



IEEE

OCEANIC ENGINEERING SOCIETY

NEWSLETTER

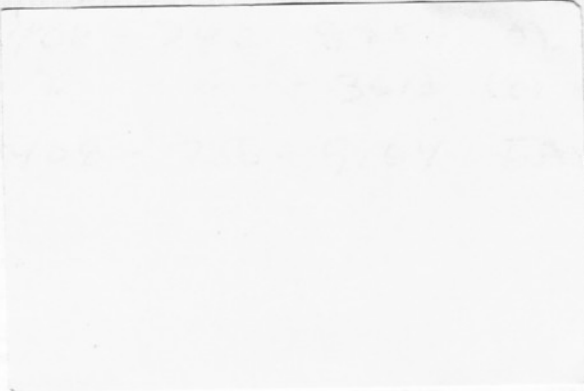


VOLUME XXVII

NUMBER 3

EDITOR: FREDERICK H. MALTZ

FALL 1992 (USPS 420-910)



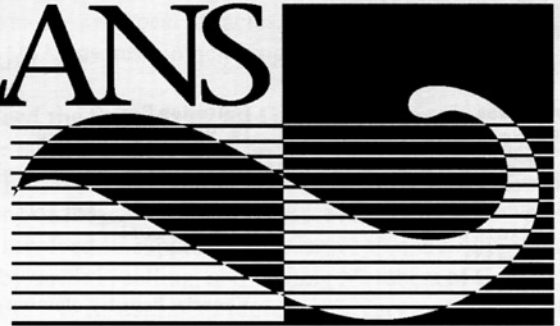
3/8/93



9 6*

OCEANS

92



MASTERING THE OCEANS THROUGH TECHNOLOGY

OCTOBER 26-29, 1992 ■ NEWPORT, RHODE ISLAND



President
GLENN N. WILLIAMS
Computer Science Dept.
Texas A&M University
College Station, TX 77843
(409) 845-8419/5484

Vice President, East
JOSEPH CZIKA
TASC
1101 Wilson Blvd., Suite 1500
Arlington, VA 22209
(703) 351-6340

Vice President, West
NORMAN D. MILLER
West Sound Associates
2644 NW Esplanade
Seattle, WA 98117
(206) 373-9838

Treasurer
ROGER DWYER
43 South Cobblers Ct.
Niantic, CT 06357
(203) 440-4511

Secretary
CLAUDE P. BRANCART
CS Draper Laboratory, Inc.
c/o Undersea Warfare Office
4301 North Fairfax Drive, Suite 700
Arlington, VA 22203
(703) 516-6042 (O)
Fax (703) 516-6060
(703) 548-4517 (H)

(Continued on inside back cover)

Journal of Oceanic Engineering Editor
WILLIAM M. CAREY
Defense Advanced Research Projects Agency
Arlington, VA 22203-1714
Editorial Office:
79 Whipoorwill Road
Old Lyme, CT 06371
(203) 434-6394
Fax (203) 434-6394

Newsletter Editor
FREDERICK H. MALTZ
2154 Sand Hill Road
Menlo Park, CA 94025
(408) 742-8298 (O)
(415) 854-9195 (H)

Regional Associate Editors (outside North America)
(For addresses please see inside back cover)

TAKENOBU KAJIKAWA
Asia (except Middle East)

GIORGIO TACCONI
Europe (incl. Middle East)

MALCOLM L. HERON
Southern (Australia, Africa,
South America, Oceania)

JOHN D. PENROSE
Western Australia

Specialty Associate Editors (North and Central America)

ROBERT C. SPINDEL
Acoustic Communication and Navigation: *Underwater Acoustics, Acoustic Communication and Telemetry, Acoustic Tomography, Navigation and Positioning (except Electromagnetic), Acoustic Tracking and Localization, Acoustic Remote Sensing (related to above)*

JOHN E. EHRENBERG
Acoustic Simulation and Sensors: *Acoustic Simulation and Modeling, Acoustics of Marine Life, Acoustic Signatures, Seismic Exploration and Subbottom Profiling, Transducers and Arrays, Acoustic Remote Sensing (related to above)*

ARTHUR B. BAGGEROER
Arctic/Antarctic Oceanic Engineering: *Environmental Parameters, Materials, Operational Hazards and Problems, Human Habitation and Protection, Equipment Transportation and Maintenance, Above and Below Ice Conditions, Iceberg Drift and Collisions*

FREDERICK H. FISHER
Editorials

ROBERT W. FARWELL
Reviews

WILLIAM J. PLANT
Electromagnetic Communication and Navigation: *Electromagnetic Communication, Electromagnetic Navigation and Positioning, Electromagnetic Tracking and Localization, Electromagnetic Signatures, Electromagnetic Remote Sensing (related to above)*

ADRIAN K. FUNG
Electromagnetic Simulation and Sensors: *Electromagnetic Simulation and Modeling, Electromagnetic Propagations, Antennas and Arrays, Electromagnetic Remote Sensing (related to above)*

ARTHUR B. BAGGEROER
Information — Acoustic, Electromagnetic, etc: *Signal and Information Processing, Beam Forming, Noise and Noise Sources*

CHRISTOPHER VON ALT
Ocean Fiber Optic Engineering and Systems

CHRISTIAN DE MOUSTIER
Bathymetry: *Bathymetry, Seafloor Surveying and Mapping, Seafloor Acoustic Remote Sensing, Signal and Image Processing Applied to Sonar Data, Sonar Calibration, Navigation and Positioning (related to above)*

FREDERICK H. FISHER
Oceanographic Instrumentation and Measurement: *Current Measurement Technology, Oceanographic Instruments (Conductivity, Depth, Pressure, Salinity, Sound Speed, Temperature), Measurement Systems and Data Acquisition*

ROBERT C. SPINDEL
Underwater Optics: *Light Sources, Underwater Vision and Visibility, Underwater Photography, Optical Imaging, Optical Scattering*

D. RICHARD BLIDBERG
Underwater Vehicles: *Manned and Unmanned Underwater Vehicles, Robotics, Applications of Machine Intelligence, Operational Hazards, Survival in the Ocean*

RICHARD STERN
Engineering Acoustics: *Equipment and Devices, Instrumentation, Materials, Measurement Techniques*

CHAPTER CHAIRMEN

New Orleans
Mr. Charles F. Getman
U.S. Naval Oceanographic
Office Code PDMM
Engineering Department
Bay St. Louis, MS 39522
(601) 688-4553

Galveston Bay
Dr. William E. Pinebrook
P & H
P.O. Box 1711
Dickinson, TX 77539-1711
(713) 339-3031

Washington/Northern Virginia
Mr. Jim Barbera
EG&G Washington Analytical
Services Center
1396 Piccard Drive
Rockville, MD 20850
(301) 840-5003 Fax: (301) 258-9522

New England
Mr. Thomas B. Pederson
Raytheon
MS 146
1847 W. Main road
Portsmouth, RI 02871
(401) 847-8000

Seattle
Mr. Edward W. Early
4919 N.E. 93rd Street
Seattle, WA 98115
(206) 543-3445

Victoria, British Columbia
Mr. James S. Collins
2815 Lansdowne Road
Victoria, BC Canada V9A 4W4
(604) 380-4605

Canadian Atlantic
Dr. Ferial El-Hawary
Tech. University of Nova Scotia
P.O. Box 1000
Halifax, Nova Scotia
Canada B3J 2X4
(902) 429-8300, X-2053/2446

San Diego
Dr. David B. Fogel
ORINCON Corporation
9363 Towne Centre Drive
San Diego, CA 92121
(619) 455-5530, X-424

IEEE Oceanic Engineering Society Newsletter is published quarterly by the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. Headquarters: 345 East 47th Street, NY 10017. \$1.00 per member per year (included in Society fee) for each member of the Oceanic Engineering Society. Printed in U.S.A. Second-class 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

Recognizing IEEE-USA — What It Is and Why It Is

by *William W. Middleton*, Chair

Opinion Survey Committee

Every organization, good or bad, has its detractors, and IEEE United States Activities (IEEE-USA) is no exception. Some of IEEE's U.S. members seem bent on derailing IEEE-USA one way or another.

Some die-hard members have never recognized IEEE's evolution beyond The American Institute of Electrical Engineers (AIEE). Some volunteers cannot stomach embracing anything beyond the technical dimensions of engineering. Some members have even failed to grasp the basic concepts of the organizational structure for professional activities and refuse to recognize that IEEE-USA has matured substantially, since its founding in the 1970s, to become a significant force on the national scene.

No one doubts the rights of members to express their opinions. What is disturbing is that in the effort to make their points, they omit numerous facts about how IEEE's professional movement evolved and how support for IEEE-USA's structure of today developed. Arguing a point of view but failing to recognize facts borders on being intentionally deceptive. We must revisit some of IEEE-USA's history to set the record straight.

How It All Began

Members' freedom of choice to add a professional objective to IEEE's purposes led to changes in IEEE's Constitution in 1972. In fact, the changes passed by a substantial margin. The Constitution now permits activities directed to the interests and needs of members residing in a particular country or area of the world.

The earliest implementation of IEEE's professional activities was executed by the United States Activities Committee, which operated under IEEE's Regional Activities Board (RAB). Members found this structural arrangement undesirable, due to RAB's transnational character, and formed the United States Activities Board (USAB) in 1974.

As with all new ventures, USAB needed funding to support its activities. In 1972, IEEE's Board of Directors agreed to use a bylaw provision permitting IEEE Regions to assess their own members a fee to meet special country, regional, or area needs beyond those suitable for funding through the general dues applicable to all members. The fee was designated to fund the professional and technical activities in IEEE's Regions. Later the provision was modified to fund professional activities exclusively.

How Are the Funds Directed?

IEEE's first regional assessment was \$5 for U.S. members in Regions 1-6. The Regions agreed to make the money available to support professional activities in the United States. This assessment was later increased to \$10, and the proceeds were aggregated to form a single fund.

While the current U.S. regional assessment now stands at a uniform \$22, the prerogative of the U.S. Regions to petition for a particular level to satisfy their own special needs has not been negated. All other IEEE Regions now have an assessment in varying amounts for their own special needs.

A Voluntary Dues Plan Just Won't Work

Detractors of the assessment means of support for professional activities suggest that IEEE-USA be organized as a voluntary organization similar to IEEE's technical societies—only participating members would pay dues. One could draw some similarities between the objectives of the Power Engineering Society and IEEE-USA; both deal in education, conferences, and publications, and both have operating committees. However, beyond that simple fact, very little commonality exists as a basis for a voluntary dues plan to finance IEEE-USA, its objectives, organization and operation.

How naive it would be even to try to support lobbying activities in the U.S. Congress, if IEEE-USA's efforts were based on how many members were interested in the "XYZ" issue; or that only 10 percent of its members were interested in supporting efforts to secure funding for cutting-edge research in Government laboratories!

No organization worth its salt goes to Capitol Hill without the full support of its members. IEEE-USA lobbies with the support of its more than 250,000 U.S. members. USAB positions are derived from surveys, papers originated by knowledgeable volunteer committees, investigations, evaluations, and extensive deliberations on the realistic and practical issues and concerns of U.S. members.

Potshots Are Easy to Take

Potshots at how IEEE-USA's \$3.5 million budget supports the pet projects of a few central planners can only come from members unaware of the process or intentionally unwilling to recognize how the budgeting process is actually done.

The task of making every buck stretch far enough to support all of the goals members would like to be accomplished is impossible. Over the years, a very carefully developed budget process has been put in place to prioritize projects based on members' expectations and careful analysis of the support required.

Each year, IEEE-USA publishes a report on the status of its projects. IEEE's Opinion Survey results repeatedly indicate an acceptable level of member satisfaction with the professional activities programs throughout the United States. Thoughtful members do not expect miracles, just continuing progress, and IEEE-USA has made much progress since 1972.

We Need the Support of All Our Members

The last thing IEEE-USA needs is further debate on how to do its job. What we do need is more attentiveness and understanding on the part of our members. Members need to become more involved in supporting the issues that are important to them by writing, calling, and visiting Members of Congress.

IEEE's U.S. members represent a very powerful force. IEEE-USA has become a leading, influential body in technology and public policy. The wisdom of our earlier IEEE leaders in setting forth the concept of IEEE-USA through extensive debate, compromise, and foresight should not be reviled through shallow and careless posturing. Not only our image, but also our influence as a respected organization is at stake.

OCEANS '92

Conference at a Glance

MONDAY							
Times	Salon I	Salon II	Salon III	Salon IV	Courageous Rm.	Conference Rm.	Freedom Rm.
8 am-12 pm	Tutorial I	Tutorial II	Tutorial III	Tutorial IV			
1:30 pm-5:30 pm	Tutorial V	Tutorial VI	Tutorial VII	Tutorial VIII			Tutorial IX
7 pm-9 pm						WHOI Ocean Industry Prog.	
TUESDAY							
Times	Salon I	Salon II	Salon III	Salon IV	Courageous Rm.	Conference Rm.	Freedom Rm.
8 am-12 pm	Open Plenary Session						
12 noon-2 pm	Sponsored Lunch at Newport Islander Doubletree Hotel						
2 pm-5 pm	Session A1-1	Session A2-1	Session A3-1	Session B2-2 (Part 1)	Session B3	Session B2-1	Session D2-1
5 pm-7 pm	Sponsored Reception at Newport Islander Doubletree Hotel						
8:30 am-7 pm	Exhibits Open at Newport Islander Doubletree Hotel						
WEDNESDAY							
Times	Salon I	Salon II	Salon III	Salon IV	Courageous Rm.	Conference Rm.	Freedom Rm.
8 am-12 pm	Session A1-2	Session A2-2	Session A3-2	Session B-1	Session D3	Session B2-3	Session B2-2 (Part 2)
12 noon-2 pm	Sponsored Lunch at Newport Islander Doubletree Hotel						
2 pm-5 pm	Session A1-3	Session D-4	Session B2-3 (Part 1)	Session B2-3 (Part 2)	No session	Session E3-1	Session D2-2
7 pm-10 pm	OCEANS'92 Banquet at the Marriott Hotel						
THURSDAY							
Times	Salon I	Salon II	Salon III	Salon IV	Courageous Rm.	Conference Rm.	Freedom Rm.
8 am-12 pm	Session C1	Session C2	Session D1	Session D5	Session E2	No session	Session D2-3
12 noon-2 pm	Awards Luncheon at the Marriott Hotel						
2 pm-5 pm	Session A1-4	Session E1	Session B2-4 (Part 2)	Session B2-5	Session B2-6 & B2-7	Session E3-2	Session D2-4

Matrix Key

A. Computing and Information Management

- A.1 Modeling, Simulation and Databases
- A.2 Knowledge-based Systems and Neural Networks
- A.3 Geographic Information Systems

B. Sensing and Processing Technologies

- B.1 Satellite Remote Sensing

- B.2 Underwater Acoustics
- B.3 Nonacoustics

C. Communication and Navigation

- C.1 Autonomous Vehicles
- C.2 Acoustic Telemetry

D. Instruments and Measurements

- D.1 Laboratory and Analytical Techniques
- D.2 In Situ Techniques

- D.3 Climate Monitoring
- D.4 Severe Environments
- D.5 SEAFAC: A New Navy Acoustic Test Range Facility

E. Technology Advances

- E.1 Underwater Robotics
- E.2 Power Sources and Materials
- E.3 Vehicles

Registrations in center foyer area of the Marriott Hotel:

Sunday, October 25	3:00 pm - 7:00 pm
Monday, October 26	7:30 am - 1:30 pm (Tutorial only)
	3:00 pm - 7:00 pm
Tuesday, October 27	7:30 am - 3:30 pm
Wednesday, October 28	7:30 am - 3:00 pm
Thursday, October 29	7:30 am - 12 Noon

Exhibits open at the Newport Islander Doubletree Hotel:

Tuesday, October 27	8:30 am - 7:00 pm
Wednesday, October 28	8:30 am - 5:00 pm
Thursday, October 29	8:30 am - 5:00 pm

Chairman's Message

It is an honor to be General Chairman of Oceans '92, "Mastering the Oceans Through Technology." With its diverse set of topics, covered by high quality presentations, Oceans '92 promises to be an exciting forum about the cutting edge technology which is helping to drive ocean science into some major new frontiers. Given national and international priorities, the Plenary Session's theme, "Global Ocean Observing Systems" is a particularly timely and important example of one of those frontiers, and will provide an appropriate orientation for the rest of the Technical Program. Sessions within that program will focus on such exciting areas as Computing and Information Management, Sensing and Processing Technologies, Communications and Navigation, Instrumentation and Measurements, and Technology Advances.

We are extremely fortunate to have Governor Bruce Sundlun of Rhode Island personally welcome attendees, and Dr. John Knauss from NOAA as our Plenary Session Keynote Speaker. One look at the roster of speakers and topics is proof of the excellent work by Tom Mottl and the members of his Technical Program Committee. In addition to Tutorials on October 26, Oceans '92 is also hosting a Student Poster Competition, a broad Exhibits Program, and an entertaining

and educational Dinner Banquet featuring Dr. Robert Ballard of the Jason Foundation and Woods Hole Oceanographic Institution. The entire Planning Committee of Oceans '92 has worked very hard over the past two years to bring you a superbly organized, first-class conference, with top-rate science and technology.

Many thanks are due to the IEEE Oceanic Engineering Society and sponsoring local chapters of MTS, OES/IEEE and IEEE for their support and their contributions to our efforts in achieving high quality in the technical program, as well as in other areas of the conference. Such support will certainly make Oceans '92 a memorable event for all who attend.

Newport, Rhode Island is always lovely in the fall, so I hope you will take time to look around and savor the beautiful sights. As Director of the Woods Hole Oceanographic Institution, I'd also like to encourage you to continue learning about ocean research by joining in on one of the tours to the University of Rhode Island Graduate School of Oceanography or the Woods Hole Oceanographic Institution. It will be a pleasure to see you all at Oceans '92.

Craig E. Donnan
Chairman
Oceans '92

Technical Committee Chairman's Message

The Oceans '92 Technical Program has been structured to reinforce and focus the Conference theme, "Mastering the Oceans through Technology." Four specific technology areas, together with a more general "technology advances" category, have been selected to provide a basis for the presentation of over 200 technical papers organized into 33 distinct sessions. As projected in the Conference Call for Paper, these sessions are organized as follows:

- **Computing and Information Management**
 - Modeling, Simulation and Databases (4 Sessions)
 - Knowledge-based Systems and Neural Networks (2 Sessions)
 - Geographic Information Systems (2 Sessions)
- **Sensing Processing Technologies**
 - Satellite Remote Sensing
 - Underwater Acoustics (7 Sessions)
 - Nonacoustics
- **Communications and Navigation**
 - Autonomous Vehicles
 - Acoustic Telemetry
- **Instrumentation and Measurements**
 - Laboratory and Analytical Techniques
 - In-Situ Techniques (4 Sessions)
 - Climate Monitoring
 - Severe Environments
 - SEAFAC: A New Navy Acoustic Test Range Facility

- **Technology Advances**

- Underwater Robotics
- Power Sources and Materials
- Vehicles (2 Sessions)

The organization of technical papers into Sessions in Oceans '92 departs somewhat from past Oceans Conferences. Papers presented in a particular technical session will reflect common technique, methodology or technology themes rather than a common application domain. This approach can, hopefully, lend new insight, broaden perspectives and expose attendees to a wider range of useful problem solving concepts and techniques. In keeping with this perspective, the Plenary Session will close with five invited papers which address the state-of-the-art in each of the five principal technology categories around which the Technical Program has been structured.

Please come and join us at Oceans '92 in Newport to enjoy the professional atmosphere and benefit from the information and knowledge made available through the technical program, tutorials, exhibits and student poster session. Our goal is to create a high quality, high technology program which reflects the diverse state-of-the-art technologies critical to "Mastering the Oceans through Technology" — we hope you will find that this goal has been met.

Thomas O. Mottl
Technical Program Chair
Oceans '92

Advanced Unmanned Search System

James M. Walton

Code 941

Naval Ocean Systems Center
San Diego, Ca. 92152-5000

ABSTRACT

The Naval Ocean Systems Center (NOSC) is developing the Advanced Unmanned Search System (AUSS) to improve the Navy's capability to do deep ocean search. The search mission addressed by AUSS includes finding items lost on the ocean bottom (broad area search) and close up viewing of the items found (contact evaluation).

Presently, deep towed search systems exist, but the search rate of these systems is limited by cable drag. The AUSS system includes an untethered, semi-autonomous supervisory controlled vehicle. Without the burden of a cable, this vehicle is able to search at high forward velocities, turn quickly, and hover over a target.

The AUSS human operators are kept in the loop with the submerged vehicle as the vehicle control supervisors, search data evaluators, and mission decision makers by means of a high rate half duplex, digital acoustic telemetry system.

All components of the AUSS system are contained on a single support ship. In addition to the vehicle and the human operators, the AUSS system consists of a surface handling system for launch and recovery, an on-board maintenance van, and an on-board control van.

INTRODUCTION

The Advanced Unmanned Search System (AUSS) program was initiated in the mid 1970s with the goal of improving the Navy's capability to find and identify items lost or placed on the sea floor to depths of 20,000 feet. Items which have been searched for in the deep ocean (using other assets) include the Palomares H-Bomb, U.S.S. SCORPION, U.S.S. THRESHER, Korean Airlines Flight 007, Air India Flight 182, United Airlines flight 811 cargo door and other critical equipment lost by the US and other countries. The difficulties encountered in performing these searches have shown that deep ocean search is a critical technology area.

AUSS program personnel have developed an extensive knowledge and experience base in deep ocean search technology and logistics through study and modeling, and more recently, through development and at-sea testing of untethered search systems.

Two untethered search vehicles have been developed and tested at-sea under the AUSS program. The two vehicles together have logged over 100 dives to depths greater than 2000 feet. The concept of using an untethered, semi-

autonomous, supervisory controlled vehicle to conduct deep ocean search has been demonstrated, and improvements in the application of the AUSS concept continue to be developed by AUSS program personnel.

DEEP OCEAN SEARCH

The Deep Ocean Search Mission

The deep ocean search mission scenario includes mobilization, transit, equipment deployment and retrieval, broad area search, and contact evaluation. The two parts of the deep ocean search mission which involve the use of undersea equipment are broad area search and contact evaluation.

Broad Area Search: In broad area search, a large area of ocean bottom is searched rapidly to locate targets of interest for later investigation. Side Looking Sonar (SLS), which is typically used in broad area search, is a relatively low resolution device, and cannot be used to identify any but the largest of targets (ships and submarines). This brings to bear the necessity for the second part of the underwater search mission, contact evaluation.

Contact Evaluation: Contact evaluation involves the use of higher resolution sensors (typically optical) to get a closer look at the targets of interest. During contact evaluation, targets are identified, and their positions pinpointed for future work or recovery.

State of the Art In Deep Ocean Search

The state of the art in deep search systems typically involves the use of two underwater platforms. A towed fish with SLS is used for broad area search, and a tethered or manned vehicle with optical sensors is used for contact evaluation. The use of two different underwater platforms requires two independent launch and recovery systems. Two surface ships are usually required to support the two-underwater-platform search mission.

General Shortcomings: Shipboard support equipment for the towed and tethered systems used in deep ocean search are both large and heavy since they must support up to 6 miles of electromechanical cable. These cables are normally the least reliable part of the overall system. The rate at which a towed deep search platform can advance through the water for fast SLS broad area search is limited by drag on the long tow cable. Advance speeds over one knot are unusual.

Control Error: Maneuvers of the towed platform must be accomplished by maneuvering the surface tow ship. Since the ship maneuvers must be transmitted through very long cables with large catenaries, the track of the tow platform is difficult to accurately control. This control deficiency (control error) results in inefficient use of the search sensor to assure full coverage of the search area. The attempted sensor coverage during successive parallel tracks must overlap each other by an amount equal to or greater than the control error. Turns are particularly difficult. It can take several hours for a surface ship to maneuver a tow platform through a 180 degree turn between parallel search tracks.

Delayed Contact Evaluation: The towed search platform is used to look for all potential targets in a search area before the contact evaluation platform is deployed. This process may be referred to as delayed contact evaluation. Delayed contact evaluation is wasteful of search mission time particularly if the target of interest is encountered early in the broad area search.

AUSS Deep Ocean Search

System: The Advanced Unmanned Search System (AUSS) is designed specifically for the deep search mission. AUSS utilizes a single undersea untethered vehicle to perform both broad area search and contact evaluation. The undersea vehicle is small and lightweight, and requires minimal handling equipment. The basic AUSS system consists of the vehicle, a launch ramp, a maintenance van, and a control van. The entire system fits easily on a single offshore supply boat.

AUSS Vehicle Under Supervisory Control: The AUSS vehicle is untethered, semi-autonomous, and supervisory controlled. The AUSS human operators are kept in the loop with the submerged vehicle as the vehicle control supervisors, search data evaluators, and mission decision makers by means of a half duplex digital acoustic telemetry system. The vehicle autonomously performs given search mission tasks until the tasks are completed or the vehicle operator utilizes the acoustic link to command the vehicle to perform other autonomous tasks. The system operators receive near-real-time data from the vehicle search sensors via the acoustic link.

AUSS Search Concept: The AUSS search concept can be described using figures 1, 2, and 3. In figure 1, the deployed vehicle is autonomously scanning the ocean bottom with SLS while propelling itself through a pre-described search pattern. The SLS search image data is collected onboard the vehicle, and transmitted near- real- time through the acoustic link to the surface support ship. The sensor data is processed at the surface ship and presented to vehicle operators on image displays in the surface control van. Personnel in the control van examine the SLS images for targets of interest.

When a target image appears on the surface display, the vehicle operator must decide if he wants the vehicle to take a

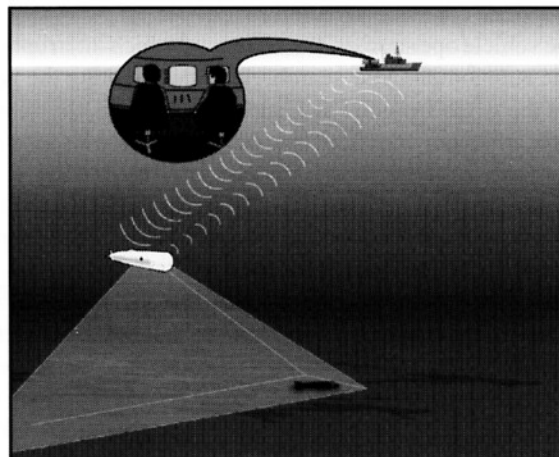


Figure 1. AUSS broad area search

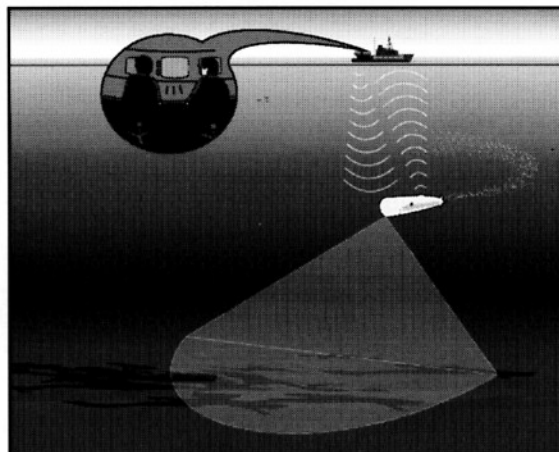


Figure 2. AUSS sonar target closing

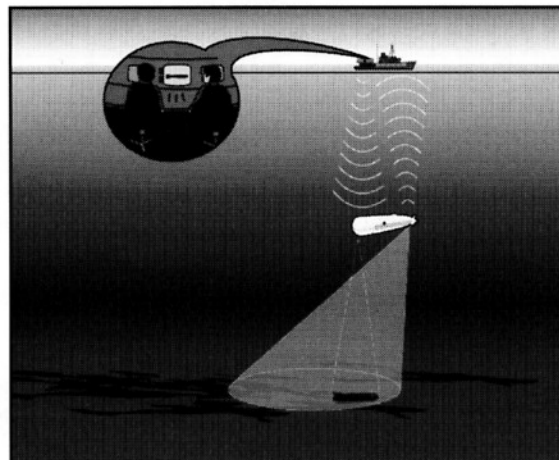


Figure 3. AUSS optical contact evaluation

closer look. If he makes this decision, he initiates the process of immediate contact evaluation.

The vehicle operator sends a command which interrupts the vehicle autonomous SLS search. After determining the position of the target from the SLS surface sonogram, the vehicle operator commands the vehicle to head toward the target while imaging the target with the vehicle forward looking sonar (FLS) (as depicted in figure 2). The FLS data is transmitted through the acoustic link and displayed in the control van for evaluation by the system operators.

When the FLS surface display indicates that the vehicle is nearly directly over the target, the vehicle operator sends commands to the vehicle which will cause it to continue to hover (in three dimensions) over the target. At this time, the operator commands the vehicle to optically document (take a picture of) the target (as depicted in figure 3). The single frame video image of the target is transmitted through the acoustic link to the operators. If the operators decide that the target is of interest, the vehicle operator may reposition the vehicle for more optical documentation. If the target is not of interest, the vehicle is commanded to resume the autonomous SLS search task.

AUSS HISTORY

Search Studies

The first phase of the AUSS program (1973 to 1979) focused upon analysis of state of the art deep ocean search and approaches to improving the state of the art. Computer modeling of search, at-sea search experimentation, and search systems tradeoff studies were conducted. AUSS program personnel have continued to study the field of search to maintain an awareness of the state of the art.

Acoustic Link Development

An acoustic link was developed by AUSS personnel between 1978 and 1981. The acoustic link depends upon the vertical acoustic channel for relatively high data rates (4800 bps) and low bit error rates (10^{-6}). The acoustic link was tested at sea on a free descent/free ascent device, BUMP (Benthic Untethered Multipurpose Platform) to depths of 15,000 feet. The desired performance characteristics were demonstrated during these tests. The acoustic link made it possible to develop a search system based upon a supervisory controlled untethered undersea vehicle.

Development Of A Systems Concept

By 1980, an AUSS systems concept had been defined and developed. Relying upon the modeling, search tradeoff studies, and the BUMP acoustic link experiments, the AUSS evolved into a system utilizing a single surface platform and a single underwater platform. The underwater platform was identified as an untethered vehicle which would be semi-autonomous and supervisory controlled.

AUSS Prototype Design

An AUSS testbed prototype was designed and built (1980-1984). All ingredients of the system (vehicle, launcher, and vans) were designed and fabricated to allow testing of the validity of the AUSS concept. Off the shelf search sensors were purchased, and then modified and adapted to interface with the unique requirements of an untethered supervisory controlled system. To meet the simultaneous depth and size requirements, a graphite epoxy pressure hull program was pursued. The objective of the pressure hull program was to provide a 20,000 foot hull which is the primary buoyancy for vehicle equipment. Several pressure hulls were manufactured and tested for this program. One of the earlier graphite composite hulls with an aluminum extension rated for 5000 foot sea water service was utilized in the prototype vehicle. The pressure vessel housed the vehicle energy source as well as all of the vehicle electronics (except for sensors and propulsion) and met the requirement of providing the buoyancy for the vehicle equipment.

AUSS Prototype At Sea Testing

Between 1985 and 1987 the AUSS prototype system was tested at sea. The prototype vehicle successfully completed 89 dives to 2500 feet. The prototype vehicle dives served as breadboard experiments for an untethered semi-autonomous supervisory controlled vehicle system. During this period, the system evolved to the point that an AUSS search demonstration was possible.

AUSS Search Demonstration:

During dive 87, July, 1987, a search demonstration was conducted with the prototype AUSS vehicle system in 2500 feet of sea water. Both broad area search and immediate contact evaluation were accomplished during the demonstration. The search targets had been previously placed on the ocean bottom. Three parallel search track legs were autonomously run by the vehicle, and three immediate contact evaluations were completed. The broad area search covered an area of $1/3 \text{ nmi}^2$. The average time per immediate contact evaluation (time from when the vehicle discontinued broad area search to do contact evaluation to the time that the vehicle resumed broad area search) was 30 minutes. The contact evaluations all included transmission of the still video images of the target through the acoustic link to the surface, and acoustic tracking fixes of the vehicle position while it was over the target. The SLS broad area search rate was computed to be $.4 \text{ nmi}^2/\text{hr}$. Previous to this, deep search systems had accomplished $.01$ to $.1 \text{ nmi}^2/\text{hr}$ SLS search rates, and contact evaluations were delayed by several hours or days, and took several hours to several days to accomplish.

IMPROVED AUSS SYSTEM

An improved AUSS system has recently been designed, fabricated, and field tested. The system consists of upgraded

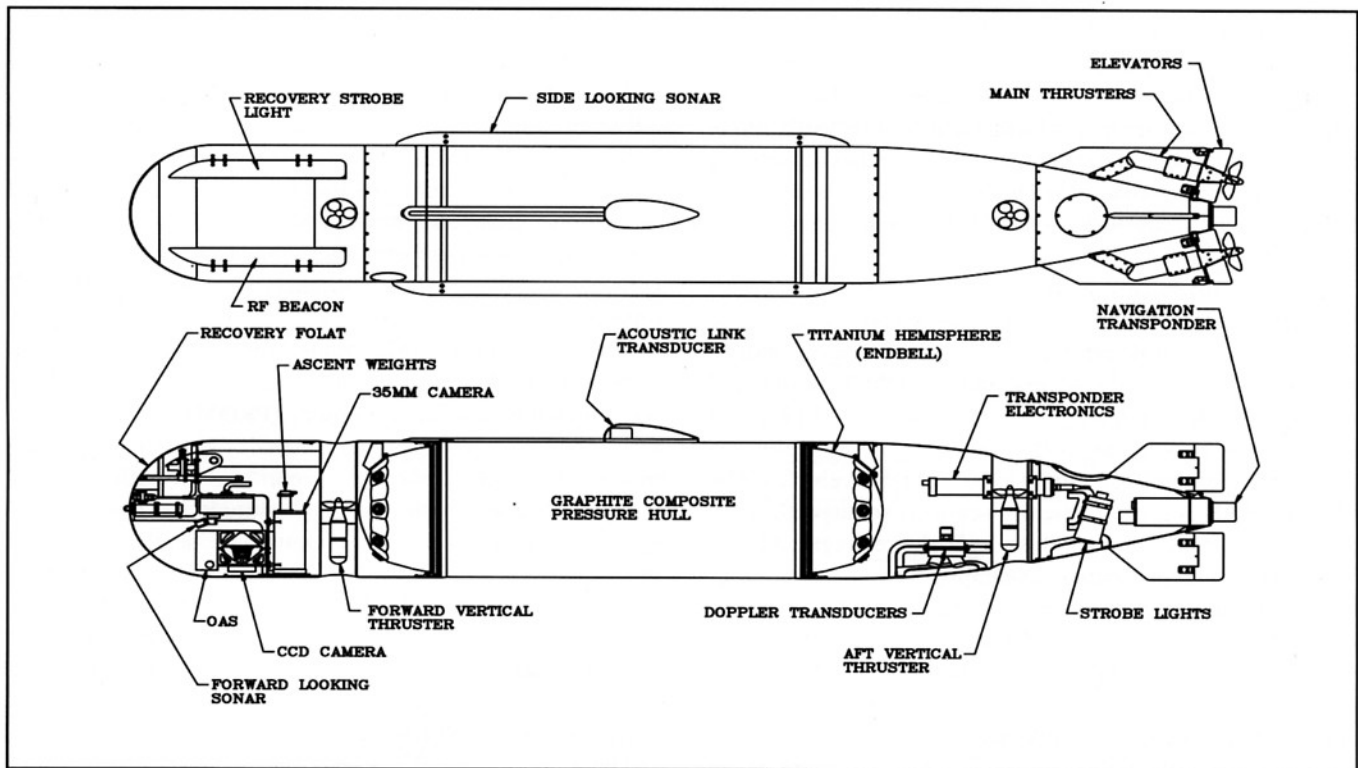


Figure 4. AUSS Vehicle

versions of eight major AUSS system components (undersea vehicle, vehicle computers, acoustic link, external acoustic relay system (EARS) towfish, surface computers, control van, maintenance van, and launch and recovery system). At the time of this writing (June 1991), the system has undergone at-sea testing in which the vehicle has logged 19 dives to depths greater than 2000 feet.

AUSS Undersea Vehicle

The AUSS vehicle is 17 feet long, 31 inches in diameter, and weighs 2800 pounds. The torpedo-shaped body (see figure 4) consists of a 20,000 foot proof tested graphite epoxy composite pressure hull attached to forward and aft free-flooded fairings. The pressure hull provides the buoyancy for the vehicle and houses the vehicle computers, electronics, and silver zinc battery. The free-flooded fairings house the search and recovery (SAR) equipment, propulsion system, search sensors, acoustic tracking transducers, and the doppler sonar transducers.

Pressure Hull: The graphite epoxy pressure hull is the result of several years of development and testing. It is manufactured by a filament wound process, in which bundles of epoxy-wetted graphite filaments are wrapped around a mandrel with alternate circumferential and longitudinal winds. There are approximately twice as many circumferential wraps as there are longitudinal wraps. The two to one filament wind ratio is used to efficiently accommodate the fact that circumferential stress is twice the longitudinal stress in a cylindrical pressure vessel. The

pressure hull meets the objective of providing buoyancy for the AUSS vehicle due to a displacement to weight ratio which is slightly better than 2 to 1.

Bonded to the ends of the pressure hull are titanium rings with a single o-ring groove for face sealing to the titanium hemispheres used for end closures (endbells). The forward and aft endbells have eight connector bosses each for 14 pin bulkhead connectors. Titanium housing connectors mounted in these bosses are used to pass through the power, control, and signal required for the vehicle propulsion, sensors, and acoustic equipment.

The computer card racks and most of the vehicle electronics are mounted in a removable chassis placed in the center of the pressure hull. The vehicle primary energy source, a 20 kWh silver-zinc battery, is also housed inside the pressure hull. The battery is made up of four 20 cell packs, of which 2 packs are mounted to the port and 2 packs are mounted to the starboard of the electronics chassis. All 80 cells are wired in series to provide 120 VDC power to the vehicle.

Attached to the port and starboard sides of the pressure hull are the side looking sonar (SLS) transducers. The transducers are mounted in protective pods bolted to the pressure hull titanium end rings. The SLS transducers operate at 100 kHz, with a 3/4 degree horizontal beam width, and 50 degree vertical beam width. The acoustic link (AL) transducer is attached to the top of the pressure hull. The AL transducer was placed on the pressure hull as a result of beam pattern experiments. These experiments showed that mounting the transducer on a pressure hull can increase the front to back ratio (the ratio between the gain in the region of a 90 degree cone above the vehicle, and the gain below the vehicle.)

Forward and Aft Free-Flooded Fairings: The forward and aft free-flooded fairings are attached to the end bells and to the pressure hull. They are constructed of Spectra 1000, a woven polyethylene mat impregnated with resin (similar to fiberglass construction). The spectra/resin composite has a specific gravity very close to that of sea water. Components inside the fairings are connected to the endbell connectors with pressure-balanced oil-filled wiring harnesses.

The forward fairing houses the forward vertical motor, the forward looking and obstacle avoidance sonars, the cooled charge coupled device (CCD) and 35mm cameras, the ascent weights and releases, and the vehicle search and recovery (SAR) equipment. The vertical motor is an oil filled brushless dc motor with integral motor controller (as are the other propulsion motors on the AUSS vehicle). The 111 kHz FLS is a mechanically scanned sonar with a 1.5 degree horizontal beam width and a 50 degree vertical beam width. The sonar is capable of scanning between 90 degrees to port and 90 degrees to starboard. The obstacle avoidance sonar (OAS) is a 267 kHz fixed "fan beam" (5 degree vertical beam width and 50 degree horizontal beam width) device which will be used by the vehicle to detect and avoid obstructions which the vehicle may encounter. The OAS is not implemented at this time. The CCD camera is an electronic 576 by 384 pixel still camera. The CCD camera is cooled to minimize thermal noise in order to increase its sensitivity. The CCD pixels are digitized to 14 binary bits. The 35mm camera is a photographic color camera with a 250 picture capacity. The vehicle SAR equipment consists of a recovery float, a strobe light, and a RF beacon. Upon surfacing, the recovery float is released, and the strobe and beacon are erected to a vertical position above the floating vehicle. Attached between the float and the vehicle is a polypropylene line used to recover the vehicle to the AUSS launch and recovery ramp.

The aft fairing houses the aft vertical and port and starboard main propulsion motors, the elevators, the strobe lights, and the doppler sonar transducers. The main propulsion motors are used to propel and steer the vehicle, and are angled slightly to provide a larger turning moment about the center of the vehicle. The elevators are utilized at high speeds to pitch the vehicle, thereby controlling depth. They are driven by a stepper motor through a worm gear. At lower speeds, where the elevators are less effective, the vertical thrusters are used to change and maintain pitch and depth. The strobe lights are located with the maximum separation possible from the cameras to create the best source/receiver separation and therefore minimize backscatter. The shutters on both cameras are opened, and the strobes fired to simultaneously document an item on the bottom of the ocean. The doppler sonar consists of a set of four transducers in the aft fairing and electronics in the pressure hull which are used in conjunction with a gyro compass to determine the velocity vector of the vehicle relative to the ocean bottom. The doppler/compass system is used by the vehicle to self-navigate during autonomously run search tracks. The doppler sonar is also used to determine the altitude of the vehicle above the bottom.

Vehicle Computers

Figure 5 is a block diagram of the AUSS vehicle computers. All of the vehicle computer equipment, except for the aft and center bit bus controllers, is mounted in a multibus II card rack inside the pressure hull. The bit bus controllers are mounted in their own card racks remote from the multibus II rack. The main and sensor computer buses are multibus II. Vehicle software is written in PLM 386 and is run under the RMK real time operating system.

The main computer (MC) controls the motion and activities of the vehicle. The vehicle control algorithms are part of the programmable read only memory (PROM) software in the main computer. This software includes heading, depth, altitude, pitch, and speed control algorithms for both the hover (vertical thruster control of depth/altitude for low forward speeds) and transit (elevator control of depth/altitude for higher speeds) modes. The MC is responsible for obtaining and handling navigation and control sensor information directly and through the MC bus from the bit bus controllers, and controlling the propulsion system. MC software is also responsible for the higher level control of the vehicle through maneuvers such as SLS search patterns, hovering over a target, and photomosaic search patterns. The bit bus controllers handle sensor signals to the MC, and propulsion and actuator control signals from the MC. The bit bus system is used to improve the noise environment by replacing low level multiple sensor and control wire runs with a higher level serial bus. The serial bus carries the signals to a remote intelligent node near the sensors.

The main computer also monitors several critical vehicle functions and takes emergency actions based upon the status of these functions. In the case that the MC fails, the emergency computer (which is resident in the center bit bus controller) takes over the emergency functions normally handled by the MC. Most emergency conditions eventually result in a drop of two independent ascent weights to bring the vehicle to the surface. The conditions which may cause this are: 1) The vehicle has not received acoustic link communications for a specified period of time (usually 45 minutes). 2) The main silver zinc energy source voltage has dropped below allowable limits. 3) An individual cell voltage in the main battery has dropped below allowable limits. 4) The emergency backup battery voltage has dropped below allowable limits. 5) The voltage across any of the ascent or descent weight release solenoid activation capacitors has dropped below allowable limits. 6) A salt-water intrusion is detected by leak detect circuits placed throughout the interior of the pressure hull.

The Sensor Computer (SC) communicates with the MC through RS-232 serial links. SC software is resident in PROM. The SC handles communications traffic on board the vehicle. The SC hands supervisory commands which it receives from the acoustic link to the MC. The MC strips off MC commands and passes sensor related commands back to the SC.

The SC manages the sensor data coming from the SLS, FLS, OAS, and the CCD camera. The sensor data is prepared and formatted for transmission in the image manipulation computer and sent over the SC bus to the acoustic link com-

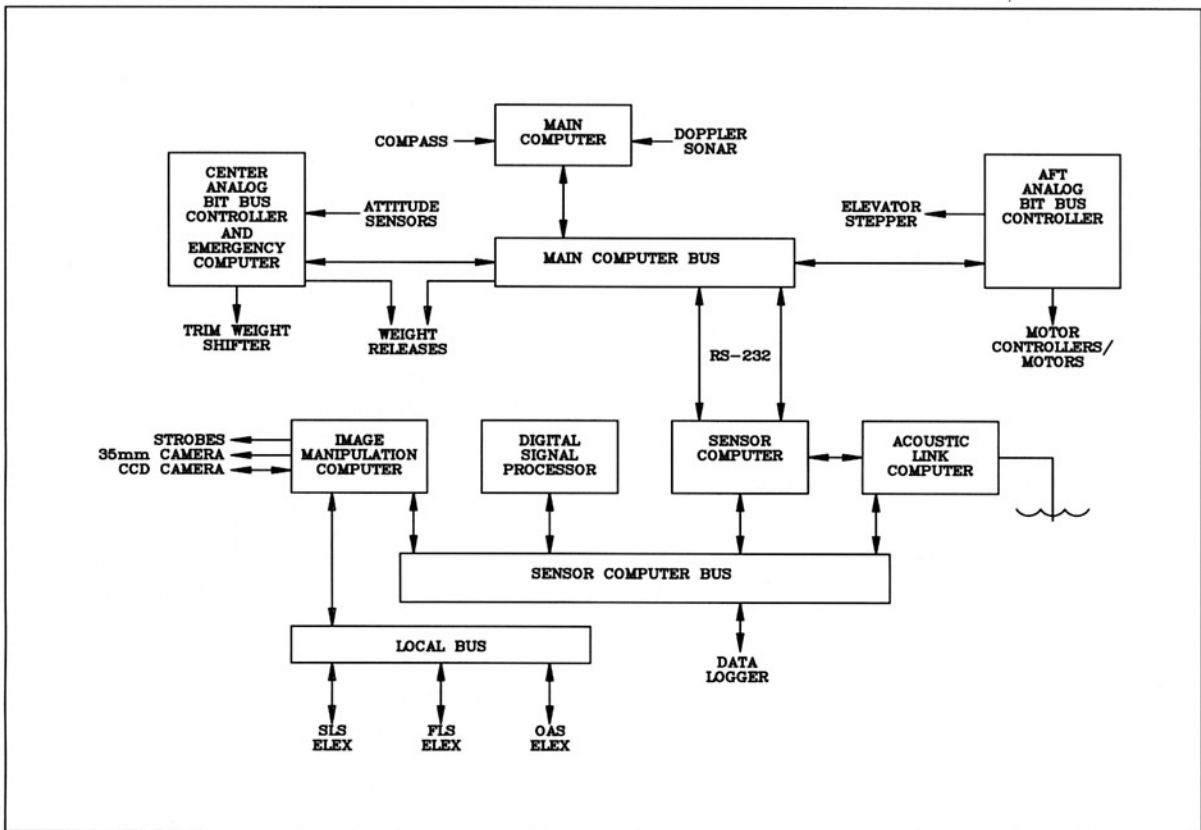


Figure 5. Vehicle Computers

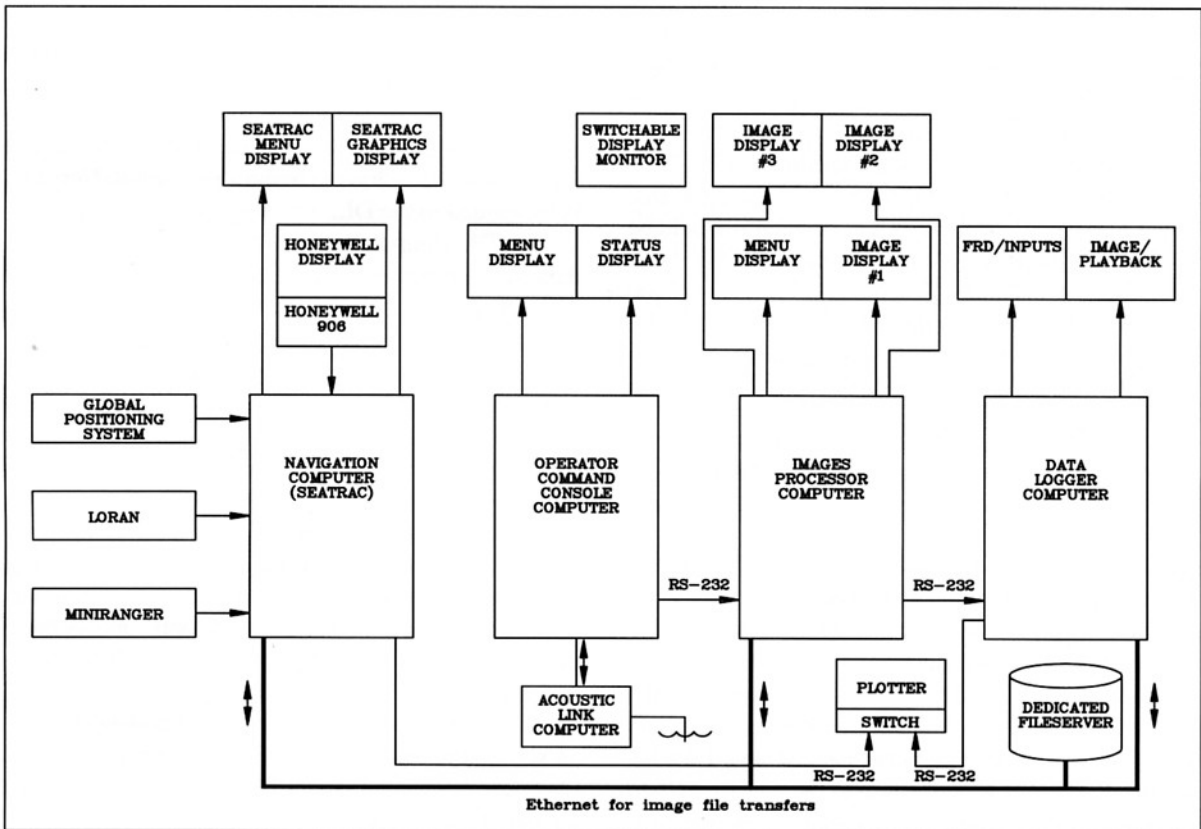


Figure 6. Surface Computers

puter under the control of the SC. A digital signal processor is used to develop a two dimensional discrete cosine transform (DCT) of SLS and CCD 16 X 16 pixel elements, reduce the DCT coefficients, and to Huffman code and run length code the matrix information for compressed transmission of the data over the acoustic link.

Acoustic Link

The AUSS acoustic link provides the operators at the surface with acoustically transmitted sensor data from the FLS, SLS, and CCD camera. The link also provides the vehicle operator with information pertaining to the status of the vehicle. The status information includes, in part, the vehicle depth, altitude, forward velocity, heading, doppler position, and various emergency information.

The acoustic link allows the vehicle operator to supervise the control of the vehicle. The operator uses a special computer keyboard and a menu driven display to assemble high level vehicle commands. Several of these commands are stacked into a queue at the surface console. The entire contents of the queue are sent to the vehicle over the acoustic link when the operator presses a transmit key. When the vehicle receives the series of commands, it responds with a message through the acoustic link indicating the commands were received and are scheduled for execution.

The modulation technique for the acoustic link is phase shift keying of dual independent sidebands. The center frequency of the acoustic link is 11 kHz. Two independent sidebands are 9 to 11 and 11 to 14 kHz. In the up acoustic link channel, these sidebands can be used in a dual mode (where the information is the same on each sideband) or independent mode (where the information is different on each sideband). In the event of an error on one sideband, the dual mode allows the receiving acoustic link computer to select the error free sideband, but the overall data rate is half of what it would be in the independent mode. Overall data rates can vary from 1200 bps (1200 bps per channel, dual mode) to 4800 bps (2400 bps per channel, independent mode). The lower data rates and dual mode operation can be used in the field for more robust communications in situations where the acoustic link signal is degraded by poor acoustic conditions.

EARS Towfish

A towfish with a baffled transducer is towed behind the surface ship at depths between 50 and 300 feet. The transducer is primarily used to receive acoustic link information from the vehicle, and to transmit surface acoustic link information from the surface toward the vehicle. The baffle around the transducer is constructed of closed cell wetsuit rubber and serves the purpose of creating a beam pattern suited for the vertical acoustic path. The beam pattern of the towfish baffled transducer is essentially a 90 degree cone centered on a vertical line running from the transducer to the bottom of the ocean.

Surface Computers

Figure 6 is a block diagram of the surface computers. The four main computers (Navigation (NAV), Operator Command (CMD), Image (IMG), and Data Logger (DL) computers) are industrial grade ATs upgraded with 386 processor chips. The surface computer operating system is DOS, and most of the surface software is written in C. Except for the CMD, these computers are connected to a local area network (Ethernet). Operational software and boot instruction software resident in the file server are accessed through the Ethernet. Each computer has a dedicated keyboard, and has outputs to various displays for displaying menus, status, and vehicle sensor images.

The NAV computer integrates the tracking information from several sources to relate the position of the ship, vehicle, bottom transponders, and search targets in one co-ordinate system, and to display these co-ordinates on one color display. The tracking sources are MiniRanger (for range- range microwave tracking of the surface ship), LORAN C and GPS (for tracking the surface ship), and Honeywell RS906 (for acoustic tracking of the underwater vehicle).

The CMD computer receives all uplink data from the acoustic link computer and displays status information on the vehicle status display. The CMD also provides the menus and keyboard interface for the vehicle operator to assemble high level commands into the command queue for transmission over the acoustic link to the vehicle. All uplink and downlink communications are also sent to the IMG via a RS232 link.

The IMG computer receives vehicle sensor data from the CMD through a RS-232 serial link. The IMG configures the sensor data for display, and allows the IMG keyboard operator to manipulate, enhance, and zoom the sensor data on the sensor displays. The IMG also "decompresses" SLS and CCD image data if it is sent in compressed format. Non-image data is forwarded to the DL.

The DL computer logs all navigation, status, and image data into a time based data base in the dedicated fileservers. The DL is also used to access and display the data base information.

Control Van and Maintenance Van

The Control and Maintenance Vans are stackable containers which are installed on-board the surface support ship as an integral part of the AUSS system.

The primary function of the AUSS Control Van is to house the surface computers and the operators during at-sea operations. The van is air conditioned, and the operators sit in high-backed chairs facing the operator displays and their associated keyboards.

The Maintenance Van provides an area where the vehicle can be maintained on board the ship either at-sea or in-port. Overhead hoists and specially fitted maintenance carts allow the maintenance crew to open and close the pressure housing, exchange the silver zinc battery, extract and insert the main

CALENDAR ADVISORY

National Engineers Week will be celebrated February 14-20, 1993.

National Engineers Week (NEW) has usually been scheduled by the NEW Secretariat and the NEW Steering Committee during the week of George Washington's actual birthday (on February 22), which often falls in the same week as the official Presidents' Day holiday.

Please note that in 1993 Presidents' Day occurs on Monday, February 15, a week before Washington's birthday, and the 20-plus-society Steering Committee has approved February 14-20 (Sunday through Saturday) as the week of our celebrations.

Beginning in 1994, the volunteer-composed Steering Committee is requiring that Engineers Week coincide with Washington's actual birthday on February 22.

electronics chassis from the vehicle, and perform most necessary maintenance and repair tasks on the vehicle. A separate sealed battery room within the maintenance van is used to recharge the silver zinc battery.

AUSS Launch And Recovery System

Part of the AUSS shipboard equipment is an integrated launch and recovery (L/R) system. It consists of a L/R ramp, a ramp translation system, and overhead beams used to transport the AUSS vehicle between the maintenance van and the launcher.

During recovery, the aft end of the launch ramp is placed in the water by translating the ramp aft until it pivots over center. The ramp floats on the water due to buoyancy voids in its structure. The ramp pivots at its attachment point at the ship's stem to decouple the floating end from the motion of the ship as the ship pitches and heaves. The ramp also swivels in azimuth (yaw) at its attachment point. The vehicle, which is free floating on the surface of the ocean after a dive, is obtained with a grappling line. The grappling line is thrown across a polyethylene line attached to a float which is deployed from the nose of the vehicle upon ascent. The vehicle

nose line is pulled through a docking cart at the aft end of the ramp until the vehicle nose mechanically mates with the docking cart. The vehicle is brought up the ramp by a electric motor-driven cable system attached to the docking cart. The ramp is pulled out of the water and back over center by the ramp translation system, until the vehicle and the ramp are parallel with the ship deck. The vehicle is lifted out of the launcher by hoists on overhead beams, and transported into the maintenance van where it is lowered onto and attached to maintenance carts. For launch, the process is reversed, except the recovery line and float remain in place on the vehicle, and the vehicle is released from the launcher by releasing a catch hooked into the forward vertical thruster tube.

AUSS NEAR TERM PLANS

The next series of AUSS sea tests (scheduled to begin in June, 1991) will include the first implementation of SLS on the improved system vehicle, and the first at-sea tests of the acoustic link data compression technique.

After development and demonstration tests are completed to depths of 2500 feet, the system will be demonstrated for vehicle depths of 12,000 feet and then 18,000 to 20,000 feet.



IEEE Leads National Engineers Week 1993

WASHINGTON, June 25 — “As the world becomes increasingly technologically sophisticated, the nation’s fate will lie even more in the minds and hands of engineers,” said Dr. Martha Sloan, incoming president of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) in an announcement today. “That is why we need to highlight our contributions to society during National Engineers Week (NEW),” she added. IEEE is leading NEW, February 14-20, 1993, with Dr. Sloan serving as chair of the event. Honorary Chairman is Kenneth T. Derr, head of Chevron Corporation.

NEW '93 is co-sponsored by 18 engineering and educational societies and 50 additional participating societies. Throughout the week, engineers in the United States and Canada will participate in activities that increase public awareness of the profession. Sloan is calling on all IEEE members to take the lead in the following: educating local officials about engineering; displaying engineers’ achievements at public locations; and providing facility tours.

A national event calling on middle school students to design a city block of the future is being planned in an effort to link students with practicing engineers. Energy-efficient innovations submitted by students will be displayed during the

week in a “mini-city,” followed by a luncheon for participants and the media.

The “E” for the 1993 Discover “E” educational outreach theme represents “energy.” Over 30,000 engineers are expected to participate in the program by presenting lessons to three million students on how engineers find, generate and distribute energy.

To highlight the contributions of electrical and electronics engineers, IEEE United States Activities is sponsoring a special photo contest, “Visions of Technology: Powers of Energy.” Practicing engineers and engineering students of all disciplines are being invited to submit photos of the ingenious methods engineers use to produce energy. Prizes will be awarded during NEW in two categories and include: \$500, for first place; \$250, for second place; \$100 for third; and certificates, for five honorable mentions.

Some 50,000 NEW kits, including suggested volunteer activities, Discover “E” lessons and promotional materials, will be distributed in October.

IEEE members who are interested in participating in local NEW events can call IEEE section leaders. Information on national events is available from Jeanne Quick at the IEEE-USA Office in Washington, D.C., 202-785-0017.

Multiple Energy Sources Needed to Meet Demands for Electricity

WASHINGTON, June 12 — Multiple sources of energy supplies must be found to meet a growing demand for electricity, say the nation’s technology engineers. In Congressional testimony, the U.S. policy arm of The Institute of Electrical and Electronics Engineers, Inc. (IEEE) expressed strong support for a national energy policy designed to satisfy that demand in the short, medium and long terms.

Ensuring an adequate future supply of reliable, low-cost, and environmentally acceptable energy is critical for the nation’s continued economic growth, national security and international competitiveness. According to IEEE United States Activities, demand for energy in the form of electricity has closely followed growth of the domestic economy. That demand will continue to grow as the transportation sector becomes increasingly electrified and environmental concerns become more pressing, the group said.

In statements filed with the House and Senate Appropriations subcommittees responsible for energy research and development, IEEE-USA urged aggressive development of advanced energy technologies that will provide options for meeting this challenge. The organization called for increased

investment in advanced nuclear energy, timely demonstration of fusion as a viable power source, and continued development of energy storage technologies for both utility and transportation applications.

IEEE-USA said a technically-sound national energy policy should direct R & D to improve the economics of alternative energy sources, particularly the use of renewal energy sources such as solar and biomass. Such a policy should remove or streamline institutional and regulatory constraints that limit energy choices and stimulate innovation and development of electrically-powered personal and mass transportation.

In addition, the organization supported development of less complex, standardized, advanced nuclear reactors, with improved passive safety features. Nuclear fuel reprocessing and waste disposal processes should also be formulated to resolve the political, administrative and regulatory issues that inhibit the use of nuclear power.

The IEEE, with over 320,000 members, is the world’s largest professional technical society. IEEE-USA promotes the career and technology policy interest of nearly 250,000 U.S. electrical, electronics and computer engineers.



Engineers Endorse Extension of Copyright To Government/Private Sector Software Efforts

WASHINGTON, June 12 — Unless government agencies are allowed to copyright computer software jointly developed with the private sector, the nation risks losing valuable technology to foreign interests, say U.S. members of The Institute of Electrical and Electronics Engineers, Inc. (IEEE).

In testimony last month before the House Subcommittee on Intellectual Property and Judicial Administration, IEEE United States Activities voiced support in concept for H.R. 191 the "Technology Transfer Improvements Act of 1991." The legislation would allow copyrights for computer software prepared entirely or in part by government employees working under a cooperative research and development agreement (CRADA) with the private sector. Under present law, agencies working with private industry can file for patents but not for copyrights.

David M. Ostfeld, chairman of IEEE-USA's Intellectual Property Committee, noted that U.S. government software technology can be duplicated by foreign entities without compensation, causing the taxpayer and private sector participants to lose their investments.

"Even if the U.S. pays half the cost," Ostfeld said, "the private sector is reluctant to participate in the development of software under a CRADA without copyright protection."

IEEE-USA recommends several technical clarifications in the pending legislation including amendments to ensure continued public access to already existing Federally-generated computer software.

"We are convinced that H.R. 191 is a step in the right direction," said Ostfeld. "The legislation will enhance U.S. competitiveness and provide rewards to both Federal government inventors and authors of computer software."

The IEEE, with over 320,000 members, is the world's largest technical society. IEEE-USA promotes the career and technology policy interest of nearly 250,000 U.S. electrical, electronics and computer engineers.

Note to Editors and Journalists: For a copy of the Congressional testimony and comments on technical amendments, contact Scott D. Grayson, IEEE-USA Office, Suite 1202, 1828 L Street, N.W., Washington, DC 20036; telephone (202) 785-0017; facsimile, (202) 785-0835.

Comprehensive Technology Employment Guides Available to Engineers, Graduates and Scientists

WASHINGTON, July 17 — For recent technology graduates and for engineers and scientists hit by defense industry cutbacks, help in finding employment is now available through a single source.

Two volumes of an *Employment Guide for Engineers and Scientists*, updated for the '90s, are being offered by IEEE-USA, the United States Activities' arm of The Institute of Electrical and Electronics Engineers, Inc. The *Guide* is available in two editions: one designed for those with employment experience; the other, for students and recent graduates.

The student edition, just published this month, contains basic information on conducting a job search. Special features include a list of the 50 most-asked questions during a job interview.

Both publications contain information on salaries, along with solid advice on how to conduct a job search. They also provide assistance on how to:

- cope with job loss;
- write resumes;
- prepare for interviews;
- work with employment services;

- interact with colleagues and friends;
- evaluate compensation packages; and
- assess legal rights in the employment process.

Both versions include a *Directory of Employers of Engineers*, a comprehensive state-by-state sourcebook that lists hundreds of companies, including telephone numbers and contact persons.

The *Guides* are sold through the IEEE Service Center: \$14.95 to members; and \$19.95 to non-members, plus tax and shipping. To order, call 1-800-678-4333 and request Catalog No. UH0186-7, for the experienced engineer edition; or UH0188-3, for the student edition.

A copy of either *Guide* will be provided at no charge to non-student IEEE members who are unemployed. Written requests, including membership number, should be sent to William R. Anderson, IEEE-USA, 1828 L Street, N.W., Suite 1202, Washington, DC 20036.

{Note to Editors and Journalists:} For a review copy of either version of the *Employment Guide for Engineers and Scientists*, call IEEE Public Relations in Washington, 202-785-0017; facsimile, 202-785-0835.]

Elected Administrative Committee

DANIEL L. ALSPACH
ORINCON Corp.
9363 Towne Center Drive
San Diego, CA 92121
(619) 455-5530

STANLEY G. CHAMBERLAIN
Raytheon Co.
Submarine Signal Division
1847 West Main Rd.
Portsmouth, RI 02871-1087
(401) 847-8000, ext. 4423

JOSEPH CZIKA
TASC
1101 Wilson Blvd., Suite 1500
Arlington, VA 22209
Tel (703) 558-7400
FAX (703) 524-6666

RUI J.P. deFIGUEIREDO
IERF Bldg., Rm. 208b
University of California
Irvine, CA 92717
Tel (714)-856-7043
FAX (714)-856-4152

SHELDON BALK
Lockheed Missiles & Space Co.
0/90-20 Bldg. 201
3251 Hanover St.
Palo Alto, CA 94304
(415) 424-2180

DAVID E. WEISSMAN
Hofstra University
Dept. of Engineering
Hempstead, N.Y. 11550
(516) 560-5546

ROGER DWYER
43 South Cobblers Ct.
Niantic, CT 06357
(203) 440-4511

EDWARD W. EARLY
4919 N.E. 93rd St.
Seattle, WA 98115
(206) 525-2578

FERIAL EL-HAWARY
Tech. Univ. of Nova Scotia
P.O. Box 1000
Halifax, NS, Canada B3J 2X4
(902) 429-7541

ROBERT W. FARWELL
Code 240
Naval Oceanogr. & Atmos. Res. Ctr.
Stennis Space Center, MS 39529
(601) 688-5230

GORDON RAISBECK
40 Deering St.
Portland, ME 04101
(207) 773-6243

CHRISTIAN DE MOUSTIER
Masrine Physical Lab.
Scripps Instit. of Ocean.
La Jolla, CA 92093
(619) 534-6322

NORMAN D. MILLER
West Sound Associates
2644 NW Esplanade
Seattle, WA 98117
(206) 373-9838

CHARLES E. STUART
DARPA
1400 Wilson Blvd.
Arlington, VA 22209
(202) 841-7200

MICHAEL SEROTTA
General Dynamics
Two Corporate Place
Middletown, RI 02840
(401) 848-8531

ROBERT C. SPINDEL
Applied Physics Laboratory
University of Washington
1013 N.E. 40th Street
Seattle, WA 98105
(206) 543-1310

FRED AMINZADEH
Unocal-Science & Tech. Div.
Brea, CA 92621
(714) 528-7201

Ex-Officio

Jr. Past President
DANIEL L. ALSPACH

Sr. Past President
ANTHONY I. ELLER
SAIC
1710 Goodridge Dr.
P.O. Box 1303
McLean, VA 22102
(703) 734-5880

Membership Development
FERIAL EL-HAWARY

Nominations
DANIEL L. ALSPACH

Chapters
LLOYD Z. MAUDLIN

Publicity
J. DAVID IRWIN

Journal Editor
FREDERICK H. FISHER

Constitution and Bylaws Committee
JOSEPH CZIKA

Standards
FREDERICK H. MALTZ

Meetings
GLENN N. WILLIAMS (East)
LLOYD Z. MAUDLIN (West)

Awards and Fellows
DANIEL L. ALSPACH

Fellows Evaluation
W.A. VON WINKLE

Publications Review Board
GLEN N. WILLIAMS

Newsletter Editor
FREDERICK H. MALTZ

Associate Editors

ARTHUR B. BAGGEROER
Dept. Ocean Eng. — Rm. 5-204
Mass. Inst. Technology
Cambridge, MA 02139
(617) 253-4336

RICHARD STERN
Applied Research Lab.
Penn State Univ.
P.O. Box 30
State College, PA 16804
(814) 865-6344

TAKENOBU KAJIKAWA
Ocean Energy Sect.
Electrotechnical Lab.
1-1-4 Umezono
Sakura-Mura, Niihari-Gun
Ibaraki, 305, Japan
(0298) 54-5397

D. RICHARD BLIDBERG
Marine Systems Eng. Lab.
Univ. of New Hampshire
Marine Program Building
Durham, NH 03824-3525
(603) 862-4600

JOHN E. EHRENBERG
Boeing Aerospace & Electronics Co.
P.O. Box 3999
MS 82-22
Seattle, WA 98124-2499
(206) 773-0325

JOHN D. PENROSE
Centre for Marine Science & Tech.
Curtin University
Kent St., Bentley, W. Australia 6102
Australia
61 9 351 7380

WILLIAM J. PLANT
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543
(617) 548-1400, ext. 2725

ADRIAN K. FUNG
Elec. Eng. Dept.
Univ. of Texas at Arlington
Box 19016
Arlington, TX 76019
(817) 273-2671

GIORGIO TACCONI
University of Genoa
Dept. Eng., Biophy. & Elec. (DIBE)
Via all' Opera Pia 11a
16145 Genoa, Italy
39 (0) 10 31 18 11
39 (0) 10 31 18 11

CHRISTOPHER VON ALT
Dept. of Ocean Engineering
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543
(508) 548-1400, ext. 2290

MALCOLM L. HERON
Physics Dept.
James Cook University
Townsville, Queensland 4811
Australia
61 77 81 4117

CHRISTIAN DE MOUSTIER

ROBERT W. FARWELL

ROBERT C. SPINDEL

Technical Committee Chairmen

Underwater Acoustics Technology, ROBERT W. FARWELL
Arctic Instrumentation, EDWARD W. EARLY
Autonomous Unmanned Underwater Vehicle Technology, DANIEL STEIGER
Current Measurement Technology, GERALD F. APPELL
Marine Communication and Navigation Technology, JAMES ATKINSON
Modeling, Simulation, and Data Base Technology, GEORGE DWORSKI

Oceanographic Instrumentation and Data Acquisition Technology,
OREST I. DIACHOK
Remote Sensors Technology, DAVID E. WEISSMAN
Technical Committees Coordinator, STANLEY G. CHAMBERLAIN
OCEANS '92 General Chairman, DR. CRAIG E. DORMAN, (Newport R.I.)
TECHNICAL CHAIRMAN, Thomas Mottl
OCEANS '93 General Chairman, DR. JAMES COLLINS, (Victoria, BC, Canada)