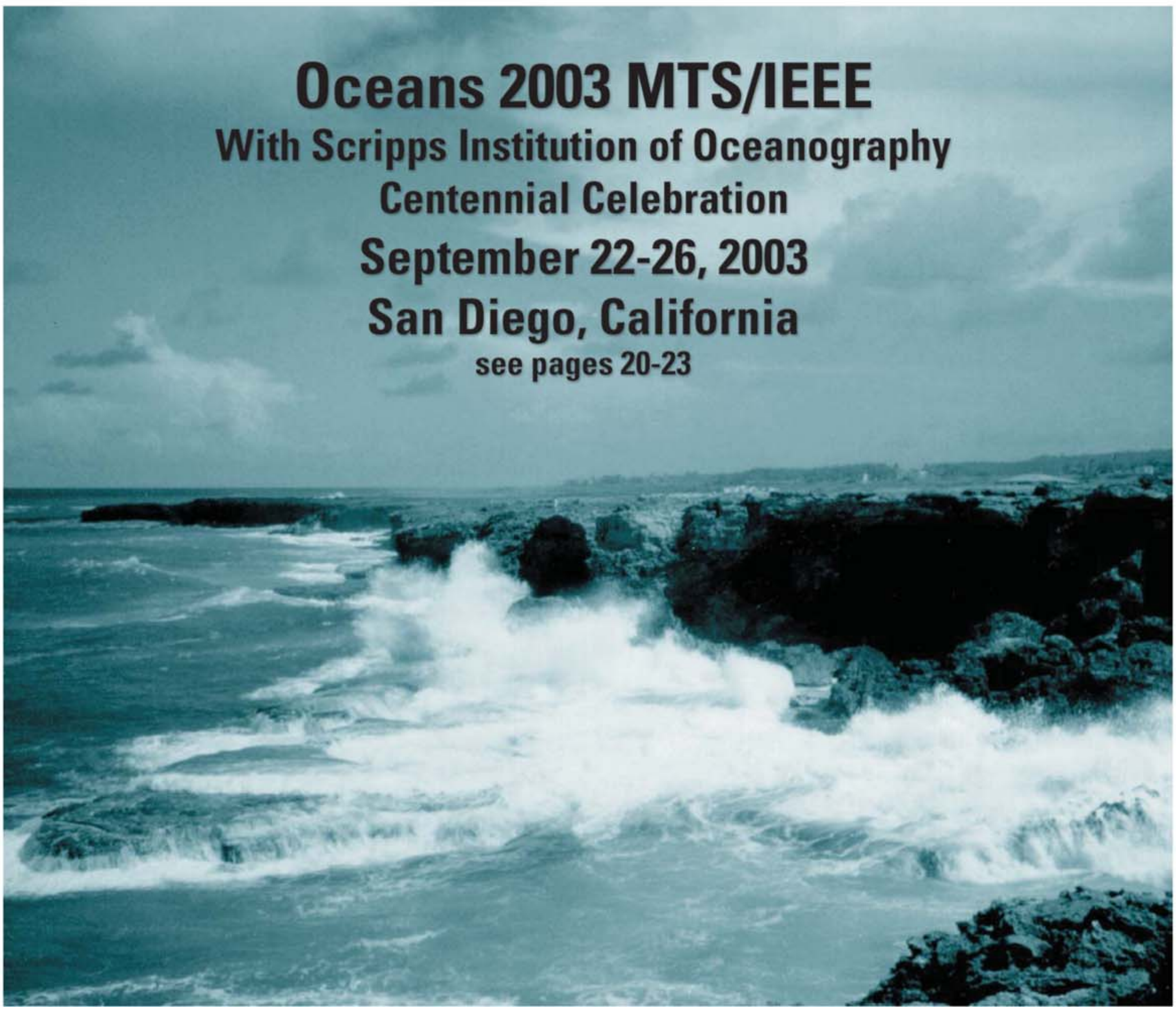
IEEE

Oceanic Engineering Society Newsletter

OES

VOLUME XXXVIII NUMBER 2

EDITOR: FREDERICK H. MALTZ SPRING 2003 (USPS 420-910) ISSN 0746-7834



IEEE OCEANIC ENGINEERING SOCIETY

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IEEE Oceanic Engineering Society Newsletter (ISSN 0746-7834) is published quarterly by the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. Headquarters: 3 Park Avenue, 17th Floor, NY 10017-2394. $1.00 per member per year (included in Society fee) for each member of the Oceanic Engineering Society. Printed in U.S.A. Periodicals postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to IEEE OCEANIC ENGINEERING SOCIETY NEWSLETTER, IEEE, 445 Hoes Lane, Piscataway, NJ 08854

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OES President's Column

Executive Committee Meeting January 2003

The Executive Committee met January 30 and 31 at Mitretech Systems, where Secretary Steve Holt provided excellent hospitality. The focus of the meeting was a continuation of the Strategic Planning activities begun in Honolulu in 2001 and continued in Biloxi last October.

Thomas F. Wiener

Because Of the fine work René Garello, Stan Chamberlain, and the Committee on Conference Policy did, we focused more on governance and professional activities than on conference activity. We reviewed the results of the Strategic Planning Sessions from Biloxi and began developing plans to make the Oceanic Engineering Society more useful to the public, the profession, and to the members. Norm Miller, as Vice President for Professional Activities, has primary responsibility for pursuing these efforts. He has been working with other members of the Society to bring these plans to life. When he calls, please join in.

Dan Alspach and Jim Barbera are working on developing a Financial Model and Business Plan for the Society. We are trying to formalize the current practices and to identify opportunities to run the Society more efficiently.

We are also working toward a major revision of the Constitution and By-Laws. Significant elements of the proposed change are establishing four Vice Presidents and revising the committee structure. The four Vice Presidents proposed are VP – Conferences. VP – Publications, (the products), VP – Technical Activities, and VP – Professional Activities (the resources). While the Administrative Committee elected At Large will probably not change, the *Ex Officio* membership and the Standing Committees probably will. We will have the essentials of the changes documented for our AdCom Meeting in May in Houston with a view to adopting them at the AdCom meeting in San Diego in September.

Administrative Committee Meeting May 2003

The Administrative Committee will meet in Houston May 3 and 4 in conjunction with the Offshore Technology Conference and the Marine Technology Society Board meeting. We will review the progress of our Strategic Initiatives. We will also have a joint meeting with the MTS Board.

IEEE Finances

The IEEE continues to make progress in controlling its finances. Our 2002 performance was not all that might have been hoped, primarily because conferences did not return the surpluses that had been forecast. The turmoil over finances has led to some serious soul searching by the IEEE leadership. One result was a very quick study by a team of consultants that identified many opportunities to improve the governance of the Institute. I will not go into detail here, but two elements are important for our consideration. First, the lack of internal communication within the Institute and among its organizational units has led to a marked diminution of mutual trust. Correcting this situation is high on everyone's priority list. Some unlikely actions were taken during the February board meetings because of efforts to improve communication, mutual trust, and support.

The second element is the need to simplify the business practices of the Institute. One example that we all see is the extraordinarily complex renewal form. The vast number of choices and the convoluted pricing schemes (some that rival airline pricing) are expensive far beyond any benefit gained. As a member of the Technical Activities Board Finance Committee, I am in the thick of dealing with that issue.

Another element where marked progress has been made is the redefinition of the Institute's investment policy and the change in its investment portfolio. This effort has been spearheaded by Dr. John Vig, the Director from Division IX where our Society resides. As a result of these changes, you can expect that the massive hits to our reserves will diminish. The corollary to this condition is that rising markets will not bring us nearly as much surplus as we experiences in the last decade.

OCEANS '03

I hope to see you in San Diego for OCEANS '03. As you know, it will be held in conjunction with the Scripps Centennial celebration. Bob Wernli and his team promise a great show, the biggest OCEANS to date.

IEEE SENSORS 2003

The OES is a Member Society of the Sensors Council, established in 1999. The Council presents a conference each year. Last year's conference, the first of its kind, drew over 400 papers and 700 participants. This year's conference will be in October in Toronto. It presents another opportunity to participate in an outstanding conference. I invite you all to come.

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. In addition, 2004 will be the first Two-Ocean year with OCEANS '04 Europe in Brest in May with René Garello as General Chair, and OCEANS '04 MTS/IEEE in Kobe, Japan with Tamaki Ura as General Chair. We are also participating in the International Geodesy and Remote Sensing Symposium '04, which will be held in Anchorage, Alaska in August.

Bannon Elected Fellow

Congratulations to Robert T. Bannon, a member of our Administrative Committee and Secretary- Treasurer of the Sensors Council, on his recent election to the grade of Fellow of the IEEE. Please congratulate him on this well deserved honor.

Thomas F. Wiener

Technology Focus Areas In The IEEE Oceanic Engineering Society

By Dr. Stanley G. Chamberlain, IEEE/OES Vice-President/Technical Raytheon Company / Integrated Defense Systems Mail Stop: T1FM3 50 Apple Hill Drive Tewksbury, MA 01876 (978) 858-5012 (Phone); (978) 858-1955 (FAX) s.chamberlain@ieee.org (Email)

Within a society with as broad a set of technologies as the IEEE Oceanic Engineering Society, there is a need to provide technology focus areas that allow those with similar interests to interact to meaningful depths. Such focus areas are provided by the technical committees of the Society. We have a dozen technical committees whose function is to provide activities in their focus areas. These activities include organizing and chairing sessions at the OCEANS conferences, organizing and operating focused technology symposia and workshops, publishing and encouraging publication of papers in the society journal and preparing review papers for inclusion in the society newsletter.

In the recent OCEANS 2002 Conference in Biloxi, MS, 345 papers and 96 technical sessions were in the focus areas of our technology committees. The chairs of our technical committees chaired 30 sessions at the Conference, and Dr. Frank Caimi, Chair of the Non-Acoustic Processing Technology Committee, served as Co-Chair of the OCEANS 2002 Technical Program Committee. Last year Claude Brancart and his Autonomous Underwater Vehicle Committee organized the AUV'02 Workshop, the sixth in the series of biannual workshops, whose focus in 2002 was on energy systems for autonomous underwater vehicles. This year, Dr. Sandy Williams and his Current Measurement Technology Committee organized the 7th Current Measurement Technology Conference, the latest in the series that has produced a technical conference in its focus area essentially once every 4 years since 1978.

If you are active professionally in one of the focus areas of the Society, I encourage you to participate by presenting a paper at one of our conferences, publishing a paper in our Journal of Oceanic Engineering, chairing a session at an OCEANS conference or participating in the stimulating discussions at our conferences and workshops. Beginning in 2004, the Oceanic Engineering Society will be cosponsoring two OCEANS-type conferences a year, the OCEANS-TECHNO-OCEANS'04 Conference in Kobe, Japan and the IGARSS-OCEANS '04 in Anchorage, Alaska. We anticipate the need for additional assistance to our technical committee chairs in soliciting papers and chairing sessions. If you would like to participate, please contact the chair of the technical committee of your interest and identify your desire to participate. If you believe there are other focus areas which are not now covered by one of our technical committees, and for which there are exciting developments that ought to be presented at an OCEANS conference, and if you are interested in helping to establish a forum in this area, please contact me.

The twelve technical committees in OES are listed below, along with their chairs and brief statements of their technology focus areas.

OES Technology Committees, Chairs and Focus Areas

1. Modeling, Simulation & Visualization Technology Committee

Chair: Dr. Ed Gough Science & Technology Advisor
Headquarters of the Commander
U.S. Pacific Command HQ CDR US PACOM / J006
Box 64028
Camp H. M. Smith, HI 96861
808-477-0812 (Office)
315-477-0812 (DSN)
808-477-0797 (FAX)
goughec@poidog.pacom.mil (Email)

Technology Focus Area: The technology focus of the Modeling, Simulation & Data Bases Technology Committee encompasses all activities and products associated with computer oriented modeling, simulation and databases within ocean engineering and science. The Committee identifies three major issues to be focused on in the next few years. The first one concerns quality control in existing and developing databases and their user interfaces. The second relates to the need for a better description of applicable models, introducing the notion of an informal "sunset law" for their codes. The third issue is attainment of a greater interdisciplinary interaction with workers in the other technical fields under OES cognizance. The Committee considers the activities in its domain to be primarily a service tool for solving concrete problems in the other areas of the ocean engineering arena, and intends to serve as a bridge - in a advisory capacity - between application needs and solution means.

2. Marine Communication, Navigation & Positioning Technology Committee

Chair: Dr. C. David Chadwell
Assistant Project Scientist
Marine Physical Lab
Scripps Institution of Oceanography, UCSD

9500 Gilman Drive MS 0205
La Jolla, CA 92093-0205
Tele: (858)534-2663
Fax: (858)534-6849
cchadwell@ieee.org (Email)

Technology Focus Area: The technology areas of interest for the Committee are:

- Marine Communication: Communications systems used between all possible combinations of marine platforms, shore based facilities, and intermediate relay facilities. This includes electromagnetic and acoustical systems of all wavelengths. It also includes data and verbal communications.
- Navigation Systems: Systems which are used to derive present location and to provide the ability to move a platform to another relative or geographic location in the marine environment within a desired error budget. It includes electromagnetic positioning systems and electronic processing systems which use all sources of location or motion data. It also includes the interfaces to the user.
- Positioning: Systems which are used to establish the position of platforms in the marine environment. This area addresses the technology of positioning in the marine environment and the sensitivities of positioning accuracy to environmental factors.

3. Oceanographic Instrumentation Technology Committee

Chair: Mr. Kenneth Ferer
114 South Fork Court
Hertford, NC 27944
252-426-1226 (Voice)
252-426-5135 (FAX)
kferer@ieee.org (Email)

Technology Focus Area: The technology interests of the Oceanographic Instrumentation Technology Committee include new developments in oceanographic instrumentation and data acquisition, and their dissemination through workshops, conferences and publications; the solicitation and evaluation of papers related to instrumentation and data acquisition; and the development, evaluation and acceptance of standards for oceanographic measurements and acquisition of data.

4. Current Measurements Technology Committee

Chair: Dr. Albert (Sandy) J. Williams 3rd
Woods Hole Oceanographic Institution
MS #13
Woods Hole, MA 02543-1053
(508) 289-2725
(508) 289-2456 Secr-Judy White
(508) 457-2194 FAX
awilliams@whoi.edu (Email)

Technology Focus Area: The Current Measurement Technology Committee is concerned with methods of measuring current for studies of the general circulation; vertical and horizontal profiles of current in harbors and rivers; spatial mapping of currents in estuaries, rivers and dams; and boundary layer studies. Our members include those who use current meters and want to know how good they are; those who test current meters to discover how good they are; and those who develop current measuring technology. Acoustic Doppler current profilers and acoustic Doppler velocimeters have taken a major position in our technology below the surface while HF and VHF radar are used to map surface currents. Studies of the surface boundary layer, wave motion, the bottom boundary layer, the wave boundary layer, and sediment transport require fast, small, precise, non-invasive velocity probes and acoustic Doppler and travel-time current meters are being applied there. These instruments represent a continuation of the development of direct current sensors but other techniques including correlation sonar and drifting floats offer alternatives for current sensing. Survivability of sensors remains an issue, particularly in harbors and where fishing is intense on the shelf. Trawler proof mountings for ADCPs have been developed by several of our constituents and tested by others. Horizontal current profiling is a recently employed technique to avoid losses from shipping and fishing.

5. Underwater Acoustics Technology Committee

Chair: Dr. Kenneth G. Foote
Woods Hole Oceanographic Institution
98 Water Street, MS #10
Woods Hole, MA 02543
(508) 289-2445
(508) 457-2194 (FAX)
kfoote@ieee.org (Email)

Technology Focus Area: The technology domain of the Underwater Acoustics Technology Committee comprises all aspects of applied acoustics in the ocean environment, including, for example: (1) design, fabrication, and testing of acoustic instrumentation (transducers, transducer arrays, hydrophones, sound sources, transponders and recording systems); (2) use of acoustic instrumentation (active and passive sonar systems) for such applications as acoustic telemetry, bottom mapping, underwater imaging, acoustic navigation, ocean measurements, observation and quantification of biological organisms, target surveillance and tracking, and position keeping; (3) modeling and prediction of ocean acoustic parameters, such as multipath arrival structure, scattering, reverberation, and noise, which influence sonar system performance.

6. Autonomous Underwater Vehicles Technology Committee

Chair: Claude P. Brancart
18 Juniper Road
Brunswick, ME 04011-3414
(207) 729-7873
c.brancart@ieee.org (Email)

Technology Focus Area: The focus of the AUV Technology Committee encompasses all aspects associated with autonomous underwater vehicles. These include: vehicle design, launch and recovery, control systems, energy systems, power distribution, navigation and path planning, collusion avoidance, mission management & control, sensors, object detection, underwater vision, acoustic imaging and mosaicking, computer architectures, communications, and multiple vehicle cooperation.

7. Air/Space Remote Ocean Sensing Technology Committee

Chair: Dr. David E. Weissman
Department of Engineering

104 Weed Hall
Hofstra University
Hempstead, NY 11549
(516) 463-5546 (O)
(516) 463-5544 Secretary
(516) 463-4939 FAX
eggdew@hofstra.edu (Email)

Technology Focus Area: The challenges facing ocean remote sensing are as unlimited as the variety of sea surface dynamics and meteorological conditions across the globe, and their range of spatial and time scales. The ultimate goal is to be able to make accurate estimates of a selected set of geophysical variables, with the intention of either making predictions across time and spatial boundaries, or advancing fundamental knowledge through developing empirical relationships and/or theoretical models. Advances are constantly being sought in both our understanding of the geophysical processes themselves (the electromagnetic and microwave properties of the surface and its associated air-sea interface) and their monitoring using the vast number of specialized technologies that can be selected to concentrate on one or a few of the physical processes for accurate measurements. The blending of deployed sensor programs (satellite-based or other platforms) with geophysical monitoring demands skills in making continuous observations and real-time interpretations that never seem fully adequate. The wide range of spatial scales of the sea surface (from millimeters to kilometers) must be matched by a broad spectrum of sensor technologies that have the optimum capabilities based on their electromagnetic frequency, polarization, incidence angle, coherence, Doppler characteristics and spatial/time resolution. Progress seems to be at an exponential pace, and the more effort a specialist devotes to advancing his or her own field, the more they may feel that there is a wider gulf between themselves and their colleagues. The OCEANS Conferences and the Journal of Oceanic Engineering are valuable means for immediate contacts with colleagues and professionals in related fields, and keeping abreast of their accomplishments and gaining ideas and insights for future directions.

8. Sonar Signal & Image Processing Technology Committee

Chair: Dr. James Candy
University of California
Lawrence Livermore National Laboratory
P.O. Box 808, L-156
Livermore, California 94551
(925) 422-8675
(925) 422-8277
candy1@llnl.gov (Email)

Technology Focus Area: The technical scope of the Sonar Signal & Image Processing (SSIP) Technology Committee has an emphasis on sonar processing with a "focus" on the signal and image processing aspects including theory, algorithms and applications, both simulated and experimental. The major technical areas that fall within the bounds and interests of the SSIP and are considered within its technical scope are:

- DETECTION
- CLASSIFICATION
- LOCALIZATION
- TRACKING
- ESTIMATION
  * Signal
  * Parameter
  * State
  * Bayesian
- DECONVOLUTION
- EQUALIZATION
- SIGNAL ANALYSIS
  * Spectral Estimation (temporal and spatial)
  * Higher Order Statistics
  * Time-Frequency
  * Wavelets
- SIGNAL PROCESSING
  * Array Signal Processing
  * Adaptive Signal Processing
  * Environmentally adaptive
  * Parametrically adaptive
  * Bio-Processing
  * Model-Based Signal Processing
  * Space-Time Signal Processing
  * Time-Reversal Signal Processing
- IMAGE PROCESSING
  * Image Enhancement
  * Image Restoration
  * Image Reconstruction
- INVERSION
  * Tomography
  * Holography
  * Matched-Field
  * Imaging
- PATTERN RECOGNITION
- MULTISENSOR FUSION
- SYNTHETIC APERTURE SONAR (active)
- APPLICATIONS

9. Non-Acoustic Image Processing Technology Committee

Chair: Dr. Frank M. Caimi
SkyCross, Inc
POB 650163
Vero Beach, FL 32965-0163
(561) 713-1147 (M)
(561) 567-1223 (H)
(321) 308-6631 (O)
f.m.caimi@ieee.org (Email)

Technology Focus Area: The focus of the Non-Acoustic Imaging Technology Committee consists of all aspects of electromagnetic technology for obtaining images or multidimensional data constructs useful in undersea sensing applications. Included are: (1) active or passive optical/electromagnetic/magnetic methods and techniques for mapping, robotics, inspection, navigation, identification, localization, and detection, (2) improved methods of modeling, predicting, describing or enhancing the image formation process in relation to the physical characteristics of the medium, (3) conventional and non-conventional optical systems development, testing, and evaluation, (4) signal and image processing techniques, implementation and performance as applied to the image formation, detection or classification process, and (5) the use of non-acoustic methods in conjunction with other technology.

Application of photogrammetric, tomographic, interferometric, LIDAR and time-gating principles to undersea imaging technology is encouraged.

10. Information Processing Technology Committee

Chair: V. William (Bill) Porto
Natural Selection, Inc.
3333 North Torrey Pines Court
LaJolla, CA 92037
(619) 455-6449 (O)
(619) 455-1560 FAX
bporto@natural-selection.com (Email)

Technology Focus Area: The focus of the Information Processing Technology Committee encompasses virtually all aspects of data presentation, database design, filtering, modeling, and analysis. This committee directly benefits from advances in computer science, mathematics, and all physical sciences. Key research areas include data fusion, neural networks, computational intelligence, artificial intelligence, and visualization tools, among many others. Though there is considerable overlap with other technical committee areas, the focus of this committee is to utilize information acquired from one or more external sources (e.g., sonar imagery) and derive/implement/apply state-of-the-art computational methods to represent this data in a meaningful manner. Information processing techniques span the range from graphical user interface design to evolution of models that optimally classify ocean mammal signals.

11. Environmental Technology Committee

Chair: James T. Barbera, Sr.
13513 Crispin Way
Rockville, MD 20853
(301) 460-4347
(301) 871-3907
j.barbera@ieee.org (Email)

Technology Focus Area: The Environmental Technology Committee is chartered to examine the impact that oceanic engineering sensors and systems have on the ocean environs and the impact the ocean has on the performance of oceanic systems and sensors. This involves the performance prediction of acoustic and non-acoustic sensors as modified by the natural environment e.g., bathymetry interaction with active sonars, and the level of disturbance that the systems bring to the ocean, e.g., high energy levels associated with active sonars with respect to mammal behavior.

12. Submarine Cable Technology Committee

Co-Chair: Robert T. Bannon, President
Bannon International Consulting LLC /
S4 Intelligence LLC
301 Willow Run East
Stroudsburg, PA 18301-8591
570-619-5430 (Voice)
570-350-0011 (Cell)
570-619-5107 (FAX)
rtbannon@ieee.org (Email)

Co-Chair: Pamela J. Hurst
Lockheed Martin NEES
Perry Technologies
17 Danielle Road
Westerly, RI 02891
401-481-3828 (cell)
pjhurst@ieee.org (Email)

Technology Focus Area: The technology focus of the Submarine Cable Technology Committee encompasses all engineering activities and underwater products associated with underwater fiber optic telecommunications systems and networks. This includes transoceanic and festooned fiber applications, and the revitalization and reuse of coaxial and paired technologies for acoustic information and data transfer for scientific ocean engineering. The committee provides a focal point for technical information exchange and promotes cooperation and coordination among fiber optic component manufacturers and installers serving the telecommunications, ocean science, oil and gas industry, government and special applications communities. The committee focus also includes the development and use of Unmanned Underwater Vehicles (UUV's), Remotely Operated Vehicles (ROV's), Autonomous Underwater Vehicles (AUV's) and Unmanned Surface Vehicles (USV's) for underwater cable technology and associated sub-systems. The Submarine Cable Technology Committee addresses standards coordination with other IEEE, ICPC and CCITT Standards Committees, laboratory and field test and repair methodologies, industry trends, technology innovations and developments based on forward looking needs. It also incorporates Department of Homeland Defense and United Nations Committee on the Law of the Sea (UNCLOS) issues as applicable to the submarine cable technology communities.

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.

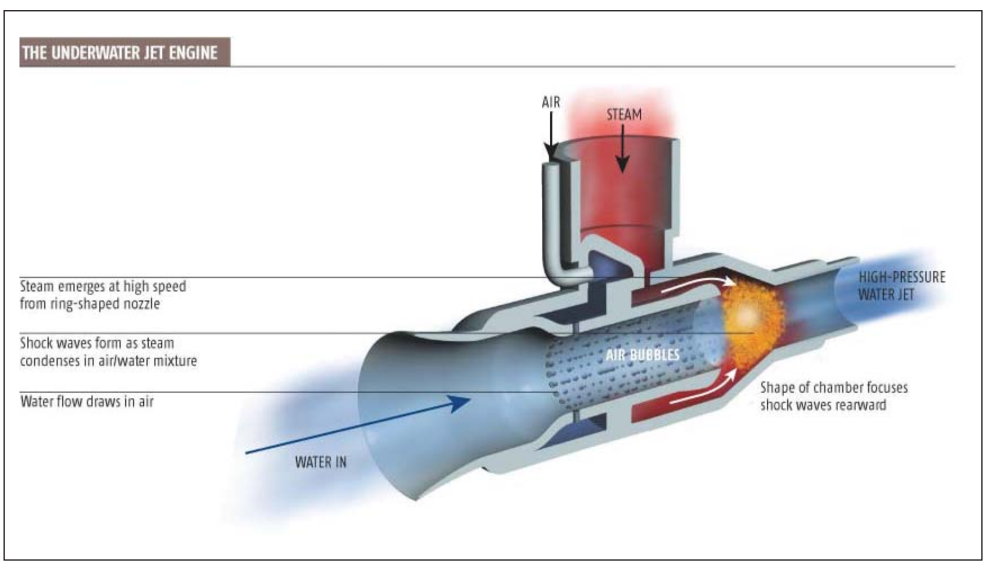
Not So Smiling Sharks

The U.S. magazines Time and Science have recently reported on the precipitous decline in worldwide shark populations, most notably in the Northwest Atlantic. Declining at a rate much faster than previously thought, this data has ominous implications for the ocean food web. Scientists feel that current marine reserves are not capable of stemming the losses and new reserves, coupled with further fishing restrictions is needed.

Although sharks are generally over-hyped voracious man-eating machines, an average of only five people are killed every year by sharks. In contrast, 100 million sharks are killed by people - mostly fishermen. ITV news has also reported on this serious issue and their piece can be viewed at http://www.itv.com/news/242849.html

Warp Speed for Jet-Skis

A new steam powered propulsor, described by its inventors as "an underwater jet engine", may soon find its way into recreational watercraft. The "Pursuit Marine Drive", invented by Australian engineer Alan Burns and developed in Britain by engineers at Pursuit Dynamics in Royston, Hertfordshire, produces thrust by using steam to draw in water at a front intake, then causing the water to be expelled at the rear. One important aspect of the engine is the way air is introduced just ahead of the steam injection point. The air apparently greatly improves the efficiency of the device. The full text of the article can be found online at http://www.newscientist.com/news/news.jsp?id=ns99993321



A little wave here, a little wave there....

and pretty soon you've got a real chop brewing in your harbor. That's what Brian Fullerton, a research engineer at the Stevens Institute of Technology in Hoboken, New Jersey discovered. By analyzing data from pressure sensors placed at the bottom of the Hudson River, he concluded that the most of the chop churning in New York Harbor comes from the wakes of the commuter ferries that crisscross the Hudson and East Rivers. It turns out that the intensity of chop was strongly correlated with the frequency of ferry traffic and not with the natural tide schedule.

In a New York Times article, Brian's suggestion for alleviating the chop was surprisingly not to reduce the speeds of ferries. Since many newer ferries are designed to ride higher in the water at increased speeds, slowing them down would result in greater water displacement and increased chop. Instead, his suggestion is to have ferries conduct the majority of their trip parallel to the shore, to enhance the dissipation of wave energy and thus reduce the amount of wake induced damage that occurs to docks and other structures. The full text of the article can be read at http://www.nytimes.com/2002/12/24/science/physical/24FERR.html?tntemail0

If you see an article (whether in print or in electronic form) that you would like to see mentioned in this column, please let me know by email, fax, phone, or regular mail. Email contributions can be sent to a special address: Soundings@Sygnus.Com. Information for phone, fax, and regular correspondence can be found in the back of newsletter where I am listed in the AdCom section.

Edward W. Early - Founding Member of the Oceanic Engineering Society

Mr. Edward W. Early, one of the IEEE founders of the Oceanic Engineering Society, died on January 21, 2003. Ed was a member of the original IEEE organization called the Oceanographic Coordination Committee that was organized to sponsor a conference called "Engineering in the Ocean Environment" in 1970. The OCC continued to sponsor conferences. In 1973 the name of the Conference was changed to OCEAN "73" under Ed's leadership. In 1976 the OCC became the Oceanic Engineering Society and the name of the conference was changed to "OCEANS" XX. Ed was a long champion of conferences and was co-chair of OCEANS 73, OCEANS 80, OCEANS 89 and OCEANS 99 that were held in Seattle, WA. Ed served as president of the OCC and worked with Eric Herz in preparing the Constitution and Bylaws for the Oceanic Engineering Society when OES was formed in 1981. He served on the Administrative Committee until 1998. Ed chaired the formation of the Seattle Chapter and served as Chairman for several years. Ed was twice awarded the OES Distinguished Service Award.

Ed was born in Ferndale, California and was the sixth of eight children and the only boy. He became interested in ham radio and installed his receiver and transmitter in a room over the family garage. He also developed an interest in the trumpet and played in a swing band in high school and was in the process of organizing a band in the retirement home were he was living. During World War II he served in the Army in the South Pacific as a radio repairman. Returning from the war he went to Oregon State University and received his BSEE. Following graduation he moved to Seattle, WA and worked for Boeing for two years. He then joined the Applied Physics Laboratory at the University of Washington under Dr. Joe Henderson. He became interested in the Arctic and had 13 trips to the Arctic. He was heavily involved in underwater acoustics and related work at APL and retired after 33 years of service, but retained a desk there.

Ed and his wife Vandene had a beautiful home and yard on the shores of Lake Washington and raised five children. Ed loved to work in the yard and to travel. He and Vandene had a trip through the Panama Canal planned for this spring. In the fall of 2002 his family persuaded them to move to a retirement home. They were comfortably settled when Ed became ill and was diagnosed with lung cancer. A memorial service was held with all of his family present including his fourth great granddaughter who was born after his death! He was buried in Tahoma National Cemetery with full military honors. OES lost a great friend and valued colleague.

Norman D. Miller

Upcoming Conferences

Offshore Technology Conference 2003
May 5-8, 2003
Houston, Texas
http://www.otcnet.org

Oceanology International Americas 2003
June 4-6, 2003
New Orleans, Louisiana
www.oiamericas.com

The 3rd International Workshop on Scientific Use of Submarine Cables and Related Technologies
June 25-27, 2003
Tokyo, Japan
http://seasat.iis.u-tokyo.ac.jp/SSC03

IGARSS '03
July 21-25, 2003
Toulouse, France
General Chairman (didier.massonnet@cst.cnes.fr)

13th International Symposium on Unmanned Unethered Submersible Technology
August 24-27, 2003
University of New Hampshire
Durham, NH (tel) 603-868-3221

MTS/IEEE Oceans 2003
September 22-26,2003
San Diego, CA
www.oceans 2003.org

2003 IEEE Sensors
October 21-24, 2003
Toronto, Canada
www.ewh.ieee.org/tc/sensors/

Oceanology International
March 16-19, 2004
London
www.oceanologyinternational.com

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

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

A Remote Monitoring System for Open Ocean Aquaculture

A.P.M. Michel, K.L. Croff, K.W. McLetchie
Department of Ocean Engineering
Massachusetts Institute of Technology
J.D. Irish
Woods Hole Oceanographic Institution
MIT Room 5-225
77 Massachusetts Avenue
Cambridge, MA, 02139, USA
amichel@mit.edu, croff@alum.mit.edu, kmwm@mit.edu, jirish@whoi.edu

Abstract- The purpose of this project was to determine the practicality and characteristics of a remote monitoring system for an open ocean aquaculture fish cage. The Open Ocean Aquaculture program at the University of New Hampshire currently uses two fish cages to develop the technology and methodology to raise finned fish in the open ocean. The cages are located about six miles offshore in the Gulf of Maine, making daily monitoring both expensive and time consuming. Scientists and aquaculture farmers, therefore, need a way to remotely observe fish feeding habits and growth on a regular basis without having to visit the cages themselves and eventually control the feeding and offshore operations monitoring remotely.

This project was a first-order feasibility study on the utility of using optical and acoustic sensors to monitor the submerged North Atlantic Halibut (*Hippoglossus hippoglossus*) fish cage, and remotely telemeter data back to shore. There, scientists will be able to monitor the status of the fish and feeding operation. Video and sonar systems were selected to image fish in the cage, and a radio telemetry system was tested on the cage's feed buoy. Imaging capabilities of the optical and acoustic systems, and the data transfer capabilities of the telemetry system were tested.

Preliminary results for this feasibility test are encouraging. Adequate imaging cannot be accomplished by camera or sonar alone. Further testing and development is required, but after a first-order analysis of results, a dual system is recommended for fish cage monitoring. In addition, the telemetry system seems feasible.

I. INTRODUCTION

This project examined the feasibility of developing a remote monitoring system for an open ocean aquaculture fish cage. The University of New Hampshire (UNH) Open Ocean Aquaculture program currently uses two fish cages to raise finned fish in an experimental program (Fig. 1) [1]. The cages are located in the Gulf of Maine approximately six miles offshore of Portsmouth, New Hampshire near the Isles of Shoals, making daily monitoring both expensive and time consuming (Fig. 2). The scientists, therefore, need a way to remotely observe fish feeding habits and growth on a regular basis without having to visit the cages themselves.

The overall goal of the UNH Aquaculture effort is to stimulate the further development of commercial aquaculture in New England, thereby increasing seafood production, creating new employment opportunities and contributing to economic and community development. To accomplish this, UNH is working at a demonstration site to (1) develop the technology and engineering tools to deploy open ocean fish containment structures, (2) develop the methodology of feeding and maintaining an open ocean aquaculture operation, (3) study various finfish as candidates for aquaculture in the Gulf of Maine, and (4) transition these findings to the commercial sector.

This project was a first-order feasibility study on the utility of using optical and acoustic sensors to monitor North Atlantic Halibut (*Hippoglossus hippoglossus)* (Fig. 3) in a submerged fish cage and to remotely telemeter data back to shore. There, scientists will be able to monitor the status of the fish, particularly during the feeding operation. Video and sonar systems were selected to image the fish cage, and tests were carried out from aboard the R/V Gulf Challenger. A radio telemetry system was installed on the cage's feed buoy and its data transfer capabilities were set up to be tested for one week. In addition to the selection and testing of hardware, the second goal of the project was to carry out a cost comparison for the two monitoring systems and to provide recommendations based on capabilities and cost.

Fig. 1. Photograph of the Ocean Spar fish cage at the surface during deployment. These cages have been used to raise summer flounder, haddock and cod. The cage that was imaged during this study was submerged and was being used to raise halibut. The commercial fishing boat in the background was deploying the mooring system for the fish cage system [2, 3, 4].

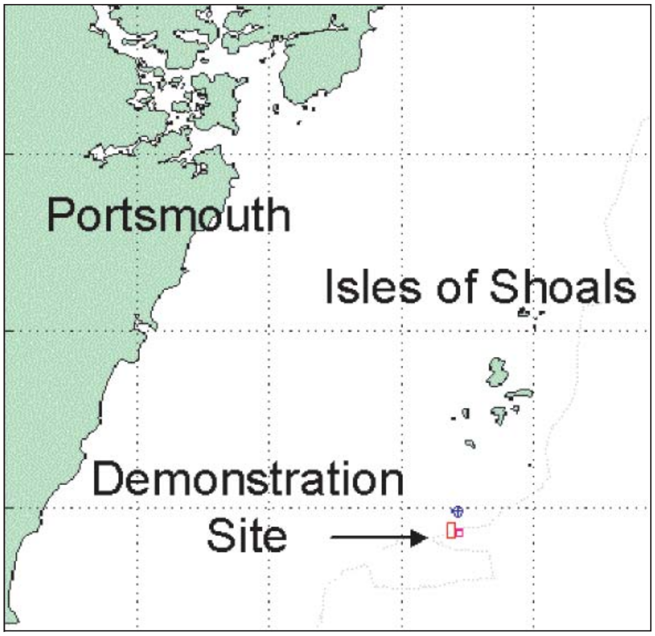


Fig. 2. A map of the coastal waters of the Gulf of Maine off New Hampshire showing Portsmouth, NH, the Isles of Shoals, and the fish cage site. The site is six miles off the NH coast in 52 meters of water [2].

Fig. 3. Close-up of a 30g halibut (*Hippoglossus sp.*) at the R&R Finfish Development Ltd. Facility in Digby, Nova Scotia [1].

II. OBJECTIVES

As stated above, the goals of this project were to determine the feasibility and cost of a remote monitoring system for the submerged UNH fish cage. The cage itself is octagonal, with a 15-meter main axis, and ten meters tall (Fig. 4) [5].

The cage is completely submerged and is attached via a compliant feed hose to a surface feed buoy (Fig. 5). Approximately 1,700 halibut, each about 30 centimeters long, live in the cage. This project was broken down into three tasks:

1. Image fish in cage using both optical and acoustic sensors.
2. Characterize a spread spectrum radio telemetry link from the food buoy to shore.
3. Compare the monitoring sensors for their potential benefits to the system as a whole and the ability to provide the required information for control and monitoring of an offshore aquaculture effort.

The experimental system consists of three parts: an underwater still camera for optical imaging of the fish in the fish cage, an Imagenex scanning SONAR for acoustic imaging of the fish, and a radio telemetry system for sending the imaging data back to shore. The testing was designed to determine the following characteristics.

Optical System

1. The usable range of the Deepsea Power and Light SeaCam camera, with consideration for the camera characteristics and physical factors.
2. The number of cameras needed to image the entire cage.
3. Type of light, ambient or artificial, required for good imaging.
4. Required power and amount of data collected.

Acoustic System

1. Ability of acoustics to image the fish
2. Length of time needed to scan the entire cage.
3. Optimum acoustic frequency.
4. Required power and amount of data collected.
5. Ability to calculate fish biomass.

Telemetry System

1. Amount of data that imaging systems will produce.
2. Robustness of telemetry link.
3. Maximum data transfer rate.
4. Constraints on data being transmitted given telemetry link characteristics.
5. Required power.

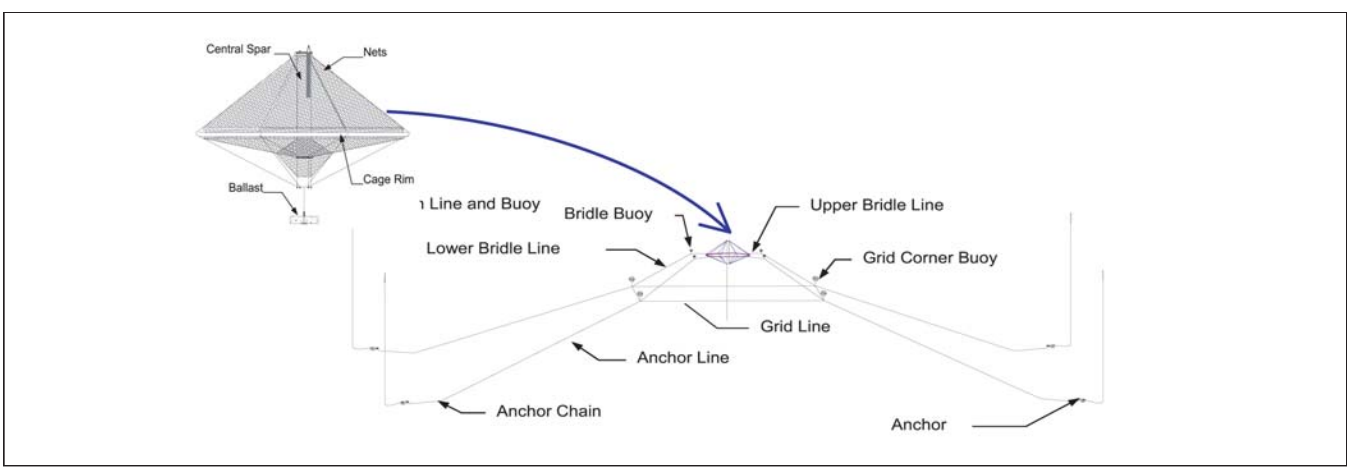


Fig. 4. Open ocean aquaculture fish cage [2].

Fig. 5. Surface feed buoy platform for controlling the feeding operation, observing the fish in the cage below and telemetering the images to shore [2].

III. SYSTEMS OVERVIEW

A. Optical System

The optical system consisted of a Deepsea Power and Light Multi-SeaCam, underwater cabling, a power supply, a standard video monitor, and a video recorder. The housing of the camera was titanium, making it corrosion resistant and giving it a depth rating of up to 6,000 m. The camera was rated to a much higher depth than is necessary for this application. Therefore, in an actual set-up, a less expensive camera, with a lower depth rating could be used. The camera is equipped with fixed focus optics. The camera lens used in this test is a 2.9 mm, f1.8 wide-angle lens. The camera is capable of focusing as close as 10 cm. In water, the field of view is 75° (H) x 92° (V) x 81° (D). The camera uses a 1/3" CCD image sensor, and works between -10°C and +40°C. A cable connected to the camera provided power (11-30 volts DC) and allowed the images to be sent to the video system inside the R/V Gulf Challenger (Fig. 6) [6].

B. Acoustic System

The primary component of the acoustic system was an Imagenex Model 881-000-420 Digital Imaging/Profiling Sonar Head (Fig. 7). This particular unit is multi-frequency, capable of operating at 1MHz, 675 kHz, and 310 kHz, with 1.4 deg., 2.4 deg., and 4.8 deg. beamwidths, respectively. The unit can image objects at a range of 10-50 meters, depending on operating frequency. Power required is 22 - 48 VDC at a maximum of 1A. Maximum operating depth is 1,000m. This unit has an azimuth control to the standard 881A sonar head that allows two axes of motion to enable the entire fish cage to be imaged [7, 8].

The sonar unit was controlled by a Toshiba Satellite personal notebook computer, running WIN881A, a Windows program that controls, displays, and records data from the sonar head. WIN881A uses a 2-wire RS-485 COM port to communicate with the sonar head.

Divers attached the sonar head to the middle of one of the sides of the fish cage near the rim, as shown in Fig. 8. The transducer was not exactly in the same plane as the cage rim, as will be shown in the results. The sonar was attached to the fish cage netting, and therefore moved slightly with the waves and currents, between and during images. This provides some unnecessary distortion to some images that would not be present with a permanent installation to the cage rim.

Power and communications cables ran up from the sonar unit to the ship and into the lab. From the ship's lab, a number of tests were run to characterize the capabilities of the sonar system, in relation to the movement and characteristics of the fish in the cage (Fig. 8).

Fig. 6. Video equipment setup on boat.

Fig. 7. Imagenex two axes SONAR system. The red section houses the pencil beam transducer, the grey section houses the electronics and motor for the 881A and the black case houses the azimuth rotation motor, control and overall electronics for the system.

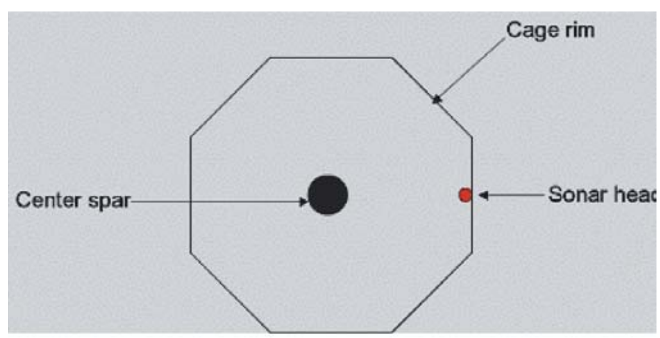


Fig. 8. Top view of the fish cage, with the sonar head mounted to the center of one of the sides.

C. Telemetry System

The telemetry system consisted of a Persistor CF1 microprocessor and a Data-Linc SRM6000 spread spectrum radio modem (Fig. 9) [9]. Both were enclosed inside of a waterproof PVC housing along with a battery pack of three parallel 12V batteries (made of 8 D-Cells each). In a final, working system, the Persistor would:

1. Turn on at user specified interval such as two times a day to allow for power saving.
2. Power-up acoustic and/or optical system and gather data for a set length of time.
3. Power up the RF modem and send data files to shore.
4. Receive user input while the RF modem is powered up to change sampling or fish feeding parameters.
5. Enter low-power mode.
6. Return to step one at correct time.

In our test system, the Persistor was set up to send a fixed test data file, a temperature reading from a thermistor outside the pressure case, and a battery voltage reading to shore for a period of one week. It operated as follows:

1. Turn on at user specified rate of once/hour or twice/hour.
2. Warm up the radio for one minute, during which the user can telemeter into system to change parameters.
3. Sample the system battery voltage and the air temperature (thermistor voltage divider).
4. Transmit the temperature, battery and fixed data file.
5. Leave the radio on for one minute during which time the user can telemeter into system to change parameters and the remote radio can continue sending the data if the transmission link is poor and it has had to retransmit many packets.
6. Enter low power mode.
7. Return to step 1.

The temperature was sampled with a thermistor, placed outside of the housing. The thermistor's voltage divider circuit was wired directly onto the Persistor board. The battery voltage was also measured directly from the Persistor board (with a 6:1 voltage divider), and the analog battery and temperature signals were digitized by the Persistor's 12 bit A/D converter [10].

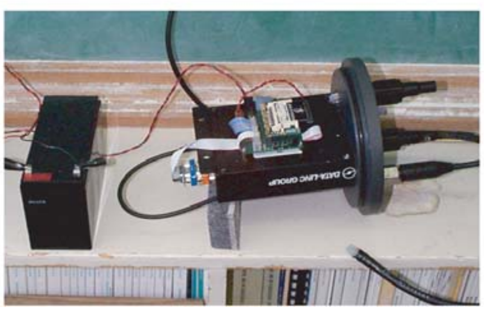


Fig. 9. Radio system being tested in lab prior to sea trials.

The user could telemeter into the system for two minutes per transmission cycle by typing a Ctrl-C command. The user was then prompted to change the sample rate between once/hour and twice/hour. The fixed file sent was a 56.8 kB binary data file converted into a 113.6 kB hex file upon sending. Although the hex file was larger, it was more useful as sample data, because it could be easily seen on the monitor as it was received. The test data is similar to the acoustic or optical data that would be sent once the final system is complete.

To test the system, it was mounted on top of the feed buoy (Fig. 10) and set up to communicate with the shore station, an RF modem at the UNH Seacoast Science Center. The on-buoy radio was set to talk to the Persistor at 9,600 baud, while the on-shore radio was set to talk to its control computer at 19,200 baud. The two radios communicated at 114 kbaud.

IV. RESULTS

A. Optical System

The first objective of the optical system test was to determine if optical imaging would give a good picture of what was going on inside the cage. The camera was first placed in the cage, and the video screen remained black. The divers discovered that the cage was covered with a thick mat of algae. Ambient light was not able to penetrate the algal mat therefore making the inside of the cage very dark. A diver then took a dive light into the cage and the illuminated diver could be seen in the video all the way from where the camera was mounted at the rim of the cage to the central spar, a distance of approximately seven meters. Fig. 11 shows that it was possible to see a fish when a light source was used. This was using a narrow beam of light. The camera was able to capture the entire diver, which demonstrated that a large field of view is possible with even a limited light source.

Fig. 10. Radio antenna on feed buoy.

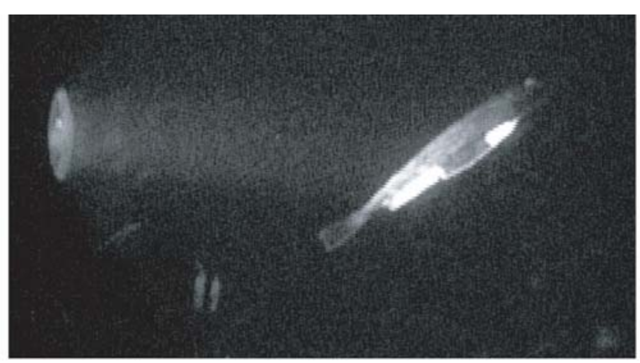


Fig. 11. Image of a fish as seen in the cage with a dive light as illumination.

1) Optical Solution

If the cage was not covered in an algal mat, ambient light may be sufficient. If additional light is needed, it could be added with strobe lights or continuous lights. The divers reported that the water in the cage was very clean as a result of the filtering of particles by the algal mat, therefore, eliminating backscatter. A light source could then be used without worrying about backscatter. However, when additional light is added, the effect on the fish must be considered. Biologists urge against the use of strobe light as the sudden flash startles the fish and instead they suggest the use of a steady light. As part of biological studies it has become apparent that continuous light delays the sexual maturity of some fish and allows for more meat growth before energy is spent on gonad development. This is a definite plus for aquaculture. A continuous light is therefore recommended to be used if ambient light were not sufficient. It must be noted however that one drawback with the use of continuous light is that it has a significantly higher power requirement than strobe lights.

The placement of the cameras must be considered to allow for the best imaging. The present day aquaculture use of video images places the camera at the bottom of the cage looking upward. This allows silhouettes of the fish to be seen against the sky since fish tend to swim horizontal. These images are therefore less subject to light variations than normal images, but details on the fish cannot be seen. Also, a camera directly under the feeding tube can image the feed falling through the cage and detect when the fish are finished eating and the feed is falling out of the cage. Since feed is a significant cost in aquaculture, optimizing its use is paramount.

Since the results of the halibut imagining in the offshore cage were poor, the SeaCam with an Axis 2400 Video Server [11] digitizer was used in a shallow cage under the dock at the UNH Coastal Laboratory which contained small cod fish. The camera was placed at the bottom of a cage located two meters underwater (Fig. 12). The shadow in the upper right was caused by a cover to prevent birds from “lunching” on the fish and to prevent sunburn on the juvenile fish. These additional tests on the small cod with a camera looking upward resulted in quality images. Feed was tossed into the cage to see if it could be imaged, and was seen falling past the fish, indicating that they were through eating and it was time to stop supplying feed. This image (Fig. 12) easily allows the food and the fish to be distinguished and the feeding operation monitored. However, the range of fish imaged is much smaller as the coastal cage does not have the depth or volume of the offshore cage.

Using two cameras is also beneficial since their images can be used to determine the size of the fish. By taking stereo pairs of images, standard software can be used to determine fish distance and size. Therefore, several pairs of images could be taken, then telemetered over the radio link to shore. Then using the software, in 15-20 minutes the size of a dozen fish could be compared.

2) Optical Advantages and Disadvantages

The advantages of an optical system are that it is easy for people to use and it will monitor the feeding very well. People are used to looking at video images and know how to interpret the images. However, several disadvantages exist with this system.

Fig. 12. Small (about 6-8") cod fish from the SeaCam in an upward looking configuration imaging the fish near and far from the camera in a coastal fish cage. The black dots between the fish are feed pellets that were thrown into the cage to simulate the release of feed by the feed buoy.

A camera system may not provide an accurate view of the fish if a significant number of the fish are in the bottom of the cage. If lights are used, they would require a lot of power, which is not practical for a battery run system. Since strobes are not feasible, continuous illumination would require significant power.

Another consideration is that for accurate imaging, a good lens is required which adds cost. With two cameras, stereo images can be made allowing fish size to be obtained with standard software. However, distortion free lenses would be required. Aquaculture has traditionally used wide angle lenses to see more of the fish cage, which is quite expensive to do with high quality lenses, and can also produce inaccurate results.

B. Acoustic System

1) Optimum frequency

Frequency tests were inconclusive. The sonar was able to scan the entire cage using the frequency range available (310kHz-1MHz). Fig. 13 shows an image of the cage, using a 1MHz frequency and 20-meter range. This configuration gives good resolution all the way to the opposite side of the cage. The upper right portion of the fish cage shown in Fig. 14 has clearly distinguishable lines outlining the net and cage rim. The two cannot be distinguished in the bottom of this image because the transducer is slightly tilted. The central spar is in the middle of the cage, and it blocks a portion of the cage rim opposite the sonar head.

Individual fish were not identified at any frequency, however a group of fish may be seen in Fig. 15 as the green mass directly in front of the sonar. Fig. 16 shows that a diver can be identified in the sonar image.

2) Scan duration

The amount of time required to scan the cage depends on the geometry of the cage and the parameters of the sonar (frequency, beamwidth, etc.). When the sonar head is mounted at the middle of one of the rim cage sides, it must rotate a maximum of 210 degrees, and the azimuth angle is a maximum of 110 degrees. For 1MHz imaging, it takes approximately six seconds per horizontal scan (210 degree). Twenty-five scans are required to image 110 degrees in azimuth, so the maximum scanning duration is 150 seconds – about three minutes. This time could be reduced if the horizontal sector length were reduced as the sonar head images the top and bottom of the cage. Fig. 17 and Fig. 18 show that the sector angle can be reduced when moving away from the horizontal.

In addition, the azimuth increments can be optimized according to beamwidth, which depends on the selected frequency. However, the time to take an acoustic imaging by scanning the cage is still more than one minute long, and more accurate imaging requires more time as the sonar head moves slower to allow time for digitizing the additional data.

The cage needs to be imaged quickly as the fish are active swimmers. For example, having an image of 3,400 fish, when there are 1,700 in the cage, is undesirable. How fast the fish actually move could be quantified over a long period of time using sonar and cameras. The volume seen by the acoustic system half way across the cage is ½ m by ½ m by 10 cm, so can not resolve individual fish, but returns the scattering strength which can be related to the size and number of scatters.

3) Fish biomass and scattering

After conducting the acoustic tests, it was discovered that the haddock in the cage had not yet fully developed their swim bladders. The swim bladders are the most acoustically reflective organ because of the air-water interface. Therefore, the type of fish and age is critical when using this type of acoustical imaging. Additional tests on some small cod being grown in a cage before transfer to the offshore cages were more successful (Fig. 19). The individual and groups of fish were easily imaged, and so the acoustic backscattering could be integrated to get total biomass estimates. However, again the imaging volume of the sonar is generally much larger than one small fish. The geometry can be determined from the transducer beam pattern. Once the swim bladders can be distinguished by the sonar, the biomass in the cage can be calculated from the size and number of bladders in the cage. The biggest drawback it that it takes minutes to get a detailed image which may not be an effective solution for swimming fish.

4) Interference

One unexpected roadblock encountered was external interference. Fig. 20 shows the Gulf Challenger's echosounder interfering with the received acoustic signal. Echosounders

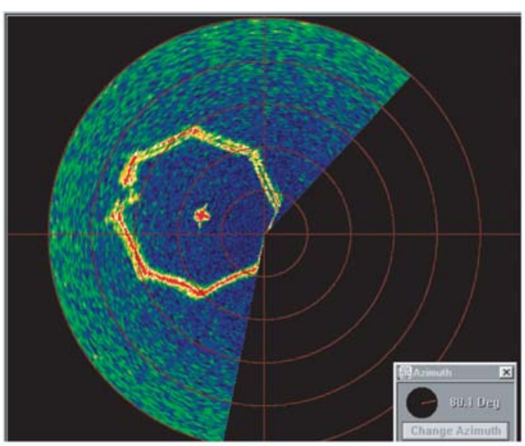


Fig. 13. Scan of fish cage.
1MHz, 20m range.

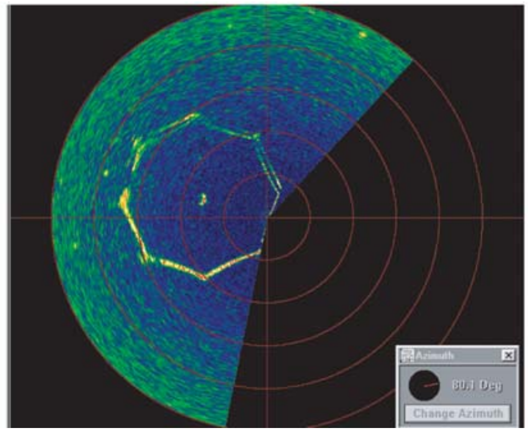


Fig. 14. Change in gain (23dB).
1MHz, 20m range.

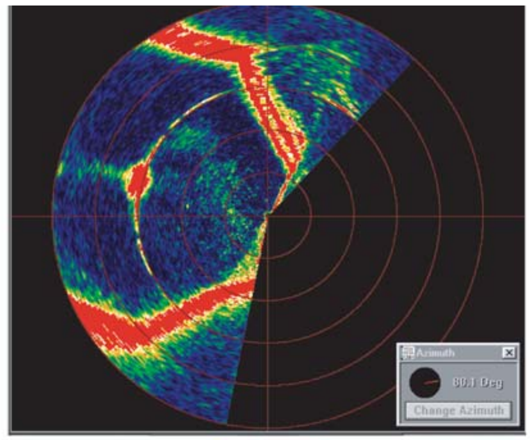


Fig. 15. Possible school of fish in cage.
675kHz, 10m range.

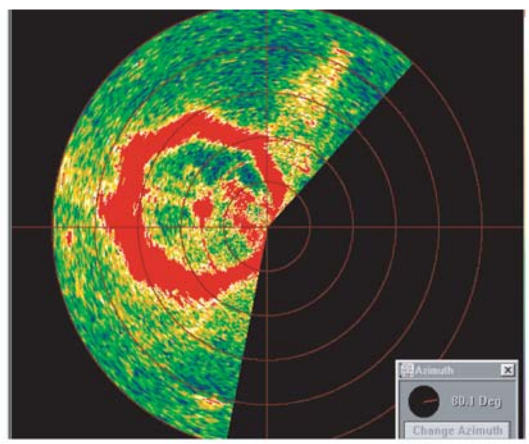


Fig. 16. Fish cage with diver in front of spar.
675Hz, 20m range.

typically operate at low frequencies (up to 200-300 kHz). If a permanent sonar system is to be installed on the cage, it should not use a low frequency if images are required when a service vessel with operating sonar is nearby. However, this is unlikely most of the time.

C. Telemetry System

The telemetry system worked well during bench tests, and uncorrupted data was received at the correct times by an RF modem in the lab. However, when the system was placed on the feed buoy for a week, the shore station received no signals

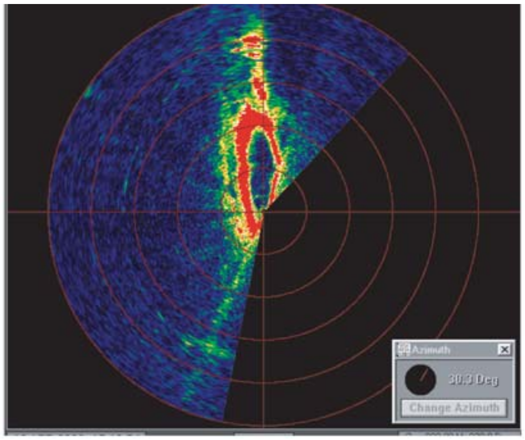


Fig. 17. Image of the top of the cage.

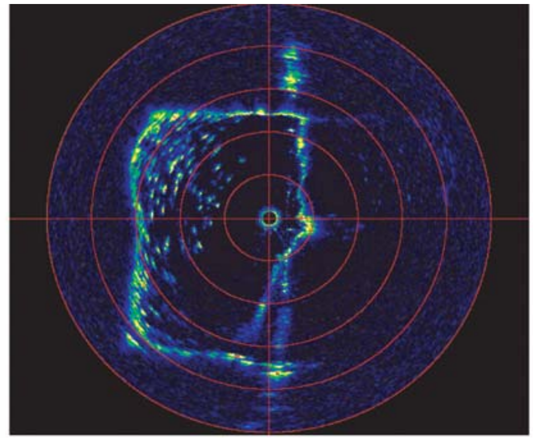


Fig. 19. Acoustic image of cod in a near-shore cage. The bottom of the cage is the left most part of the image.

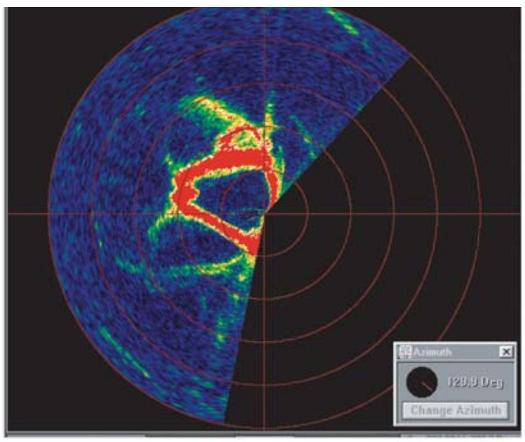


Fig. 18. Image of the bottom of the cage.

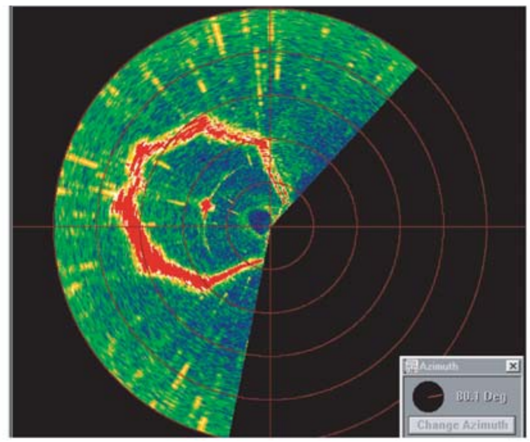


Fig. 20. Echosounder interference. 370kHz, 20 m.

from it. The shore station did not receive the data because the RF transmission power was nearly zero. This problem was discovered once the system was taken back to the lab after the failed telemetry attempt. It still worked in the lab, because the low power required to produce enough signal strength to communicate over short distances – several feet. The radio system failed because the coaxial connector in the radio had a broken center connector that did not make contact with the antenna.

The system was repaired, and tested on land sending the file and diagnostic data to the radio at both 9,600 and 115,200 baud over the same distances as at sea – about five miles. The files were sent during two overnight tests without difficulty or errors. Plans are underway to continue tests of the radio link on cruises the offshore site and from a wave rider buoy during summer 2002 to determine the optimum configuration and capability to connect a computer on a moving platform with the shore based support team.

V. CONCLUSIONS and RECOMMENDATIONS

The preliminary studies show promising results but raises a number of issues that must be addressed in order for the imaging to be effective. Optical tests involved the characterization of a Deep Sea Power and Light Multi-SeaCam, and the determination of the physical properties in and around the cage. It was found that an algal mat of at least six inch thickness had grown over the cage. This mat blocked all ambient light from entering the cage, but it also cleaned the water inside the cage. This resulted in an extremely low light environment, with very little particulate matter that would backscatter artificial light introduced into the environment. The camera used requires a high light level to get an image and therefore the images obtained were poor. A low light level camera may have worked in this environment. Light level and variations in light need to be further studied to optimize camera and power requirements.

An acoustic system has the potential to provide fish biomass information. An Imagenex scanning sonar was tested as a possible alternative to optical methods. The sonar was able to scan the entire cage using the frequency range available – 310 to 1,100 kHz. The fish, however, had not yet developed their swim bladders, so no conclusive data could be gathered on the effectiveness of acoustic methods.

To send the data back to shore, a radio telemetry system is recommended. Although electrical problems prevented the experimental telemetry system from working, identical systems have been used for similar long distance two-way communication, and have functioned properly. The spread spectrum technology appears to work well, but severely limits the amount of data (number of images) that can be telemetered. Another possible solution to this bandwidth problem may be to use the new Ethernet modems, although their power and range are marginal for this application. Their large advantage is speed, e.g. 11 Mbps data rate.

After examining the results of these preliminary tests it is recommended that several different solutions be tried to minimize the power consumption and cost. The solutions are described here in the order in which they should be tried. The cost increases with each subsequent solution.

1) A pair of cameras should be placed in a looking upwards configuration with a known separation. The cameras would image an overlapping area to allow for redundancy of imaging and to allow for stereo imaging. The sole light source would be ambient light and the fish would be fed twice per day. A basic waterproof camera, with a plastic casing, can be purchased for ~$300. [12] This type of camera uses only 130mA of power and can be used with about 100 times less light than the camera used in this experiment. An underwater camera can range up to a cost of about $1200 and up to about 300mA. This solution will determine if the imaging can be done with a low light camera and only ambient light. This solution is the least expensive and uses the least amount of power.

2) A faster telemetry system would be tested which would allow the images to be taken at a speed that would allow them to create almost a real-time video of the fish feeding. A standard spread spectrum radio has a baud rate of 120kbps and costs $1,000 for each one, with two being required for this application. Each one uses one watt of power and can accept Ethernet or RS232 serial input. A high end telemetry system could use a wireless Ethernet modem (e.g. Esteem Model 192E) with a high telemetry rate of 11Mbps. Again two are needed and they each have a cost of $2,000. Each wireless modem uses 800mA for transmitting data and 300mA for receiving data. One issue that would need to be explored is how reliable the wireless modems are when used on a moving platform. The high speed modems are rated for traveling up to five miles and all of these radios are "line-of-site" transmissions.

3) Additional cameras could be used for imaging. This would enable more area of the cage to be imagined. A total of six cameras would be required to image the full cage. The Axis 2400 Video has inputs for four cameras, so two could be used for the stereo pair, and two more easily added elsewhere.

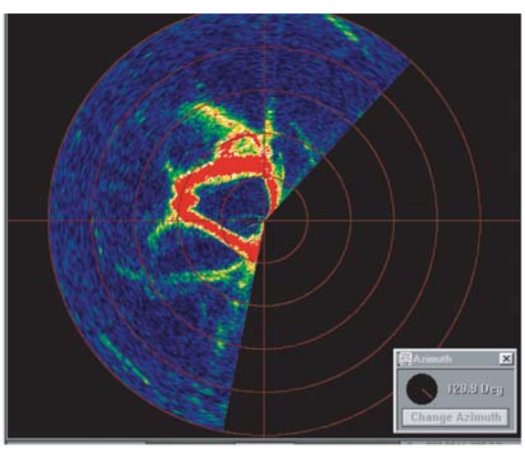


Fig. 21. Image taken with a DIDSON of adult salmon swimming at a range between two and four meters. [10]

4) Acoustics has the potential to allow estimation of the biomass in the cage. Emerging technologies in acoustics should be explored. A higher resolution, but more costly acoustic solution, would be to install a system such as the Dual Frequency Identification Sonar (DIDSON), which has been designed and built at the University of Washington Applied Physics Laboratory. DIDSON operates at two frequencies and can image objects from 1 to 30 meters in range. It results in near-video quality images that can be used to identify objects under water (Fig. 21) [13].

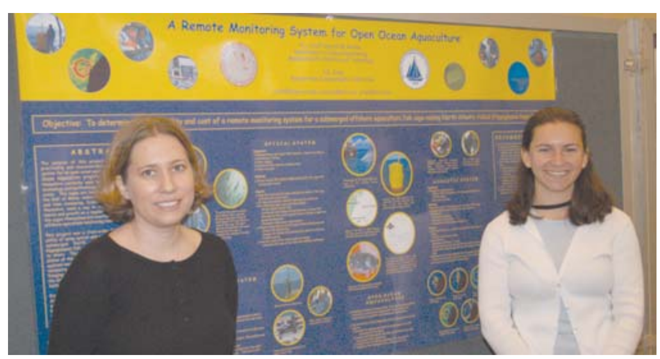
The 2-axis Imagenex system used in the tests costs approximately $18,000, while a DIDSON system (still under development) would be about $80,000. The difference is a rather large price jump, but may be a worthwhile investment, as the DIDSON image quality is significantly better than the Imagenex. An additional cost of ~$2,000 would be necessary for a microcontroller that would be used between the sonar and telemetry link.

For all solutions a $1,300 video server, for example the Axis 2400 server, is necessary to digitize the images and to put them out on a serial port with a radio modem or by Ethernet. A microcontroller would be needed to turn on the video. This microcontroller could also be used to control any necessary lights and feeding operation. Therefore, this microcontroller is probably necessary for all of the above solutions. The microcontroller uses negligible power.

Preliminary results for this feasibility test are encouraging. Further testing is required to determine the best solution for the fish monitoring and to determine an effective telemetry system.

Acknowledgments

We would like to thank Dr. A.J. "Sandy" Williams, Dr. Hanu Singh, and Robin Singer of the Woods Hole Oceanographic Institution for sharing their engineering expertise with us. In addition, many thanks to Michael Chambers, Glen Rice, and Randy Cutter of the University of New Hampshire, and the Captain and crew of the R/V Gulf Challenger for the field work assistance.



Left to Right, Anna Michel (co-author) and Katy Croff, Second Place Winners at Oceans 2002 Conference.

Katy Croff earned her bachelors degree in Ocean Engineering from theMassachusetts Institute of Technology in 2000. She spent a year as a JohnA. Knauss Marine Policy Fellow at the NOAA Office of Ocean Exploration,and is currently studying towards her masters degree in MaritimeArchaeology at the University of Southampton. She plans to return to MITfor her Ph.D. in Technology and Policy, focusing on ocean systems andtechnology.

Anna Michel received dual bachelors degrees in Chemical Engineering andBiology in 1998, and her masters in Ocean Engineering in 2002 from MIT.Currently, she is working on her PhD in the MIT Woods Hole OceanographicInstitute Joint Program. Her research focuses on the development ofa new instrument for in-situ chemical analysis of deep oceanenvironments. Anna is the recipient of the NDSEG and LinkFoundation fellowships.

Katy and Anna are the co-founders of the MIT Course 13 StudentEngineering Association (13SEAs), a collaboration of ocean science andengineering professional societies, IEEE/OES, MTS, SNAME, ASNE, and MOTN.13SEAs holds seminars, job fairs, and social activities to facilitate interaction between students, faculty, and alumni, as well as the largerocean engineering and marine science community. If you want to learn moreabout 13SEAs, check out the website at http://web.mit.edu/13seas

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KELLY AWARD WINNER

The Captain Joseph P. Kelly award was presented to Mr. Henry (Hank) Stanton Fleming of the Naval Research Laboratory on Feb 12, 2003. The Kelly award is given annually by Commander, Undersea Surveillance in recognition of innovation and ingenuity in the development or use of undersea surveillance system capabilities. The award, sponsored by ORINCON Corporation International, was presented by Dr. Henry Cox, Senior Vice President and Chief Technical Officer of ORINCON.

The award is named in honor of Captain Joseph P. Kelly, the father of SOSUS, who for more than 21 years beginning in 1951 led the development and installation of the Navy's Undersea Surveillance System.

The award reads:

CAPTAIN JOSEPH P. KELLY AWARD

"The Nation's Pioneer for Undersea Defense"

Captain Joseph P. Kelly, the father of undersea defense, pioneered the concept of undersea surveillance, using innovation, creativity, and leadership to overcome the barriers of emerging technology, tight budgets, and people's reluctance to change. His dedication made undersea surveillance a reality, enabling us to defend our country, our people, and our friends against undersea threats.

The upper portion of the plaque is beveled glass with a photo of Captain Joseph P. Kelly. It ismounted on wood from the main mast base of "Old Ironsides" – The U.S.S. Constitution Commissioned October 21, 1797 – present and is certified by Mr. Henry Vadnais, Curator of the Naval Historical Center, Washington, D.C.

The Award is presented annually by Dr. Henry Cox "Captain U. S. Navy Retired" who is himself a pioneer in Undersea Surveillance, a Fellow of the IEEE, a IEEE Oceanic Engineering Society (OES) technical achievement award winner, and a member of the National Academy of Engineering.

Scripps Institution of Oceanography Celebrates Its Centennial

On September 26, 2003, Scripps Institution of Oceanography marks its 100-year anniversary.

Scripps began as a tiny marine laboratory in the boathouse of the Hotel del Coronado, near San Diego. In the summer of 1903, University of California, Berkeley, professor of zoology, William E. Ritter, and a handful of his students arrived in San Diego for a field session in marine biology. By the end of the summer, Ritter, members of the local Scripps family, and other community members had cofounded what would become Scripps Institution of Oceanography.

Throughout the 20th century, Scripps played an important role in defining the new science of oceanography in the U.S. and around the world. Scripps's fifth director, Roger Revelle, led the task of creating a San Diego campus of the University of California, which opened in 1961.

Scripps has made numerous contributions to oceanographic technology, from oceanographic wire rope to manned undersea habitats. The institution conducted the first photographic survey of a hydrothermal vent field in 1976, using the towed camera platform DeepTow, and first discovering life forms there. In cooperation with the U.S. Navy, Scripps developed the first research diving program using scuba, which became the basis of all such diver-certification programs. And more than 40 years ago, Scripps scientists invented FLIP, the Floating Instrument Platform, which flips from a horizontal to a vertical position to become a stable ocean research platform.

Today, the institution has a fleet of four research vessels, as well as R/P FLIP, and more than 300 research programs under way in 65 countries.

Among the areas of research are:

- global climate change
- earthquakes and geology
- pharmaceuticals and other products from the sea
- the diversity and conservation of marine life
- marine genomics
- coastal resources
- development of new technologies to support ocean and atmospheric research

The continuing evolution of oceanography and Scripps Institution will be on display when San Diego hosts Oceans 2003, September 22-26. The conference and exposition, jointly sponsored by the Marine Technology Society, the IEEE-Ocean Engi-

SCRIPPS INSTITUTION OF OCEANOGRAPHY

The Birch Aquarium at Scripps today

neering Society, the American Geophysical Union—Ocean Sciences Division, the American Society of Limnology and Oceanography, the Acoustical Society of America, and others, will feature presentations on Scripps's first hundred years and the century to come for global ocean science and technology. (For more information, visit: oceans2003.org.)

Scripps is dedicating its centennial celebration to communicating the importance of ocean science to the global community and to reaching out to friends and colleagues at UCSD and around the world. For more information about the Scripps centennial, please visit: scripps100.ucsd.edu.

Photos, courtesy of Scripps Institution of Oceanography.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Scripps Institution of Oceanography campus, 1912

SCRIPPS INSTITUTION OF OCEANOGRAPHY

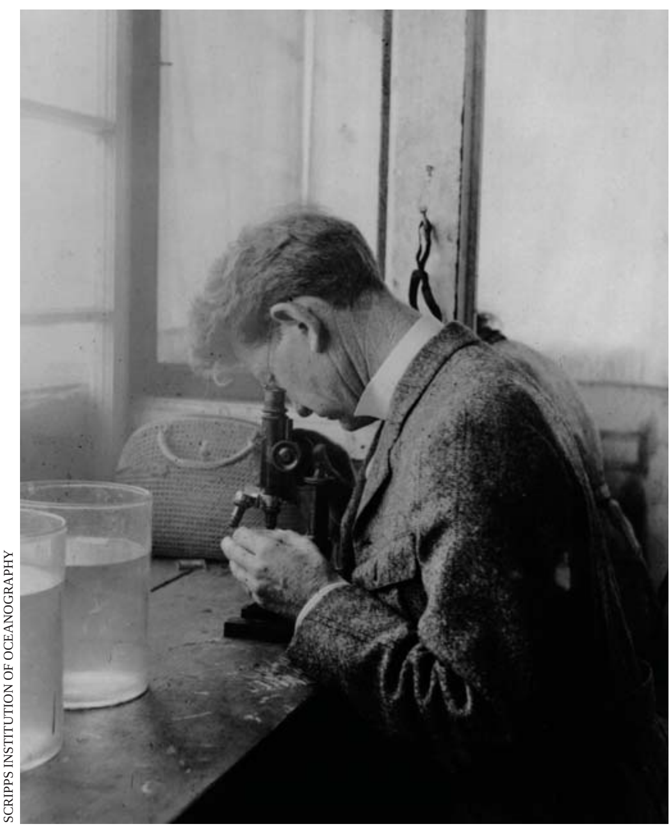
The Scripps fleet at the Nimitz Marine Facility; clockwise from top: *Melville*, *Robert Gordon Sproul*, *Roger Revelle*, *New Horizon*, FLIP

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Researchers aboard R/V *Roger Revelle*

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Scripps Institution of Oceanography pier and campus today



SCRIPPS INSTITUTION OF OCEANOGRAPHY

Founding Director William E. Ritter

OCEANS 2003 MTS/IEEE PREVIEW

DON'T MISS THE LARGEST OCEANS EVENT EVER!

THE OCEANS 2003 CONFERENCE AND EXHIBITION HAS RESERVED THE ENTIRE TOWN & COUNTRY HOTEL AND CONVENTION CENTER.

WELCOME TO SAN DIEGO

OCEANS 2003 MTS/IEEE once again returns to San Diego. And with it comes the first ever OCEANS **"Umbrella Conference."** The active participation by the scientific community from the AGU, ASLO, ASA and the other societies (seen along the top of this Preview flyer) will more than double this year's attendance.

We expect participation from over 20 countries and have established an International Coordination Committee to help increase the international participation.

When you visit San Diego, you gain access to 1% of the population of the U.S. And, when combined with local educational, commercial and government, the attendee demographics will span the entire spectrum of ocean science and technology. Combine this with the Scripps Institution of Oceanography's Centennial celebration, our Thursday VIP Keynote on the results of the President's Commission on Ocean Policy, and OCEANS 2003 will be an event that can't be missed. See you in San Diego.

Robert Wernli and Dr. Charlie Kennel
Conference Co-Chairs

HIGHLIGHTS INCLUDE:

Sunday
Golf Tournament
Underwater Film Festival I

Monday
Tutorials with UCSD Continuing Education Credit
20 Scientific and Technical Sessions Through Friday
Early Bird Reception
Film Festival II

Tuesday
Opening Plenary
MTS Luncheon
Two Floors of Upgraded Exhibits Through Thursday
Cyber Café and Poster Sessions
Exhibitor's Reception

Wednesday
IEEE/OES Luncheon
Sea World Extravaganza

Thursday
Keynote address by Admiral James Watkins, Chair, President's Commission on Ocean Policy

Friday
Celebration of Scripps Institution of Oceanography Centennial

Saturday / Sunday
Enjoy San Diego.

EXHIBITS ON SALE NOW! WWW.OCEANS2003.ORG

TECHNICAL PROGRAM

The OCEANS '03 Technical Program Committee is accepting abstracts for scientific and technical papers and posters. The Technical Program offers five days of presentations and posters on Ocean Sciences, Oceanic Engineering and Marine Technology topics; 20 meeting rooms have been reserved for five days, allowing more parallel scientific sessions and technical tracks. Poster opportunities are available within an area including scientific and technical exhibits, a general lounge area with tables, an exhibitors lounge area, a cyber café, a snack concession and an in-process central sand sculpture attraction.

ABSTRACT DEADLINE:
Advance Program: 1 April 2003
Final Program & Proceedings: 1 June 2003

Submit your abstract on the OCEANS 2003 website where the entire list of session topics is located. The conference proceedings will be published in DVD and CD-ROM formats. Post conference printed copies can be ordered.

STUDENT POSTER COMPETITION

OCEANS 2003 is sponsoring a Student Poster program to encourage the participation of scientific and engineering students in professional conferences. All Science and Technology related students are invited to submit poster abstracts on topics related to the subjects listed in the Science/Technical tracks on the conference website. Selected students will receive an invitation to present their posters at the conference, and will be provided conference registration and lodging, as well as reimbursement for travel expenses. Monetary awards will be presented to the top students. Visit the website for details.

REGISTRATION RATES

Register early for the best rates.

Full Package prior to 22 August
- Member - $415
- Non-Member - $490

Full Package at the conference:
- Member - $495
- Non-Member - $570

Daily Rates prior to 22 August
- Member - $175
- Non-Member - $225

Daily Rates at the conference:
- Member - $215
- Non-Member - $265

Student Full Package "Anytime" Rates:
- Member - $230
- Non-Member - $250

Exhibits Only:
- FREE prior to 22 August
- At the Door - $20

Tutorials:
- Half Day - $150
- Full Day - $300

Visit the website for other rates.

TUTORIALS

The OCEANS '03 Tutorial Committee is accepting abstracts for scientific and technical Tutorials to be presented on Monday September 22, at OCEANS 2003.

Provision has been made for tutorial participants to receive UCSD Continuing Education Credit. The tutorials will be promoted through the UCSD Extension Catalog. Proposals for a half-day or full-day tutorial can be submitted through the OCEANS 2003 website.

ACCOMMODATIONS

The OCEANS 2003 conference has reserved the entire Town and Country Resort Hotel complex. This gives us the ability to provide an unlimited technical program, two levels of exhibits and many other special events. ALL attendees will receive the lowest lodging rate of $99.00 (equivalent to the federal per diem rate). Visit the website to register. Be sure to ask for the **"OCEANS 2003 Block of Rooms"** for the reduced rate.

EXHIBITORS

The following exhibitors have signed up as of March 12, 2003:

Aanderaa Instruments, Inc.
AGU
Airmar Technology Corp.
APM Hexseal
Applied Microsystems Ltd.
ASA
ASL Environmental Sciences Inc.
ASLO
Association of Diving Contractors
Axys Environmental Systems
Benthos, Inc.
C & C Technologies, Inc.
Chesapeake Technology, Inc.
CodaOctopus Ltd.
CODAR Ocean Sensors
CORE
Cortland Fibron BX
CRP Group
D & A Instrument Company
Deep Sea Systems International
DeepSea Power and Light
Desert Star Systems
Dynacon, Inc.
EDO Electro-Ceramic Products
Emerson-Cuming Composite Materials
Event Theater
EvoLogics GmbH
Falmat Inc.
GeoAcoustics
Guildline Instruments Inc.
Harbor Branch Oceanographic Institution
Harris Maritime Communications (MCS)
Hawaii Ocean Science & Technology
Hydroid, Inc.
IEEE
Impulse Enterprise
Insite Pacific
Interactive Visualization Systems
International Industries, Inc.
International Transducer Corp.
InterOcean Systems, Inc.
ITP Ltd. - Feedback Inc.
Knudsen Engineering Limited
Kokes Marine Technologies, LLC
Kongsberg Simrad
L-3 Communications/Sea Beam Instruments
LinkQuest Inc.
Louisiana State University, School Of The Coast And Environment
Marine Advanced Technology Education (MATE) Center
Marine Magnetics
Marine Sonic Technology, Ltd.
Marine Technology Society
Materials Systems Inc.
Metocean Data Systems
NASA EOS
Nautilus Marine Service GmbH
Naval Meteorology & Oceanography Command
Nekton Research, LLC
NOAA Office Of Ocean Exploration
NRL
NSWC Carderock
NUWC
Ocean Data Equipment Corp.
Ocean Design
Ocean Engineering and Production/Harbor Branch
Ocean Innovations
Ocean Marine Industries
Ocean News & Technology
Oceans/Techno Ocean 2004
Orcina Limited
Orincon Defense
Paroscientific, Inc.
Prevco Subsea Housings
Quester Tangent Corporation
RD Instruments
Richard Brancker Research Ltd.
Science Applications International Corporation
Scripps Institution of Oceanography
Sea Con/Brantner & Associates, Inc.
Sea Technology Magazine
Sea-Bird Electronics, Inc.
SEAmagine
Sensor Technology Ltd.
Service Argos, Inc.
Sidus Solutions, Inc.
Sippican Inc.
Sonatech, Inc.
SonTek/YSI, Inc.
Sound Ocean Systems
South Bay Cable Corp.
SPAWAR Systems Center
SSC San Diego
Subconn Inc.
Sunwest Technologies
Tenix LADS, Inc.
Thales Geosolutions (Pacific) Inc.
The OceanScience Group
TMT Laboratories
Tritech International Limited
Triton Elics
Underwater Intervention
Veridian
WS Envirotech
YSI Environmental, Inc

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