IEEE

# OCEANIC ENGINEERING SOCIETY

## NEWSLETTER

VOLUME XII NUMBER 4

EDITOR: HAROLD A. SABBAGH WINTER 1983 (USPS 420-910)

## EDITOR'S COMMENTS

Now that we are a Society, we want to expand our *Newsletter* to offer the widest possible services. To that end, in our last issue we introduced the Current Measurement Technology Committee's News and Information column, contributed by the Committee chairman, Bill Woodward. We would be glad to publish any other such news and information exchanges; let us know your wishes and interests. We continue to look for a patents editor, an educatin editor, and for contributions of broad-based technical papers.

With the March 1984 issue, we will introduce Rod Mesecar as our new Editor for Technology. Rod will be seeking material under the general heading of technology in the ocean environment, which includes instrumentation and a host of other things. We will need the cooperation of our readers in providing contributions to this forum. Please contact Rod with your suggestions. His address is

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In this issue we introduce a column of personal reflections, entitled WHAT OCEANIC ENGINEERING MEANS TO ME. Our first contribution, "The EE, the SNa and me," was written by Art Westneat, who is one of the founding fathers of the IEEE Oceanic Engineering Society, and is presently chairman of the Chapters Committee. I'm certain that you'll enjoy reading Art's thoughts, and we solicit similar contributions from our readers. One advantage of such a column is that it may help young people in choosing a career in oceanic engineering.

Whatever oceanic engineering, in its infinite variety, means to each of us, however, the present season can only mean one thing: PEACE ON EARTH, GOODWILL TO MEN.

Have your merriest Christmas, ever, with your happiest New Year!

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# OCEANIC ENGINEERING SOCIETY

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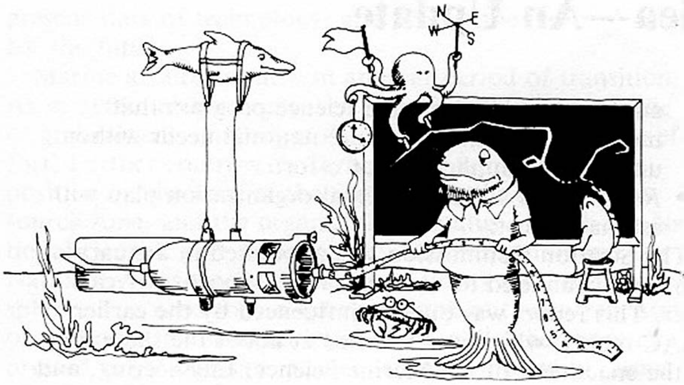


## CURRENT MEASUREMENT TECHNOLOGY COMMITTEE NEWS AND INFORMATION

A primary objective of the Current Measurement Technology Committee (CMTC) of the Oceanic Engineering Society (OES) is to provide a focus for information exchange and promote cooperation and coordination among those in the marine community involved in current measurement. To this end, this column has been established as a regular feature of the *OES Newsletter* and everyone is encouraged to participate by submitting news items and information about active or planned current measurement efforts to Bill Woodward (301) 443-8444 or Jerry Appell (301) 443-8026 for publication in the column. This will be an effective forum only if everybody participates, so let's hear from you.

The National Ocean Service of NOAA has just completed a 3-year circulation survey of the Chesapeake Bay. In 1984, NOS will begin a 15-month circulation survey of the Delaware River and Bay and a 6-month survey of the Southeast Alaska estuaries. The NOS uses Grundy Model 9021 current meters on the east coast and Aanderaa current meters on the west coast.

Contact Richard Patchen, (301) 443-8501.

The Pacific Marine Environmental Laboratory (PMEL) in Seattle, Washington, is a major participant in the study of the role of the oceans on the global climate system. A central focus of the program has been a study of near surface circulation in the equatorial Pacific with routine deployments of conventional current measuring instruments. To augment this effort, an Ametek Straza DCP 4400/115 Acoustic Doppler Profiler was recently installed aboard the NOAA Ship DISCOVERER, which is a 93 m oceanographic research vessel operated by the National Ocean Service. The profiler utilizes the doppler shift of pulsed acoustic signals to determine the relative motion of acoustic scatterers within the water column. The nominal operating depth limit is 300 m with the range divided into 63 "bins," or depth layers, which are spacially averaged to effectively smooth the doppler signal.

The initial operations in the fall of 1983 will emphasize intercomparison experiments with the shipboard profiler and moored current meter arrays. Seven heavily instrumented single point taut line moorings deployed in the region of high vertical shears along the equator will be utilized in this study. Additionally, comparisons will be made with data from the free fall velocity profiler TOPS, which will be utilized on upcoming cruises. We hope to gain confidence in the system through these and other experiments and look forward to cooperative efforts with other users of shipboard doppler profilers.

New 'Smart' CTD and ACM instruments introduced by Neil Brown instrument Systems. The first two modules in a new series of low cost, lightweight oceanographic instruments have been introduced by Neil Brown. The instruments use proven sensors and technology to make precise, high-resolution underwater measurements of conductivity, temperature and depth (CTD), and water speed, direction and temperature (ACM).

The Smart ACM, which may be remotely deployed for up to 45 days with its own power supply and solid-state memory, takes up to two measurements per second; the Smart CTD may be used in both deployed and profiling modes, and measures its parameters at rates of up to 5 samples per second.

Both instruments are interfaced to microprocessor electronic packages, and may operate independently or on command from a bidirectional communications loop (Serial ASCII Instrumentation Loop—SAIL). Operating parameters such as sampling rate, telemetry conditions, and baud rate may be programmed by the user and modified during operation as required. The system controller can be as simple as an RS-232 compatible terminal for real time, hard-wired applications or can be custom-designed for use in an autonomous mooring, with multiple devices being polled, and data stored on one logger and/or telemetered in real time.

The Neil Brown Smart CTD and Smart ACM instruments offer levels of accuracy, flexibility and reliability previously unobtainable in low-cost devices.

Contact Neil Brown Instrument Systems, Inc., P.O. Box 498, 1140 Rte. 28A, Cataumet, MA 02534, USA (617) 563-9317/TELEX 951008.

On November 2 and 3, 1983, NOAA and the IEEE CMTC convened The Acoustic Current Profiling Symposium in Washington, D.C. The Symposium objective was to bring together selected program management and technical people to review where the community is in the development of acoustic methods for profiling currents, to identify critical areas of the technology that require further work and to provide guidance and direction for continued short and long term development and application. Twenty five invited speakers came to present their experiences with acoustic profiling to an audience of another 50 research, management and commercial colleagues. The Symposium was declared by all to be a success and proceedings which will include speaker abstracts as well as an overall summary are now being prepared. For further information contact: Bill Woodward (301) 443-8444, Dave Porter (301) 443-8444 or Jerry Appell (301) 443-8026.

# Effective Use of the Sea—An Update

The theme of OCEANS '83, "Effective Use of the Sea—An Update," is based on three reports written between 1966 and 1972 that had a profound influence on oceanic affairs, both nationally and internationally. The first report, "Effective Use of the Sea," was written by the Panel on Oceanography of the President's Scientific Advisory Committee (PSAC) and released in 1966 by President Lyndon Johnson. The Stratton Commission (the Commission on Marine Science, Engineering, and Resources, chaired by Julius A. Stratton) wrote the second report, "Our Nation and the Sea, A Plan for National Action," which was released in 1969. The third report, "Toward Fulfillment of a National Ocean Commitment," was written by the Marine Board of the National Academy of Engineering and was released in 1972.

These reports embodied a profound change of thinking about the oceans. The period between 1965 and 1972 was a time of transition in the course of marine affairs. Prior to this period, the greater portion of oceanic effort supported national security, and the academic scientific study of the oceans was done under the title of oceanography. During this period, an intense controversy developed over the adequacy of our national effort to understand, explore, and develop the oceans. The space program was well under way, and during this period, such statements as "We know more about the back of the moon than we do about the bottom of the ocean" were prevalent.

In Congress, the action was heated, and as many as 19 bills regarding the ocean were submitted during the summer of 1965. These actions culminated in the Marine Resources and Engineering Development Act, Public Law 89-454, enacted by Congress on 17 June 1966. The Act called on President Johnson to develop a comprehensive, long-range, and coordinated national program in marine science, with the assistance of a National Council on Marine Resources and an advisory Commission on Marine Science, Engineering, and Resources. This advisory commission (the Stratton Commission) was made up of fifteen members from Federal and State Governments, industry, laboratories, and other marine institutions. Four members of Congress served as advisors to the Commission; all members were appointed by the President. Specifically, the Commission was charged to:

- *Review* the known and contemplated needs for natural resources from the marine environment to maintain the expanding economy.
- *Review* the surveys, applied research programs, and engineering projects required to obtain the needed resources from the marine environment.
- *Review* the existing national research programs to ensure realistic and adequate support for basic oceanographic research that will enhance human welfare and scientific knowledge.
- *Review* the existing oceanographic and ocean engineering programs, including education and technical training, to determine which programs are required to advance our national oceanographic competence and stature, and which are not adequately supported.
- *Analyze* the findings of the above reviews, including the economic factors involved, and recommend an adequate national marine science program that meets the present and future national needs without unnecessary duplication of effort.
- *Recommend* a Governmental organization plan with estimated cost.

The Stratton Commission was appointed in January 1967 and submitted its comprehensive report two years later. This report was directly influenced by the earlier PSAC report, which was released at about the same time as the enactment of the Marine Science, Engineering, and Resources Act. One of the fundamental changes found in the PSAC report was the redefining of the word "oceanography" to connote more than the scientific study of the sea. The PSAC report defined oceanography to include all activities involving the ocean that have significant scientific or technological content.

The PSAC report had four principal objectives:

- To draft a statement of goals for a national program to serve the marine interests of the United States and to define the Federal role in the pursuit of these goals.
- To assess current and planned ocean-oriented programs for technical soundness, adequacy of scope, balance of content, appropriateness of organization, funding, and management in light of relevant national goals.
- To identify major opportunities for new programs in technology and science that should be given high priority in the next five to ten years.
- To recommend measures to effect an ocean science and technology program consonant with national needs and interests.

Besides broadening the definition of the term oceanography, the PSAC report also looked at ocean resources, primarily fisheries, as an international issue and stressed the need to preserve the near-shore environment.

The third report was written by the Committee on Ocean Engineering of the National Academy of Engineering, which was renamed the Marine Board before the report was issued in 1972. This was the first committee to be organized (April 1965) by the newly formed National Academy of Engineering. From 1966 through 1970, the Committee was active as an advisor to the Army, the Navy, the Departments of Commerce, Interior, State and Transportation, the National Science Foundation, the National Research Council on Marine Resources and Engineering Development, and the Stratton Commission. The Committee believed that besides a solid program of scientific research on the ocean, the nation needed a comprehensive program of engineering research and development to fulfill the proposed national program as outlined in the Stratton Commission report. The committee's report established the current state-of-the-art in the various fields of ocean engineering and projected these needs into the future.

When the committee for OCEANS '83 was formed in 1982, one of their first decisions was to establish a meeting format that would result in a set of published proceedings that would update the changes in ocean technology occurring over the last decade, evaluate the present state of technology, and project the national needs for the future.

Marine affairs are now in another period of transition. As in 1966, intense controversy, both within and outside of government, challenges the adequacy of our marine effort. Further controversy involves the administration's position on the Law of the Sea Treaty, the 200-mile resource zone, and the organizational status of both the National Oceanic and Atmospheric Administration and the National Advisory Committee on Oceans and Atmosphere. The need for an extensive look at the current state of marine affairs and national ocean policy has been expressed in government, academia, and industry in recent months.

Although Congressman Breaux (D-Mississippi) first voiced the need for another Stratton-Commission-type study, Congressman Walter B. Jones (D-North Carolina), the Chairman of the Merchant Marine and Fisheries Committee, introduced the first bill to address this issue on 2 May 1983, called the "National Ocean Policy Act of 1983."

This Act is similar to the Marine Resources and Engineering Development Act of 1966. The proposed Act states that "the Congress find that it is in the national interest to:

- Encourage the development of international oceans law in a manner that will promote the peaceful uses of the ocean and balance the interests of the United States and all nations.
- Encourage and promote the continued leadership of the United States in conducting research on, and in conserving, managing, and developing marine resources. . . . (living and nonliving).
- Promote the wise use and compatible development of marine resources.
- Encourage United States investments in the exploration of marine resources and technologies.
- Ensure the equitable allocation of the responsibilities for marine research, conservation, management, and development among the various levels of government and the private sector, and promote the efficient use of the limited resources for such. . . ."

Sen. Ernest F. Hollings (D-South Carolina) and Sen. Bob Packwood (R-Oregon) may introduce a similar bill in the Senate in the near future, and it seems certain that some legislation on ocean policy will be enacted after a period of hearing and debate. This likelihood has strengthened the resolve of the OCEANS '83 committee to publish a proceedings that will contribute to a forward-looking National Ocean Policy that will guide the United States over the coming decade.

Many of the principals involved in the OCEANS '83 Conference were also involved in these historic reports. Dr. Henry Menard, a member of the Blue Ribbon Panel, was one of the Technical Assistants on the Panel on Oceanography for the PSAC report. Jim Wenzel, Chairman for OCEANS '83, and Conrad Welling, Chairman for one of the technical sessions, were consultants to the Panel on Oceanography. For the Stratton Commission study, John Knauss, one of OCEANS '83 keynote speakers, was a member of the Panel on Basic Science and Chairman of the Panel on Marine Engineering and Technology. The following members of the OCEANS '83 committee participated in the Marine Board report: Claude Hocott, Elmer Wheaton, Jim Wenzel, Jack Boller, Feenan Jennings, and Don Walsh.

# Toast!

If "Here's mud in your eye" is the best you can come up with for a toast, everyone should have two or three toasts memorized for that inevitable occasion when they will be called upon to rise and give a toast.

"May you live to be 100—with one extra year to repent."

"Here's a health to your enemies' enemies."

"May the road rise to meet you; May the wind be always at your back; The sun shine warm upon your face; The rain fall soft upon your fields; And until we meet again, may God hold you in the hollow of his hand."

For dramatic effect:

"Here's to your coffin. May it be made with 100-year-old oak trees, which I shall plant tomorrow."

The word "toast" comes from an old Irish tradition dating back to the 16th Century. Imbibers of the day would put a piece of toast in a glass of whiskey or beer to improve the flavor, possibly to remove impurities. By the 18th Century, the word had taken on its present meaning.

In the two centuries, people realized that a graceful thought adds more flavor to a drink than toasted bread.

Toasting is always done with the right hand, with the glass held straight out from the shoulder. This shows there is no sword or dagger concealed, as there sometimes was when toasting first began.

The first historical records of toasting are found at about the 14th Century. Toasting is mostly an oral tradition.

The tradition of throwing glasses is rooted in the same mythology as the ringing of church bells—noise to ward off evil spirits.

The tradition of throwing the glass into the fireplace after a toast probably originated in Lithuania and Estonia during the 18th Century.

They were the first conspicuous consumers. A piece of glass was worth a great deal of money then and the Lithuanians and the Estonians were very wealthy. A wealthy nobleman would impress his guests by throwing the glass.

There are no truly American toasts. They seem to have been killed off by Prohibition. Although whiskey returned, the toast did not.

(Reprinted from *MTT-S Newsletter*, Summer 1983.)

OCEANS '83

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News

# OCEANS '83: Effective Use of the Sea—An Update

## AN INTERVIEW WITH DR. FERRIS WEBSTER

Dr. Ferris Webster, professor at the College of Marine Studies, University of Delaware, is the Keynote Speaker for Oceanography at the upcoming Oceans '83 Conference, to be held August 29–September 1 in San Francisco, sponsored by IEEE-Oceanic Engineering Society and the Marine Technology Society. The following are excerpts from an interview with Dr. Webster by OCEANS '83 staff regarding the focus of his presentation at the Conference.

O'83: Dr. Webster, this year's OCEANS conference is considered to be an update, based on the PSAC and Stratton Reports of the late 1960's, of what's been done over the past decade and a half in oceanography. Can you give us a few markers of progress so far?

FW: I would say, primarily, that we have been successful in the development of tools and technologies for oceanography: today, satellites can provide global coverage of ocean surface currents, temperature and wind stress on the sea surface, and we have the hardware and software for large-scale data processing and analysis of the immense data sets generated by these satellites. Our ability to model the ocean and atmosphere using the techniques of geophysical fluid dynamics is, to say the least, impressive.

O'83: What have we yet to accomplish?

FW: Since the sixties, public and scientific emphasis has been shifting away from the deep sea, toward the coastal regions and to more applied marine problems. Yet we seem to be only slightly ahead of the sixties in solving these applied problems. We have been slow to establish an ocean services program, and have made little progress toward improving our use of the ocean as a source of fish and other food.

O'83: What does this tell us about the future?

FW: I believe it says we must learn to apply our technologies and knowledge if we are to even achieve the hopes of the sixties during the years to come. Our past failure to meet this challenge has not been a failure of technology, but a failure of will. Research funding, national ship capability, and satellite to use must all be the focus of a unified, determined effort to develop programs for effective use of the sea. And I think that the presentations and exchange of information that will happen at the OCEANS '83 conference will help us meet this goal.

O'83: Thank you, Dr. Webster.

## AN INTERVIEW WITH DR. JOHN KNAUSS

Dr. John Knauss is Vice President for Marine Programs of the University of Rhode Island, and will be the Keynote Speaker for Marine Affairs at the OCEANS '83 Conference, to be held August 29–September 1 in San Francisco, sponsored by the IEEE-Oceanic Engineering Council and the Marine Technology Society. The following is an excerpt from an interview with Dr. Knauss and OCEANS '83 staff about his conference presentation on the role of marine science and technology in marine affairs.

O'83: Dr. Knauss, what would you say is the primary driving force behind the progress made in the United States' policies on marine affairs since the 1960's?

JK: In my opinion, marine affairs in this country and elsewhere have been shaped by the new and expanding uses of the ocean, nearly all of which are in turn, technology-driven.

O'83: Can you elaborate on that?

JK: Well, for instance, a prime example is the Law of the Sea Convention, and not just the much maligned chapter on deep seabed mining. A close reading of the entire treaty—its articles on environmental protection and scientific research, and freedom of navigation, for example—indicates how much it has been shaped in large part by technology developments, by what we can actually *do* in these areas. Even while the treaty was being negotiated, new ocean uses were being developed, such as emplacement of radioactive waste deep in the ocean sediments, OTEC, and possible new mineral resources such as cobalt crusts and polymetallic sulphides.

O'83: Many of the technological areas you mention have been developed by the private sector—what about the U.S. Federal government response?

JK: I think that's a similar case: the Federal response to the ocean has been in large part driven by technology and not by a systematic development of ocean policy. The one notable exception is, of course, the Marine Resources Engineering and Development Act of 1966 which established the Marine Council and the Stratton Commission.

Although some actions of Congress and the Administration have been to accelerate our knowledge and use of the ocean—for example, Sea Grant, and the International Decade of Ocean Exploration—most have been in response to opportunities and stresses resulting from advances in marine science and technology. Examples are: the Fisheries Management and Conservation Act, the Coastal Zone Management Act, and the Ocean Dumping Act.

O'83: If this relationship is as you state, that technology drives policy, what's the outlook for marine affairs?

JK: Well, that's part of what we'll be exploring at the OCEANS '83 Conference, of course, but I would say that anyone interested in predicting the future course of marine affairs would be well-advised to follow closely new development in marine science and technology.

O'83: Thank you, Dr. Knauss.

# ROVing the Ocean Floor

Not even Jules Verne imagined an undersea voyage like this: in the muddy water of Mendumf Pond, in southern New Hampshire, scientists are testing an experimental underwater robot equipped with onboard computers, sonar and primitive artificial intelligence. The yellow-painted robot—named EAVE (Experimental Autonomous Vehicle)—looks like a seaworthy version of "Star Trek's" starship USS Enterprise. It is programmed to navigate an underwater obstacle course, making its own decisions to turn, avoid objects or return to its starting location. "It's really eerie," says Richard Blidberg, associate director of the University of New Hampshire's Marine Systems Engineering Lab, which build EAVE. "We watch all this on film. You see this mechanical kluge [contraption] stop, think and decide to do something."

Undersea robots were first deployed three decades ago when the U.S. Navy developed a cable-controlled robot system to retrieve torpedoes from the ocean floor of its practice ranges. Today advances in computer technology and robotics have made undersea robots more versatile: the offshore oil industry uses robots—remotely operated vehicles called ROV's—to inspect and repair pipelines and oil platforms, and ROV's are used to bury submarine phone cables. ROV's are also used for undersea exploration, rescue and salvage operations and military missions. "Robotics have changed the whole way people do work undersea," says Bruce Crawford, vice president of Perry Offshore Inc., which builds ROV's.

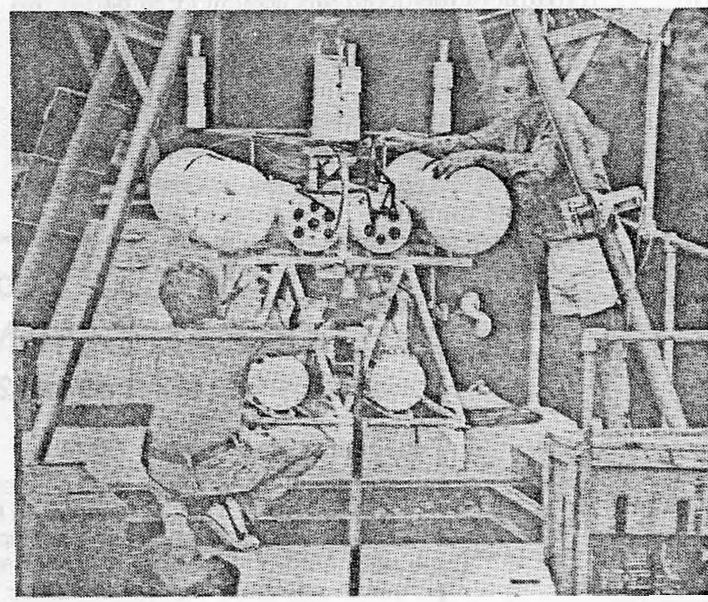
**Human Divers:** Unlike EAVE, today's undersea robots are not autonomous; they must be tethered to surface ships by long control cables. The smallest ROV's—called "flying eyeballs"—are essentially self-propelled underwater cameras. More complex ROV's have cameras, sonar, robot arms and tools to work at depths human divers cannot tolerate. The computers used to operate the robot are carried on the mother ship, to keep the ROV light and maneuverable.

More difficult undersea missions will require more advanced ROV's. Scientists at Woods Hole Oceanographic Institution in Woods Hole, Mass., are building a more sophisticated ROV than any on the market. The Argo/-Jason project, funded by the U.S. Navy's Office of Naval Research, will use two vehicles: Argo, a large tethered reconnaissance vehicle that will carry sonar and advanced TV-imaging equipment to give the shipboard operators a panoramic view of the ocean floor, and Jason, an ROV with high-resolution TV cameras and robot arms. The operators will be able to order Jason to swim out from Argo and perform special tasks like taking samples, maneuvering for inspection or placing temperature probes in the area.

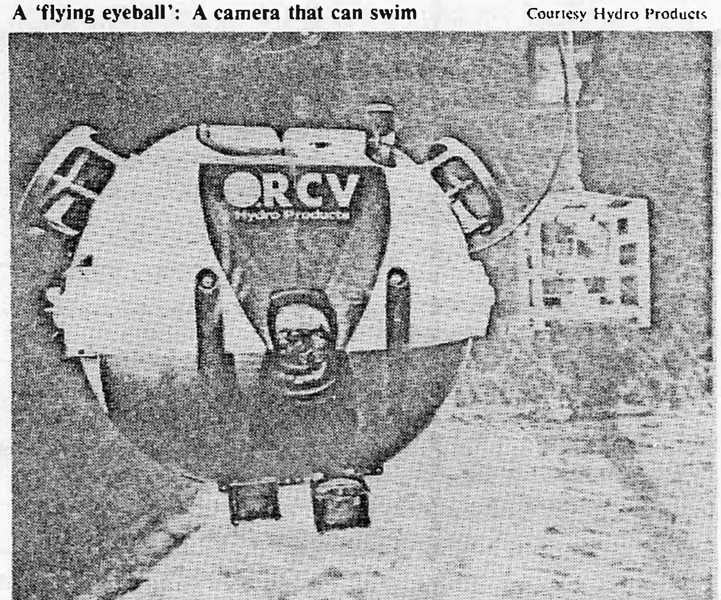
Nearer the realm of science fiction is an underwater robot with artificial intelligence, a fully functioning autonomous robot. The EAVE is only a first step. Most of the artificial-intelligence computer programs now being developed are so-called expert or knowledge-based systems: a computer is programmed with a series of "if/then" rules that incorporate a narrowly defined body of knowledge. To give an undersea robot artificial intelligence, scientists will have to devise a program that duplicates the knowledge a submarine commander uses to make decisions.

But unlike either conventional computers with artificial-intelligence programs or ordinary robots on a factory line, autonomous undersea robots will have to navigate and survive in an unpredictable, treacherous environment. Moreover, the robot's silicon-chip-based artificial intelligence will have to respond swiftly and accurately in real time. The robot must be able to distinguish fish from fixed obstacles, or analyze a tear in a hull and weld it. Some missions may require a robot that can "see," others a robot that can crawl octopuslike across the ocean floor. Two-handed operations would take sophisticated computer integration to coordinate the movements.

**Scientists testing EAVE: A computer that can navigate** Ira Wyman



**A 'flying eyeball': A camera that can swim** Courtesy Hydro Products



**'Shoebox'**: At the moment, the prospect of developing a robot that smart is remote. "It's very hard to program a robot to perform the tasks a 2- or 3-year-old child can easily do," says Alan Meyrowitz of the Office of Naval Research, which is funding research to develop autonomous underwater robots. In its sea trials in New Hampshire, the EAVE can only navigate on its own by recognizing and responding to signals from an underwater grid of acoustic transponders that serve like radio beacons guiding aircraft pilots; it cannot venture beyond the range of the signals. Truly autonomous undersea robots, says Raj Reddy, director of the Robotics Institute at Carnegie-Mellon University, are 10 to 30 years away. The development of such machines will require far more powerful and smaller computers and more advanced artificial-intelligence software. "We do not yet have supercomputers that can fit in a shoebox," says Reddy. "If you want an underwater R2D2, that's a long way off."



# The EE, the Sea and me.

Poets tell tales of the romance of the Sea,—fools in tiny boats sail round the Globe,—others man our marine defenses wearing white hats. As for me, I have made a living for more than 40 years from the Ocean, but I never smell salt spray if I can help it. I am an Electronics Engineer.

Long years ago at Purdue, under the tutelage of George Mueller, now Jokes and Games Editor of this great newsletter, and Prof. Sabbagh, the extraordinary father of the Editor in Chief of same, I became committed to that strange and voracious profession of Electronics Engineering.

Did I say voracious? Yes, indeed, our industry eats its own children! Few of that EE Class of '43 are still around, and those who are have in common the ability to adapt and to grow. Our profession has changed the face of the world, and in the process often overran the individuals who did the work. All too often today's hero in our Journals is tomorrow's forgotten footnote. Its not to be disparaged, but it hasn't been easy for the working man. Fortunately change in the marine related areas has been slower than some, for we are up against major and fundamental obstacles in that much studied environment.

For me, the Ocean has been an immense curiosity technically, full of great opportunity for improving man's lot, and the potential reward that comes from doing important things. It is both a dangerous frontier lying at our doorstep and a potential treasure chest. For as long as those ancient Poets have sung of that dubious romance, the practical have tried to tame the reality. The problem has been too complex, and our tools have long been too inadequate to make great progress. We have probed the sea at great expense, and have sometimes succeeded, largely by brute force. For most purposes the sea has proved to be too wet, too cold, too deep, and far too angry for us to coexist with it for long.

The Electronic Engineer, however, has special gifts! Now with his subminiature computer of great competence, and his ability to communicate and to control, can we not take larger steps in further exploiting the Sea? Would intelligent machines find the sea too cold, too wet or too dangerous? Could robots not serve us as well in the deep ocean, as on land?

Some five years ago my associates at the University of New Hampshire, and I, decided to attempt to employ the evolving tools of the Electronic Engineer to place intelligence in machines that might do man's bidding in the Ocean. The problems are tough and exciting. We now attempt to merge Knowledge-based Systems technology from the field of Artificial Intelligence with the theory of intelligent controllers to create systems that may respond rationally, and independently. We attempt to put vision in our remote system, and to then jam the images through narrow and perturbed acoustic channels. We try to position ourselves in an unmarked volume with a precision of only centimeters. Our tools and techniques are changing so fast that it is difficult for us to consolidate or record. But we dream of what might be, to find very soon that it can be,—if only we reach a little further.

For me Oceanic Engineering is a great adventure of growing and learning, and even sometimes of achieving. We are constantly challenged to grow past yesterday's limits. As an EE working in Ocean Technology, I constantly find areas where lasting contributions may be made that may help mankind. Oceanic Engineering for me as an EE has represented opportunity, challenge, satisfaction, growth, more than a bit of stress, and a worthy lifetime career.

More than that it has been a lot of fun!

Arthur Westneat

# 'Land-Lover' Westneat Honored For Underwater Work

Oceanic engineers, you might assume, are universally affected by a love of the sea. But even if that is generally true, it is not true of Arthur Westneat.

Westneat, an enthusiastic man who is one of the world's foremost designers of underwater electronic equipment, says he doesn't particularly care for the ocean.

"I don't like to sail; I don't like the saltwater; I don't like the cold," he declares.

Westneat is hardly embarrassed by this revelation. In fact, he appears pleased. He's presented a puzzle for the interviewer to solve—and there are few things Arthur Westneat enjoys more than a puzzle.

The solution lies in Westneat's perception of the ocean. He has the attitude of the pioneers: he sees the subsea world as a hostile environment, an alien land that challenges him to probe, use and conquer it through technology and his imagination.

"Space is the same way," he maintains, "but it costs so much more to get up there."

Westneat is a research fellow at the university's marine systems engineering laboratory. He says if you walk eastward from the campus in Durham shortly you will reach a frontier, the shore of the Atlantic Ocean. The world beneath the Atlantic's surface, he says, is "a great unknown right at the edge of our lives," presenting great opportunities for the human race.

"We can live out there, we can work out there," he asserts.

Westneat's visionary attitude has kept him at the forefront of oceanic engineering since World War II when he helped develop systems to detect German submarines. He was part of the research team at the Massachusetts Institute of Technology that developed radar to combat the Kamakazi bomber pilots of imperial Japan. Later, he worked in the aerospace industry and more recently, he was with the Raytheon Corporation as principal engineer for advanced research and development and manager of marine surveys. Much of his work has been in electronic undersea detection, which he describes as separating the sounds of man from "all the fish making love and snapping lobsters out there."

At UNH, where Westneat has been since 1978, he is still at the front of oceanic research. The marine systems engineering laboratory is a leader in the field of underwater robotics.

Last month, Westneat was honored for his contributions to oceanic engineering by two international organizations. The Institute of Electrical and Electronic Engineers, with 250,000 members worldwide, presented him its Distinguished Service Award for "outstanding and dedicated service to the council (on oceanic engineering), his prominence in the field and his energetic and effective leadership since the early days of the IEEE Oceanography Coordinating Committee." At the same convention in Washington, the Marine Technology Society named him a Fellow of the Society.

Westneat's role in oceanic engineering has been something like that of Mycroft Holmes, Sherlock's older brother, who would sit at home and solve mysteries by deduction, leaving the field work to Sherlock. He says he rarely gets wet.

"My work has been mostly sitting at home in an easy chair wondering 'how the hell am I going to solve this problem?' "

Westneat, 61, is far from retiring to his country home near Durham. He says this is a "very lively, productive" time of his life. He prefers to talk about the underwater robots of the marine engineering lab, rather than his past accomplishments.

"We find we can put these highly sophisticated, but very, very compact microprocessors in the ocean and they can survive," Westneat says. Not only can they survive, but the robots can perform almost any mechanical task a human can without the need for a life support system. Westneat says computers equal to the largest ones used in the Vietnam War are now about the size of a football.

One of the marine lab's major projects is EAVE, short for experimental autonomous vehicle. Westneat says the lab has a tower submerged in Lake Winnepesaukee. The researchers throw EAVE in the lake where it finds the tower, penetrates the maze-like structure, takes a picture and returns.

"Now that," observes Westneat with a smile, "is pretty smart for a machine."

(Reprinted from University of New Hampshire *Campus Journal*, October 28, 1982.

# 'TIS A PUZZLEMENT

## NEW PUZZLES

**Puzzlement Editor: George V. Mueller, 2229 Indian Trail, West Lafayette, IN 47906**

### HARMONIC CONTENT OF A PERIODIC WAVE

A positive portion of an alternating voltage wave follows the $y = C_0 + C_1x + C_2x^2$ through the points (0, 0), ($\pi/2$, 120) and ($\pi$, 0). A negative portion of the wave follows another curve $y = C_0 + C_1x + C_2x^2$ through the points ($\pi$, $-80$), ($3\pi/2$, $-80$) and ($2\pi$, $-80$).

Determine the fundamental, the second and the third harmonic components of the wave.

### THE CENSUS TAKER SOLVES A PUZZLE

*From Prof. Wilson Tripp, Kansas State University*

A census taker (CT) came to a house and wrote down the street number. He then rang the doorbell. A man answered. "How old are you?" the CT asked. The man gave his age. "Are there any others who live at this address?" was the next question. "There are three others," the man answered. "What are their ages?" the CT asked. The man replied, "The product of their ages is six to the fourth power and the sum of their ages equals the street number of this house."

The CT, with pencil and paper, worked for a while on the solution to this. "I do not have enough information," the CT told the man. The man replied, "One of them is older than I." The CT then told him, "Now I know their ages."

What were their ages?

## PAST PUZZLES

### Solution: Harmonic Content of a Periodic Wave

The positive and negative sections of an alternating voltage wave are symmetrical. The first quarter cycle of a positive section follows the curve $y = C_0 + C_1x + C_2x^2$ through the points (0, 0), ($\pi/4$, 75) and ($\pi/2$, 100). The second quarter cycle of the positive section follows another curve $y = C_0 + C_1x + C_2x^2$ through the points ($\pi/2$, 100), ($3\pi/4$, 50) and ($\pi$, 0). Determine the fundamental, the third and the fifth harmonic components of the wave.

In the September 1983 *NEWSLETTER* it was shown that if a nonsinusoidal voltage represented by the given equation were applied to the voltage coil of a wattmeter and the unit sinusoidal current $i_{sn} = \sin nx$ were sent through the current coil, the energy $J_{sn}$ over a base from $x_0$ to $x_2$ is given by

$$J_{sn} = \frac{1}{n}\Big[\cos nx_2(-y_2 + 2C_2/n^2) + \cos nx_0(y_0 - 2C_2/n^2)\Big] + \frac{1}{n^2}\Big[\sin nx_2(C_1 + 2C_2x_2) + \sin nx_0(-C_1 - 2C_2x_0)\Big] \text{ units}$$

Note that this equation does not contain $C_0$. This occurred because after integration there was a term $C_0 + C_1x_2 + C_2x_2^2$ for which $y_2$ was substituted and another term $C_0 + C_1x_0 + C_2x_0^2$ for which $y_0$ was substituted. Since $C_0$ does not have to be computed a computer program for solving the problem can be shortened.

To compute the fundamental sinusoidal component of the given wave insert $n = 1$ in the equation for $J_{sn}$. For the first quarter cycle of the wave the coordinates are ($x_0 = 0$, $y_0 = 0$), ($y_1 = 75$) and ($x_2 = \pi/2$, $y_2 = 100$). Substitution of these values in the equation yields $J_{s1} = 800/\pi^2 = 81.06$ energy units.

For the second quarter cycle of the wave the coordinates are ($x_0 = \pi/2$, $y_0 = 100$), ($y_1 = 50$) and ($x_2 = \pi$, $y_2 = 0$). Substitution of these values in the equation yields $J_{s1} = 200/\pi = 63.66$ energy units.

For the half cycle the total energy is $81.06 + 63.66 = 144.72$ units. The fundamental sinusoidal component of the voltage is $V_{s1} = 2 \cdot 144.72/\pi = 92.13$ v.

The third harmonic sinusoidal component of the voltage is computed in a similar fashion using $n = 3$. The result is $V_{s3} = -2.59$ v.

The fifth harmonic sinusoidal component of the voltage is computed using $n = 5$. The result is $V_{s5} = 2.03$ v.

The equation for the cosinusoidal components of the given voltage can be derived in a manner similar to that used for the sinusoidal components. Here the unit cosinusoidal current $i_{cn} = \cos nx$ is sent through the wattmeter current coil. The energy $^{u}{}_{cn}$ is determined to be

$$J_{cn} = \frac{1}{n}\left[\sin nx_2(y_2 - 2C_2/n^2) + \sin nx_0(-y_0 + 2C_2/n^2)\right] + \frac{1}{n^2}\left[\cos nx_2(C_1 + 2C_2x_2) + \cos nx_0(-C_1 - 2C_2x_0)\right]$$

By a process similar to that used previously it is determined that $V_{c1} = 11.07$ v, $V_{c3} = -6.41$ v and $V_{c5} = -1.21$ v.

The equation for the first six terms in the voltage wave is

$$y = 92.13 \sin x + 11.07 \cos x - 2.59 \sin 3x - 6.41 \cos 3x + 2.03 \sin 5x - 1.21 \cos 5x$$

(Stewart Taylor, Traverse City, Michigan calls to the attention of *NEWSLETTER* READERS an article on "PERFECT NUMBERS" in the December 1982 issue of *SCIENTIFIC AMERICAN*.)

The equations used in the above Fourier Series analysis of a wave can be used to analyze any wave. Divide the base into as many sections as necessary so that each section consists of a straight line or a portion of a parabola.

## Solution: Balanced Line Currents Produced by Unbalanced Delta Phase Currents

Consider $a$ and $b$ to be the base vertices of an equilateral triangle of line currents whose magnitude $I$ is to be determined. Choose a point $o$ that is within the triangle nearest to $b$ and farthest from $c$. Draw lines from $o$ to $a$, $b$ and $c$. Label $ao$ as 80, $bo$ as 60 and $co$ as 100. Label the angle $aob$ as $\theta_1$ and the angle $boc$ as $\theta_2$. The angle $coa$ is $360 - \theta_1 - \theta_2$. By applying the cosine law for triangles

$$I^2 = 80^2 + 60^2 - 2 \cdot 80 \cdot 60 \cos \theta_1$$

$$I^2 = 60^2 + 100^2 - 2 \cdot 60 \cdot 100 \cos \theta_2$$

$$I^2 = 100^2 + 80^2 - 2 \cdot 100 \cdot 80 \cos (\theta_1 + \theta_2)$$

From these equations it is found by trial that $I = 135.33$.

# In Leonardo's Footsteps

Nearly 450 years ago, before anyone knew anything about cloning, an attempt was made to copy a human being—Leonardo da Vinci, the Renaissance artist and scientist.

When the great man died in 1591, his half-brother Bartolommeo searched for and found a peasant woman who resembled Leonardo's mother, Caterina. He then married the woman and had a son by her. The boy, Pierino da Vinci, was raised in the same environment as his distinguished relative. It was hoped that he would "inherit" the family talent. A bright, curly haired child, he was sent to Florence at age 12 to study sculpting with Bandinelli, a friend of Leonardo's. When that didn't work out, he studied under sculptor Tribolo.

The art historian Giorgio Vasari asserted that Pierino, by age 17, had "made everyone marvel . . . and in five years he had learned more than others do in a lifetime." His forte was sculpture of great charm and sensitivity. Some of his works—like the River God at the Louvre—are so excellent that they have been attributed to Michaelangelo.

Could he have become as famous as his Uncle Leonardo? We will never know. He died from a fever at age 23.

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# Father of Magnetics And Electronics

**William Gilbert (1544-1603)**

Dr. William Gilbert of Colchester, England is claimed by both the electrical scientists and experimental scientists as a "first."

Gilbert's outstanding contribution is his book *De Magnete*, published in London in 1600, which set down the results of nearly a score of years of intensive experimentation with all the bodies having magnetic and electrical properties known in his day. For the meagerness in number of these substances showing magnetic and electric powers of attraction, Gilbert provided a varied and ingenious series of experiments to determine just what these properties were. By actually performing each experiment himself and describing it in full detail in his book, Gilbert established a pattern of methodical experimental investigation, the first in England, that helped usher in the scientific revolution. We owe to Gilbert the concept that the earth itself is a magnetic body like the loadstone then used in making the mariner's compass. His careful and oft repeated experiments swept away much of the accumulated mysticism and misinformation that had gathered around this stone with its unusual attractive properties.

William Gilbert was trained in medicine at Cambridge and rose in this profession to become physician to two monarchs (Elizabeth & James I). Living at a time of wide discovery and exploration, his curiosity was attracted by the properties of the loadstone. The reports of the explorers of the variations of the compass in different positions on the earth's surface, the phenomenon of dip and the retention of the magnetic properties of the loadstone even when broken into smaller parts, caused him to try to determine just what the exact behavior of these elements was.

In the field of electricity, Gilbert's study was the first forward step since the time of Thales (600 B.C.). By adding a chapter on electricity to the other five chapters on the magnet, Gilbert stimulated electrical investigation in the minds of the scientifically curious wherever his book was read. The Latin text of his book made its contents readily understood on the Continent as well as in England; it was reissued on the Continent in 1628 and 1633.

Up to Gilbert's time one electrical fact had been generally accepted—that amber and jet (diamond was added by Fracastoro in 1546), when rubbed, attracted light bodies. Pursuing the phenomena of attraction, Gilbert determined experimentally that a wide variety of material had electrical properties. He devised a pivoted metallic needle (a crude electroscope), and found that not only amber and jet, but more than a dozen other substances acquired electric properties when rubbed; these he termed "electrics." Those substances which could not be made to acquire the attractive power he called "anelectrics." He found glass, sulphur, wax, crystals and a dozen gems, real and artificial, to have electric attractive power when rubbed. Anelectrics included wood, bone, metals, and even the loadstone. He also found that everything solid, or things subject to our senses, could be attracted by rubbed electrics. In differentiating between magnetic and electric attractions he observed, "A loadstone appeals to magneticks only, towards electricks all things move. A loadstone raises great weight, so that if there is a loadstone weighing two ounces and strong, it attracts half an ounce or a whole ounce. An electrick substance only attracts very small weights; as, for instance, a piece of amber of three ounces weight, when rubbed, scarce raises a fourth part of a grain of barley. But this attraction of amber and of electrical substances must be further investigated."

(Reprinted from *Instrumentation and Measurement Society Newsletter*, September 1983.)

# From Riches To Rags

Two fathers of American industry, whose businesses are still going strong, ended their careers as low level employees of their own companies.

Gustave Brachhausen, an inventor and engineer from Germany, started a factory in New Jersey in the 1890's, first making music boxes. The company later switched to the manufacture of a vacuum cleaner, the Reginia Electrickbroom. Brachhausen sold his business in 1915 for $1M, but soon lost all his money. In 1919, he returned to the factory he had founded, as a tool and die maker. He later became a night watchman.

Alvah Curtis Roebuck was a watch repairman from Indiana who went into the business of selling watches through the mail in the 1880's with a former freight agent named Richard Sears. His partner's aggressive marketing and advertising techniques made Roebuck so nervous that he decided to sell his one-third interest in 1895 for $25,000. After Roebuck went broke in the 1929 crash, his old firm—now a thriving mail-order and chain-store operation—put him on the publicity department payroll to make goodwill tours. One business historian wrote that wherever Roebuck appeared "customers came in from as far as 100 miles away to shake the hand of the man whose name had been a byword in their families."

# United States Patent [19]

**Kolesar et al.**

[11] **4,381,428**

[45] **Apr. 26, 1983**


[54] **ADAPTIVE QUANTIZER FOR ACOUSTIC BINARY INFORMATION TRANSMISSION**


[75] Inventors: **Robert R. Kolesar; John T. Rickard; James R. Zeidler**, all of San Diego, Calif.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.



[21] Appl. No.: **262,362**

[22] Filed: **May 11, 1981**

[51] **Int. Cl.**[3] ................................................ **G10L 1/00**
[52] **U.S. Cl.** ............................. **179/15.55 R**; 367/134
[58] **Field of Search** ................. 179/15.55 R, 15.55 T, 179/1 SA, 1 D, 1 P; 364/724; 370/118; 358/260, 261; 367/134



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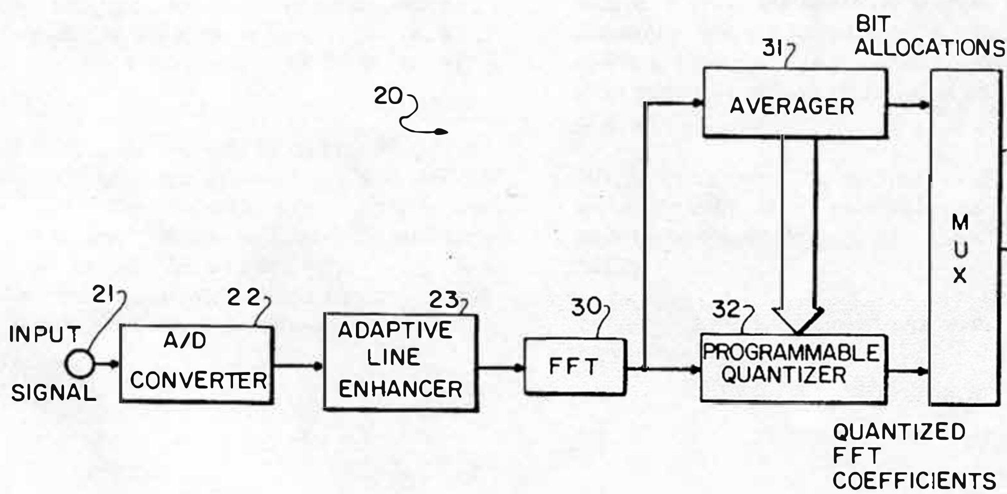
*Primary Examiner*—Emanuel S. Kemeny
*Attorney, Agent, or Firm*—Robert F. Beers; Ervin F. Johnston; Thomas Glenn Keough


[57] **ABSTRACT**

An apparatus and technique reduces the data transmission rate required to transmit acoustic signals from undersea sensors to remote monitoring locations without degrading the surveillance information content of the signals. The signals are digitized and fed to an adaptive line enhancer (Wiener filter) which processes them so that a fast Fourier transform (Karhunen-Loeve approximation) coefficient generator can feed representative signals to a programmable quantizer and a signal averager. When significant shifts are detected in the fast Fourier transform coefficient variances, responsive signals are generated by the programmable quantizer for adaptive bit allocation. An interconnected multiplexer transmits multiplexed signals to the remote monitoring station where the inverse of the foregoing allows an analysis of the acoustic signals being monitored.


**3 Claims, 5 Drawing Figures**



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