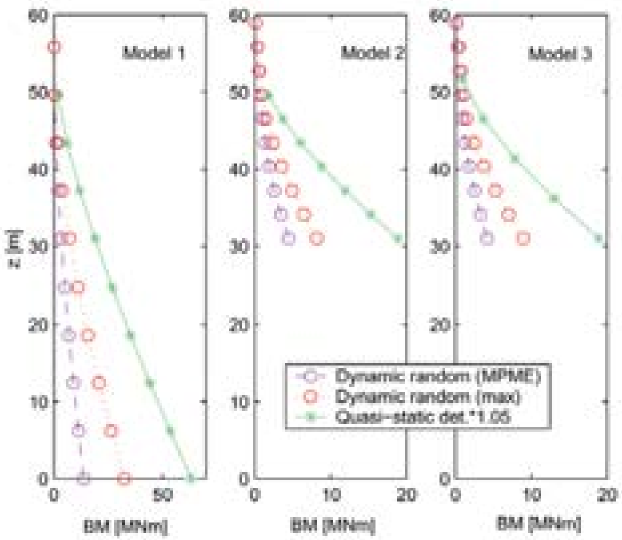

Fig. 13. Comparison of quasi-static bending moments obtained with the deterministic wave and amplified by the dynamic amplification factor of a single degree of freedom model (DAF_{SDOF} = 1.05) and dynamic bending moments (most probable values) obtained with random sea simulations. The quasi-static response was calculated using the Stream function of order eighth.

tic case. Furthermore, while the usual design practice is in general conservative, the above argument suggests a possible explanation of what might have contributed to the failure of the Campbell monopod in the wave zone. A reduced safety margin of the random dynamic versus the design quasi-static moments, possibly coupled with additional factors, may have been the case for this failure.

VI. CONCLUSIONS

In this paper, we performed non-linear, time domain, finite element analyses of three different configurations of minimum platforms. We first investigated the response under deterministic seas, using the Stream Function formulation. We then extended the analysis to random seas, using the JONSWAP spectrum. The parameters used in both cases are for the North West Shelf of Australia. We found that minimum structures, which typically are designed using quasi-static regular wave results amplified by the dynamic amplification factor for a single degree of freedom model, are strongly dynamically sensitive in both deterministic and random seas. Our study shows that braced and unbraced structures perform very differently, with the braced configurations being dynamically more sensitive than the unbraced ones, even if the latter exhibit larger top displacements.

Ringing has been identified as the main feature of the random sea analysis of the braced models for bending moments and displacements. It has been shown that in general two parameters can detect the dynamic amplification due to ringing, namely the dynamic amplification factor defined in terms of MPME and the ratio of the dynamic and quasi-static total energies. However, since these parameters are not able to recognize the kind of resonance causing the amplification in the response, we defined three indicators in order to specifically identify a ringing event. Results show that Model 3 is the one most affected by ringing.

We compared these results with those of a non-linear dynamic analysis in random seas. Our conclusions show that for design purposes, the use of deterministic versus random seas as a simulation tool for the real ocean is conservative, yielding higher values of the dynamic response for all configurations. However, particular resonant phenomena, such as ringing, are not detected by a deterministic simulation and the safety margin of the design values decreases strongly in the wave zone.

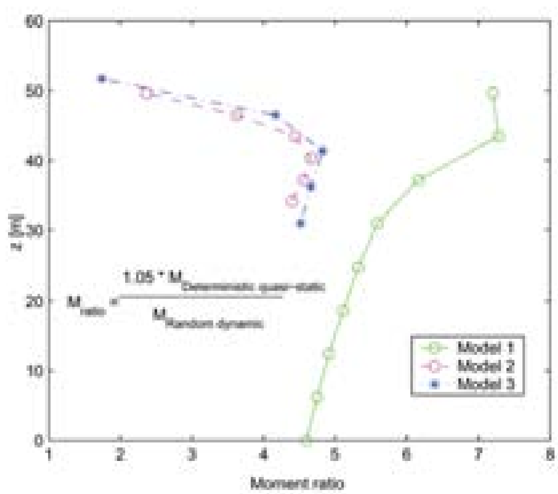

Fig. 14. Ratio between quasi-static bending moments obtained with the deterministic wave and amplified by the dynamic amplification factor of a single degree of freedom model (DAF_{SDOF} = 1.05) and dynamic bending moments (most probable values) obtained with random sea simulations.

ACKNOWLEDGMENTS

This work was undertaken as part of a research project within the Cooperative Research Centre for Welded Structures (CRC-WS), whose support is gratefully acknowledged. The entire project has been possible thanks to an International Postgraduate Fee Exemption Scholarship and a University of Western Australia Postgraduate Award. A particular thank you to Dr. Geoff Cole, whose detailed comments are always greatly appreciated.

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Sources of Information and Assistance

Deadline: March 15
The *Fellow Nomination Kit* can be acquired via the Fellow Program Website (http:/www.ieee.org/about/awards/fellows) or requested by e-mail (fellow-kit@ieee.org). Also the new Electronic Fellow Nomination Process (EFNP) is available.

OES Fellow Committee Chair: Dr. David E. Weissman,
Hofstra University, Hempstead, New York 11549
(e-mail: eggdew@hofstra.edu)

Soundings by John Irza

Welcome to the latest installment of “Soundings”, a column that reports on a broad spectrum of news items from the mainstream media as they relate to Ocean Engineering technologies. The purpose of this column is to inform the ocean engineering community of our industry’s visibility in the media and how the general public perceives our efforts.

Walking On Water

Many news services reported on an article appearing the science journal Nature that describes the the real secret to walking on water. Professor John Bush and colleagues from MIT have discovered that insects who perform this feat do so by using one of their three sets of hairy legs like oars to create vortices or spirals in the water that propel them forward at speeds of up to 60 inches per second.

“The momentum transfer is primarily in the form of subsurface vortices,” explained Bush. This is in contrary to the popular belief that insects moved simply by creating surface waves.

Man (-made) versus Nature

In a related activity, the MIT team created their own mechanical water strider, called Robostrider, using stainless steel wire actuated middle legs and four support legs (made from stainless steel wire), modeled after live water striders. More pictures and information on the Robostrider, Robosnail, and the 3-Link Swimmer can be found on the web at http://web.mit.edu/chosetec/www/robo/

Sponges Clean Up in Fiber Tech

In yet another example of nature's talent for engineering, another recent Nature article described how scientists have a discovered a sponge existing in dark, cool waters that produces high quality optical fibers. The sponge, nicknamed the "Venus Flower Basket," grows natural biological glass fibers up to 7 inches in length. The natural fibers are much more flexible than man-made fiber, which will break if bent too far. Scientists have tied natural fiber into tight knots and still have not broken the fiber.

The fibers exhibit optical transmission characteristics as good as man-made industrial optical fiber. More importantly, the sponge's fiber is formed at cold temperatures and also has a level of sodium added to the material which gives the fiber improved transmissibility. Commercial manufacturing technology, which uses high temperatures to create a more brittle fiber, cannot add sodium because of the temperatures involved.

The discovery is yet another example of the growing field of Biomimetics: studying naturally engineered systems and applying the knowledge to technology.

LASH-ing Out

USA Today recently ran an article describing the US Navy's plans to test the Littoral Airborne Sensor Hyperspectral, or LASH system off the coast of Japan this Fall. An earlier version of LASH had been used to detect spotted whales and submarines below the surface of the ocean. The system detects submerged targets by analyzing underwater color patterns and detecting color gradations too faint for the human eye to notice.

Because North Korean and Chinese submarines frequent the area where the testing will be conducted, the potential exists for a heightened level of tension in the area.

The LASH surveillance system, was developed by Hawaii-based Science & Technology International (STI). Because the system uses reflected sunlight to illuminate a target, it is useful only during daylight hours. More information can be found on the web at http://www.sti-industries.com/index.html

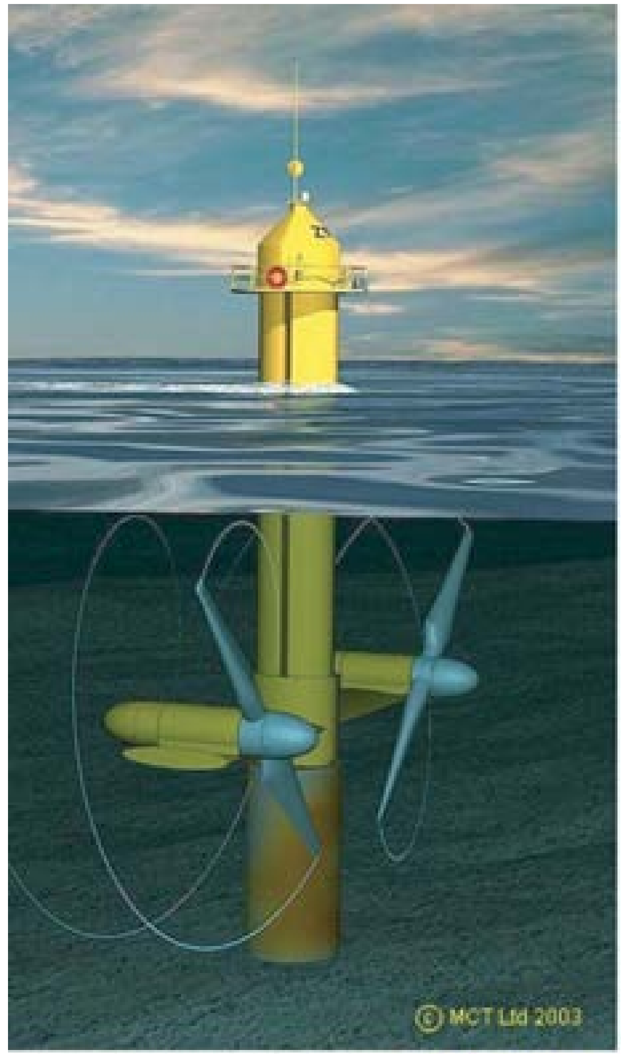
Alternative Energy: Turning the Tide

BBC News has been running a series of articles covering the installation and demonstration of a tidal driven turbine that is being deployed off the UK coast of Devon. The £3m underwater turbine uses a single 11 meter long rotor blade and is capable of producing 300 kilowatts of electricity. Because the blades rotate slowly, at 20 revolutions per minutes, the unit poses no hazard to marine life.

The single turbine demonstration unit is capable of generating enough power to light 70 houses. The developers plan to convert the system to twin rotors by the end of next year and ultimately create an underwater tidal-driven turbine farm. The project is being financed by the Department of Trade and Industry and the European Commission's energy program.

More information on the tidal turbine project can be found on the web at http://news.bbc.co.uk/1/hi/england/devon/2992996.stm or http://www.marineturbines.com/home.htm

By John Irza

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DON'T MISS!
First Joint Event of OCEANS and TECHNO-OCEAN in Japan.

OCEANS'04 MTS/IEEE / TECHNO-OCEAN'04 (OTO'04) is a joint international convention, combining annual OCEANS conference and exhibition usually held in the USA, with those of TECHNO-OCEAN held biennially in Japan. OTO'04 is the first OCEANS conference in Asia, crossing over the Pacific Ocean.

The theme of this international joint convention is "Bridges across the Oceans", which stands for our hope to provide people living in the continents and islands over the world, with bridges to connect each other, to give them chances of face-to-face talks and to exchange information on oceanic activities. You can't miss the largest and most significant convention of its kind.

KOBE, JAPAN is waiting for you to come.

The host city, Kobe, is one of the traditional port cities as well as the advanced oceanic cities in Japan. There are ocean-related organizations in research and academia, industry and public sector, including Japan Coast Guard and others, in Kobe. OTO'04 will offer you a valuable interface arena not only on ocean and coastal science, technology and engineering but also for future ocean business.

Kobe is also a very beautiful city with its sea and mountains. You can enjoy a "million dollar night view" and an easy access to Kyoto and Nara, ancient capitals of Japan. Please come and join us!

Call for papers / Tutorials / Posters

Potential authors are encouraged to submit papers and posters, or to register tutorials. You will be able to make contact with the Committee Chairpersons through the website: www.oceans-technoocean2004.com. No abstract submission fees are required.

The OTO'04 Technical Program offers a three-day session configuration, and one-day tutorials before the term on ocean, coast and marine related professional and interdisciplinary topics. Again, OTO'04 offers an important and worldwide arena for everyone in ocean-related fields across the Pacific Ocean. Suggested topics for presentation are listed below.

- Acoustics
- Coastal Engineering
- Coastal / Ocean Environment
- Deep Ocean Water Application
- Fisheries / Aquaculture
- Information Technology
- Integrated Coastal Zone Management
- Marine Bio Technology
- Marine Education / Culture
- Marine Resources
- Marine Sports & Tourism
- Naval Architecture
- Oceanic / Arctic Engineering
- Offshore Technology / Floating Structures
- Policy, Law, Security & Economics
- Port & Harbor / Marine Transportation
- Remote Sensing / Monitoring
- Renewable Energy
- Sensors
- Underwater Vehicles

IMPORTANT DATES

Call for Papers

Abstract Deadline: April 15, 2004
Notification of Acceptance: May 31, 2004
Camera-ready full paper: August 31, 2004

Call for Tutorials

Abstract Deadline: April 15, 2004
Notification of Acceptance: May 31, 2004

Call for Student Posters

Abstract Deadline: April 15, 2004
Notification of Acceptance: May 31, 2004

USA – Baltic International Symposium
"Advances in Marine Environmental Research, Monitoring & Technologies"

CMR

June 15-17, 2004
Klaipeda, Lithuania

Attending Countries

Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden & USA

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Other Organizations are pending

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SYMPOSIUM OBJECTIVES

To discuss and exchange information on:

- **problems, needs, requirements;**
- **new techniques and ideas;**
- **advances in application of new technologies.**

PROGRAM TRACKS & SUGGESTED TOPICS

TRACK 1: MARINE RESEARCH

- **Fate of pollutants**
- **Sediment transport and analyses**
- **Ocean dumping**
- **Oil spills and hazardous materials**
- **Marine biotechnologies (biological indicators)**
- **Run-off pollution**
- **Modelling**
- **Data collection, analyses and distribution**
- **Benthic respirometry**

TRACK 2: ENVIRONMENTAL MONITORING

- Real time data measurements, collection and distribution
- Status and trends
- Monitoring systems
- Satellite measurements
- Global and Baltic monitoring programs
- GOOS and GIS

TRACK 3: MARINE TECHNOLOGIES

- Oceanographic measurement (current, wave, tidal, CTD)
- Sampling techniques (water, chemistry, sediment)
- Integrated systems
- Acoustic techniques
- X-ray fluorescence and neutron activation
- Oil spill measurements and modelling
- Instrument platforms
- ROV's and robotics

Background for Prospective Authors

The Baltic Sea is a valuable natural resource shared by nine countries bordering its waters. It provides marine resources, transportation corridors, marine recreation, tourism and desirable coastal living. Economic benefits are dependent on a clean environment. The Baltic Sea is 422,000 sq. km., with a relatively shallow average depth of 55 meters. The nine countries Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, Russia, bordering the Baltic Sea are working closely together in continuous monitoring of the Baltic Ecosystem, sharing research and environmental data in order to detect and assess changes that may impact environmental health. The U. S. has similar needs and many research programs addressing coastal and global environmental problems, and can exchange information, data and experience with the Baltic Nations.

The Baltic nations are rich in sea faring tradition of plying the coastal waters for fisheries and inter nation shipping and trade. Environmental protection policies are moderate and based on sustainable development approaches. There is a growing awareness of ecological issues. Cleaning the Baltic Sea, preserving biodiversity and monitoring long range transboundary pollution are of great importance. The Baltic nations boast many protected coastal areas that also serve as parks and recreational areas. For example, in Lithuania, the Curonian Spit, a 97 km long sliver of land separates the Curonian Lagoon from the Baltic Sea. It is famous for its nature and its landscape. In 2000, UNESCO added it to the World Heritage List.

Call for Papers

We invite you kindly to attend this International Symposium. Please, send a one-page abstract addressing one of the suggested topics by E-mail to:

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Lina Siauliene
Center of Marine Research
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E-mail: lineka@delfi.lt
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Rockville, Maryland 20853 USA
E-mail: J.Barbera@ieee.org
http://www.oceanicengineering.org
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Abstract deadline: **December 30, 2003**

Abstract acceptance: **January 15, 2004**

Paper deadline: **April 1, 2004**

Abstract's Acceptance

The selection of participants of Symposium will be made by the members of the International Scientific Advisory Committee and Organizing Committee.

The basis for acceptance of abstracts is the relevance of the paper to the Symposium topics, concentration on precise research results and scientific quality. Presenting the abstracts, authors should highlight: the scientific objectives, context of their work, summary of the results and main conclusions.

Official Language

The official language of Symposium will be English. No translation will be provided.

Preliminary Structure

The Symposium will consist of Plenary Session (Part 1, Part 2), Three Major Tracks and Final Session.

Plenary Session, Part 1 and Plenary Session, Part 2. Panel of members from each of 9 Baltic nations and from U.S. Each speaker gives a 15-20 minute summary paper followed by up to 5 minutes for questions. Speakers present topics of their expertise within the scope of the theme of "Advances in Marine Environmental Research, Monitoring and Technologies" including major problems and recommendations.

Three Parallel Tracks. Track 1 "Marine Research", Track 2 "Environmental Monitoring" and Track 3 "Marine Technologies" will be held at the same time in 3 different rooms of "Klaipeda" Hotel. Each presentation shouldn't exceed 15 minutes. Time for questions and answers - 5 minutes.

Final Session. Track and Session Chairs summarize session highlights, including major problems and solutions.

Preliminary Programme Schedule

ay 1: 2004 June 15, Tuesday

08 00-08 30 REGISTRATION
08 30-08 45 Opening remarks by Symposium Co-Chairs, J.Vadus & A Stankevicius
08 45-09 15 A. Stankevičius introduces Minister or Deputy Minister for opening address
09 15-09 30 Speech of Lithuanian Minister for Environment
09 30-09 45 Coffee break
09 45-12 00 PLENARY SESSION, PART 1
12 00-13 00 Lunch
13 00-15 15 WORK IN SECTIONS
15 15-15 30 Coffee break
15 30-18 00 WORK IN SECTIONS
19 00 Reception (in "Klaipeda" Hotel)

ay 2: 2004 June 16, Wednesday

08 30-10 15 PLENARY SESSION, PART 2
10 15-10 30 Coffee break
10 30-12 00 PLENARY SESSION, PART 2
12 15-13 00 Travel to Curonian Spit
13 00-14 30 Lunch in Nida
14 30 Tour World Heritage Site

ay 3: 2004 June 17, Thursday

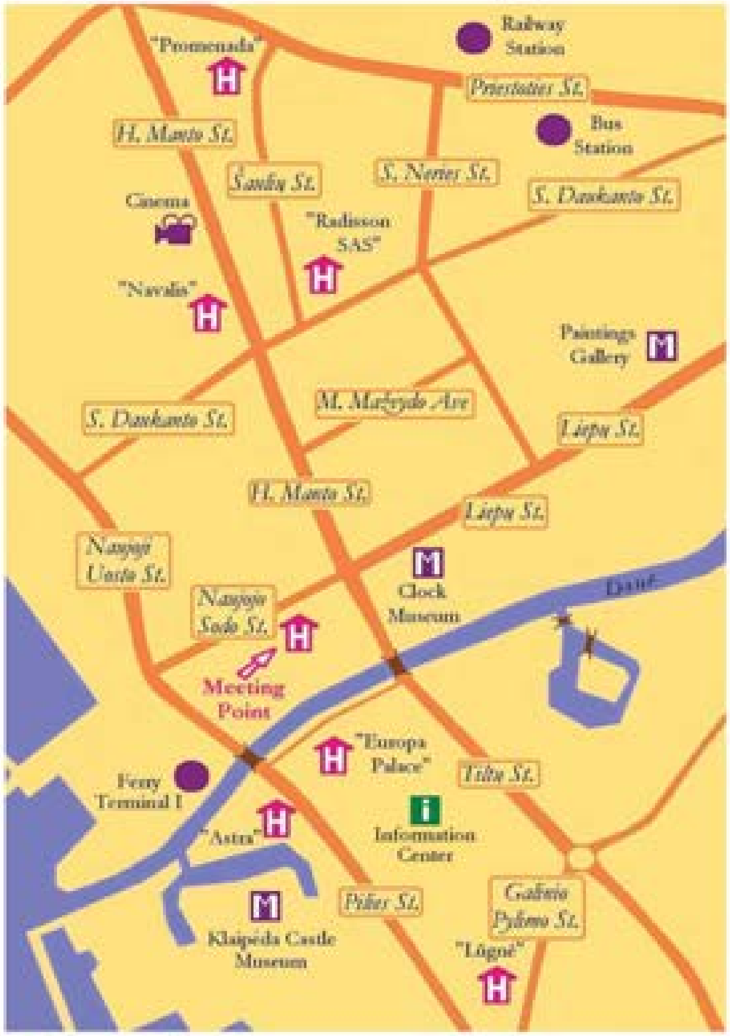
08 30-10 15 WORK IN SECTIONS
10 15-10 30 Coffee break
10 30-12 00 WORK IN SECTIONS
12 00-13 00 Lunch
13 00-14 45 WORK IN SECTIONS
14 45-15 00 Coffee break
15 00-17 00 FINAL PLENARY SESSION
18 00 Final banquet

Symposium Documents

The planned output of Symposium will be: the abstracts (on paper) and the proceedings of selected Symposium papers (on CD).

Meeting Point

The Symposium will take place in Klaipėda, in "Klaipėda" Hotel (Naujojo Sodo St. 1, Klaipėda, Lithuania).



Useful information

If you are interested in Klaipėda city, visit website: http://www.klaipeda.lt. You will find out a lot of information about the 3rd largest city of Lithuania here.

How to arrive at the meeting point

INTERNATIONAL ROUTES
FLIGHTS Palanga airport **Liepojos highway 1,** **LT-5720 Palanga** **LITHUANIA** **Tel.: +370 460 52020** **E-mail: plqairport@is.lt** **Palanga airport is only 25 km from Klaipėda city. Direct flights to Palanga from Hamburg, Oslo, Billund, Kristianstad, Frankfurt, Berlin, Moscow.**

http://www.palanga-airport.lt

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LT- 2038 Vilnius,
LITHUANIA
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Vilnius International Airport is about 300 km from Klaipėda.

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Ferry lines link Klaipėda with the ports of Karlshamn and Åhuss in Sweden; Kiel, Mukran (Sassnitz) and Travemünde ports in Germany; as well as Aarhus and Aabenraa ports in Denmark.

Local Costs

Kind of Transport	Route	Approx. Price
Taxi	**Vilnius International Airport - Vilnius Bus Station**	**5,8 EUR**
Taxi	**Vilnius International Airport - Vilnius Railway Station**	**5,8 EUR**
Bus	**Vilnius Bus Station - Klaipėda Bus Station**	**11,6 EUR**
Train	**Vilnius Railway Station - Klaipėda Railway Station**	**10 EUR**
Taxi	**Klaipėda Bus Station - Hotel "Klaipėda"**	**2,9 EUR**
Taxi	**Klaipėda Railway Station - Hotel "Klaipėda"**	**2,9 EUR**
Taxi	**1 km (within Klaipėda City limits)**	**0,3 EUR**
Local Bus	**Within Klaipėda City limits**	**0,3 EUR**

Accomodations

Participants of the Symposium should make accomodations by themselves. Reservation of Lithuanian hotels on Internet: www.lithuanianhotels.com

Note: **The reservation should be made as soon as possible, because sometimes there are no vacancies during the warm season, beginning in May.**

The organisers offer to stay in Hotel "Klaipėda" or Hotel "Radisson SAS". Center of Marine Research signed contracts with these hotels and special discounts for room's rent are applicable. Mention "Baltic Symposium" when registering.
Hotel "KLAIPĖDA" ****
Naujojo Sodo g. 1,
LT-5800 Klaipėda, Lithuania
Telephone: +370 46 404372
Fax: +370 46 404373

E-mail: hotel@klaipedahotel.lt
http://www.klaipedahotel.lt

Type of room (total: 210 rooms)	Usual Price
Single	**81 EUR**
Double	**87 EUR**
De Luxe (single)	**125 EUR**
De Luxe (double)	**130 EUR**
Apartments (single or double)	**188 EUR**

Hotel "Radisson SAS"
Šaulių St. 28,
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Telephone: +370 46 490 800
Fax: +370 46 490 815
E-mail: www.radisson.com/klaipedalt

Type of room (total: 75 rooms)	Price (1st of May - 30th of September)	Price (1st of October - 30th of April)
Single	**130 EUR**	**100 EUR**
Double	**140 EUR**	**110 EUR**

Hotel „PROMENADA"
Šaulių St. 41,
LT-5800 Klaipeda, Lithuania
Telephone: +370 46 403020
Fax: +370 46 403021
E-mail: hotel@promenada.lt
http://www.promenada.lt

Type of room (total: 20 rooms)	Price for 2 persons	Price for 1 person
Double (two separate beds)	**59 EUR**	**53 EUR**
Double (one double bed)	**59 EUR**	**53 EUR**
A luxury double (spacious room)	**73 EUR**	**67 EUR**
A luxury double (a room with a bathroom)	**80 EUR**	**75 EUR**

Hotel „NAVALIS"
H. Manto St. 23,
LT-5800 Klaipeda, Lithuania
Telephone: +370 46 404200
Fax: +370 46 404202
E-mail: info@navalis.lt
http://www.navalis.lt

Type of room (total: 28 rooms)	Price
Standard	**93 EUR**
Double	**110 EUR**
Business Class	**159 EUR**
De Luxe	**189 EUR**
Suites	**232 EUR**

Hotel "EUROPA PALACE KLAIPĖDA"
Žvejų St. 21/ Teatro St. 1
LT-5800 Klaipėda, Lietuva
Tel.: +370 46 404444
Fax: +370 46 404445
E-mail: reservation@hoteleuropa.lt
http://www.hoteleuropa.lt

Type of room (total: 50 rooms)	Single	Double
Single	**90 EUR**	-
Standard	**115 EUR**	**140 EUR**
De Luxe	**165 EUR**	**190 EUR**
Junoir Suite	**220 EUR**	**220 EUR**
Suite	**300 EUR**	**300 EUR**

Hotel "LŪGNĖ"
Galinio pylimo St. 16,
LT-5800 Klaipėda, Lithuania
Telephone: +370 46 411884;
Fax: +370 46 411884
E-mail: lugne@pajuris.lt

Type of room (total: 40 rooms)	Price
Single	**44 EUR**
Double	**50 EUR**
De Luxe (single)	**67 EUR**
De Luxe (double)	**72 EUR**

Hotel "ASTRA"
Pilies St. 2
LT-5800 Klaipėda, Lithuania
Telephone: +370 46 216420

Type of room (total: 14 rooms)	Price (1st of May - 30th of September)	Price (1st of October - 30th of April)
Single	**58 EUR**	**51 EUR**
Double	**75 EUR**	**58 EUR**
De Luxe	**105 EUR**	**105 EUR**

Registration Fee

The registration fee for participating in Symposium is 120 EUR. The registration fee includes:
coffee service,
reception,
lunches,
tour on Curonian Spit; Lunch in Nida,
final banquet,
Symposium's programme schedule and Symposium's documents.
Travel and accomodation costs aren't included in the registration fee.

PRE-REGISTARTION FORM

PRE-REGISTARTION FORM
First Name:
Surname:
Male or Female:
Title (Dr., Prof., …):
Position:
Institution:
Mailing Address:
Telephone / Fax:
E-mail:
Title of Presentation:

Oceanic Engineering meets Remote Sensing

IGARSS 2004

Science for Society
Exploring and Managing a Changing Planet

Anchorage Alaska, Egan Convention Center
September 20-24, 2004

Each year the IEEE Geoscience and Remote Sensing Society sponsors the International Geoscience and Remote Sensing Symposium. IGARSS has become an international focus for remote sensing programs, applications and activities and draws hundreds of scientists and engineers from around the world. IGARSS '04 will be held September 20-24, 2004, in Anchorage, Alaska.

This year the IEEE OES will be participating as a Co-Sponsor. Five Ocean Engineering tracks have been established for both oral and interactive presentation. More information, including a detailed Call for Papers, can be found on the IGARSS '04 web site, http://ewh.ieee.org/soc/grss/igarss.html.

We believe this shared venue and the opportunities it presents to members will be of lasting benefit to both Societies. We encourage you to participate in IGARSS '04.

1 Jan 2004: Online system open for submission

12 Mar 2004: General Abstract Submission Deadline

25 Jun 2004: Publication and Program Fee Deadline

Contact at OES:
s.chamberlain@ieee.org

r.garello@ieee.org

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OES Technical Topics for IGARSS'04

Current Measurements and Oceanographic Instrumentation

- H01 Surface Current Measurements
- H02 Acoustic Doppler Current Profilers/Velocimeters
- H03 Real-Time Monitoring

Oceanic Applications of Remote Sensing Technologies/Techniques

- H04 Modeling, Simulation and Databases
- H05 Inverse Problems (Tomography)
- H06 Environmental Technology

ROV/AUV Sensor Platforms

- H07 Localization and Tracking
- H08 Space-Time Distributed Sampling
- H09 Multi-Vehicle Cooperative Sensing

Underwater Acoustics

- H10 Sidescan, Multibeam and Synthetic Aperture Sonar
- H11 Sonar Signal Processing
- H12 Matched Field Processing

Underwater Signal, Image and Information Processing

- H13 Computer Vision and Pattern Recognition
- H14 Underwater Acoustics and Non-Acoustics Processing
- H15 Multidimensional Signal Processing

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Additional OES Technical Topics

Current Measurements & Oceanographic Instrumentation

- Electromagnetic Sensing
- Non-Acoustic Sensing
- Ocean Instrumentation
- Transducers & Arrays
- Integrated Observatories
- Air/Sea Interaction
- Atmospheric/Ocean Dynamics
- Boundary Layer Turbulence
- Buoy Technology
- Plume Sensors

Oceanic Applications of Remote Sensing Technologies/Techniques

- GIS
- Visualization
- Data compression
- Data standardization/distribution
- Communication
- Navigation
- Positioning

ROV/AUV Sensor Platforms

- Cost-effective sensing via AUV's
- Real-time In-water Groundtruthing
- AUV-to-User Data Connectivity

Underwater Acoustics

- Acoustic Boundary Interaction
- Pressure Vector Sensors
- Acoustic Tomography
- Acoustic Validation
- Marine Bioacoustic Groundtruthing
- Ocean Modeling

Underwater Signal, Image and Information Processing

- Classification
- Optics and imaging
- Holography / Tomography
- Environmentally Adaptive Processing
- Data Fusion