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OES Journal Associate Editors

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President's Message

Thomas F. Wiener

Congratulations to new AdCom members Bill Carey, Diane DiMassa, Christian de Mouistier, and Ferial El-Hawari, and for those who voted for me, thank you for your confidence. Thanks to the others who showed their willingness to serve their colleagues by allowing their names to be placed on the slate. Everyone of them is well qualified, and I plan to take advantage of their strengths in the coming months. I look forward to getting to work in Houston As I write this column, I am returning from Underwater Technology '02, held in Tokyo in April. This was the third very successful conference put on this time by Tamaki Ura and his colleagues from Japan, Korea, Taiwan, and the United States. The Tokyo Chapter of the OES was instrumental in its success. You will read more about it elsewhere in these pages. A prime mover in this successful series of conferences is our Vice President for Technical Activities, Joe Vadus.

A new feature of the conference was a Post-UT'02 Workshop staged in Taipei by the newly-formed Taiwan Chapter of the OES. I was delighted to meet many new friends and to see the fine work they presented. We are now planning UT'04, which will be held in Taipei. This is a worthy beginning for our new Chapter. I anticipate great results.

Financial problems continued to plague the Institute. in 2001. The overall expenses were $36M more than income. The result is the drawdown of the Institute's resources by that amount. Our contribution to that amount was $266K, or 30% of our reserves.

All of the officers of the Institute continue to wrestle with the problem. I wish I could report that we are making progress, but I am not sanguine. The general approach to solving this problem has been to focus on limiting expenses. In my view, understanding expenses is an important starting point. But the result of this focus is that we are beginning to look at expenses as though they should be treated like user fees, a popular approach in the past decade or so. This approach, which may be appropriate in some cases, discounts the volunteer efforts that make the Institute, its Societies, and its Regions a working proposition. In the OES we deliberately set our dues to be less than the cost of membership. The figures assembled by our staff show that while our dues are $12 per year, the cost to us of providing the services we provide to each member is $54. Thus we lose $42 each year for each of our 1616 members. Of course, we more than cover that "deficit" with the income we realize from our conferences and Journal.

I believe that we need to work the positive side of this problem. If we wish to spend the money we are spending serving our membership, the profession, and society, we need to work on ways to increase the income stream. I do not mean to countenance profligacy and irresponsible stewardship of the resources entrusted to our care. I do mean that in my experience, focusing on the negative (expenses) almost always draws energy away from opportunities to increase the positive.

One of the ways that we, and the rest of the societies, are moving is to limit the production of paper journals and proceedings. More and more we are moving to electronic publishing. Turning the finished product into paper is expensive. There is a very large cost for set up of the presses. The cost of printing is small, while the cost of binding and printing is not large but important. The upshot of the arithmetic is that it costs about $120 more per copy to produce a paper proceedings for a conference. As a result, conferences are starting to charge an extra fee for a paper copy of the proceedings. Also, Societies are starting to charge additional dues for paper copies of their journals. We will be discussing these issues at our May Administrative Committee meeting in Houston.

One of the questions that this attention to cost of member services versus income from member dues raises is how big do we want the OES (and the IEEE for that matter) to be? If we "lose money" on every member, why do we want to grow? Is there a small, critical level that we should take for our membership target? After all, most of the people who participate in our conferences are not members of OES. Likewise, most of the people who write for our excellent Journal of Oceanic Engineering are not members of OES. On the other hand, the larger we are, perhaps the more we can do for our members and the profession.

I think there are good answers to this issue. I welcome thoughts from each of you on these points. There is a lot of wisdom and experience among our membership, and I hope you will share it with me. My coordinates are elsewhere in this Newsletter.

Strategic Planning is an important activity for any organization. As I reported before, we started the process in Hawaii in October. We have made some progress, particularly in the Committee on Conference policy (CoCoPo). I expect that we will have a workable proposal for improved support for conference organizing committees by capturing the experience of past years in an advisory committee or board and having that group support the efforts of the local committee.

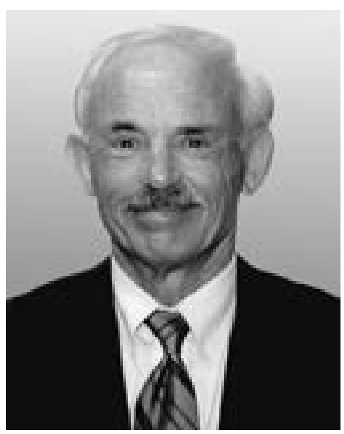
I also expect that we will see the first sketch of what a "Two Oceans" policy might look like. By "Two Oceans" I mean having one Oceans Conference in North America each year, and another one each year either in Asia or in Europe. If the idea makes sense, it is an opportunity to extend our services more regularly to our colleagues all over the world and, if we do it right, to increase the Society's income. Watch this space.

Another item on the Strategic Plan is the updating and extension of our data base. Stan Chamberlain and John Irza are hard at work on that task. And finally, if you haven't registered for OCEANS '02 in Biloxi, now is the time. Indications are that it will be a useful and important conference, and you can stay a few extra days to enjoy the Mississippi Gulf Coast.

Thomas F. Wiener

Editor's Note

NEW FEATURES OF IEEE *XPLORE*



In my last editorial I briefly described IEEE *Xplore*, the online delivery platform developed under TAB by it s Periodicals Committee. The popularity of *Xplore* has exceeded all IEEE expectations and has been reported to be a commercial success.

The latest version, *Xplore* l.4 now contains some new features for libraries which help make research faster and more efficient than with previous versions.

New features of IEEE Xplore include:

- Welcome Message, identifying the Member or subscribing institution to subscribers.
- Subscription Identifier, a "What can I access?" button, to help users better understand their content access rights.
- Forward Linking from Abstracts, to show "documents that cite this document".
- Links from Author Names, to quickly perform an author search within the abstract record.
- Links from Index Terms, to quickly perform a subject term search within the abstract record.
- Downloadable Citations, enabling subscribers to use bibliographic software.

These enhancements to IEEE *Xplore* went live on 1 April. IEEE *Xplore* is the online delivery platform which powers IEEE subscription packages, including the IEEE/IEE Electronic Library (IEL), All-Society Periodicals Package (ASPP) and Proceedings Order Plans (POP and POP All), as well as all personal electronic subscriptions for IEEE members.

I will keep you posted on the progress of other products being developed by IEEE as I hear of them. If you have any new information on IEEE products that you would like to share with the membership, please send it to me and I will include it in the upcoming newsletters.

Fred Maltz

Inertial Correction of Ship-Mounted ADCP Records

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Abstract - Acoustic Doppler Current Profilers (ADCPs) measure the velocity in a water column relative to its transducer head. When an ADCP is mounted to a mobile platform (ship, buoy, ROV, AUV, or towfish), it cannot discriminate between the movement in the water column and the movement of the measurement platform itself. The platform motion contaminates the velocity ADCP's velocity record. Typically, extended time-series averaging is applied to reduce the affect of the contamination, at the detriment of spatial and/or temporal resolutions.

An acquisition system was designed that captures the single-ping ADCP velocity profiles while recording the inertial motion of the vessel. A record of the ship motion is acquired using DGPS, gyrocompass, and an Inertial Measurement Unit, which consists of tri-axis ring laser gyros and accelerometers. Complimentary filters are used to combine the high-frequency accelerations and angular rates from the IMU with the low-frequency heading and position measurements, creating a drift-free velocity record. This enhanced signal is subtracted from the single-ping ADCP velocity record to yield the uncontaminated water velocity.

I. Introduction

ADCPs have become important tools for studying the flow structure of water bodies such as lakes, rivers, and oceans. Unlike other direct measurement systems, its non-obtrusive, non-mechanical acoustic beams do not influence the flow being measured. Its versatility allows for mounting to static sub-surface structures like oilrigs or trawl-resistant mounts, as well as, dynamic mounting aboard a ship, Remote Operated Vehicle (ROV), Autonomous Underwater Vehicle (AUV), or tow fish.

The ADCP detects water velocity, using the Doppler principle, by measuring the apparent change of frequency of its ping as a result of a relative radial velocity between itself and particles suspended in the water. When an ADCP is mounted to a mobile vessel, the vessel motion contaminates the Doppler shift by momentarily shortening or lengthening the acoustic path, causing a fluctuation in the relative velocity. At times, this platform motion can be sufficient to severely bias or obscure horizontal velocities and completely mask the vertical velocity - which is important for characterizing turbulence and mixing processes. Additionally, this motion contributes to single-ping ADCP error and generally requires many pings to be averaged to lower signal variance.

An independent measure of the ship motion can be used to correct for translational and rotational contamination from the platform motion. ADCPs generally provide a very rudimentary form of motion correction that is suitable for moored systems, but ill suited for vessel-mounted systems. Mean angular rotations are captured by the ADCP's internal tilt and heading sensors during a ping and adjustments are applied to the incoming ensemble. The internal tilt sensor uses an electrolyte to detect the angle. Under moderate to harsh sea conditions, or platform vibration, the sensor will give erroneous measurements due to insufficient damping (Appell, 1993). If the electrolyte is of particularly low viscosity, a high frequency component may be introduced due to sloshing.

Fluxgate compasses (heading sensor) have exhibited sinusoidal deviations that are a function of direction in laboratory tests and often exceed 5o (Irish, 1995). Accuracy depends on tilt and deviations in excess of three degrees per degree of tilt are not unusual (Lobo, 1995). Additionally, the compass has a slow response to rapid rotations, causing time lag errors. Thus, averaging, which reduces the spatial and temporal resolution, is still required. External software packages and post processing methods exist to incorporate GPS fixes to reconcile ADCP records to geographic positions for spatial integrity (King, 1994). However, these measurements are too slow and of insufficient resolution to correct for wave induced ship motion.

II. Data Acquisition System

A data acquisition system was designed to capture the ADCP velocity profiles while recording the inertial motion of the vessel. The system consists of instrumentation that is divided into three groups: the ADCP, the Inertial Correction Package (ICP), and external sensors from the vessel's navigation system. The ICP measures the inertial platform motions in real-time alongside the ADCP's velocity profiles. Together, the data are post processed to remove the angular and translational contamination from the individual beam velocities.

A. ADCP

A 300 kHz, RDI Broadband Workhorse ADCP is mounted to a through-hull fitting on Florida Atlantic University's research vessel, the R/V Stephan. Located approximately mid-ship and forward of the keel and propeller lines, the fitting positions the ADCP about one meter below the wa-

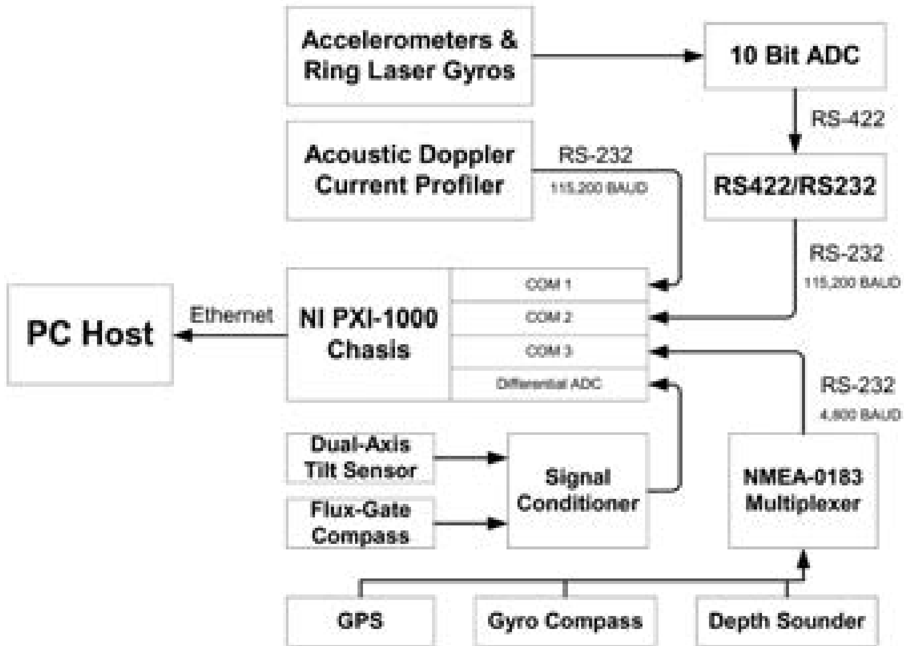

Figure 1. Block Diagram of acquisition hardware

ter surface. The ADCP is rotated 45° counter-clockwise from its normal beam-3 forward orientation. In this configuration, all four beams detect similar magnitudes of Doppler shift in relation to the ship's motion, which will aid in removing errors during post-processing. Since precise timing of the ADCP pings is required, the unit is set to an interrogation mode, where the acquisition software controls when pings are fired.

B. Inertial Correction Package

To measure the ship motion, an inertial correction package was assembled and installed onboard the 65' Stephan. The ICP is a waterproof housing containing a Honeywell HG1700AG25 Inertial Measurement Unit (IMU), a KVH C100 flux-gate compass engine, a Fredericks Company 0717 series dual-axis tilt sensor, and power conditioning. These instruments are aligned internally and the housing is rigidly mounted along the vertical axis at the top of the RD Instruments Workhorse 300 kHz ADCP.

Within the Honeywell IMU is a Ring Laser Gyro (RLG) and an AlliedSignal resonant beam tri-axis accelerometer. The unit operates in a free-run digital mode and cannot be interrogated. It samples the sensors at 600 Hz and broadcasts a six-sample average 100 times a second via serial communications. The IMU requires 3 ms to transfer its message. Since the time between IMU messages is 10 ms, this translates to approximately 1/3 duty cycle.

Both compass and tilt sensors are analog output devices. The compass provides a linearly prop-ortional output while the tilt sensor is linear to about 10°, and then becomes non-linear. Since both the tilt sensor and compass use liquid cores, they are susceptible to vibration and sloshing. Realistic sample rates of these devices are about 5 Hz, which is the published settling time for the tilt sensor.

C. Navigational Instruments

External instruments include a serial stream from a Garmin GPS-12 GPS, Furuno FCV-582 depth sounder, and a KVH Gyrotrak compass. These instruments are combined into a unified data stream using a Noland Engineering N183-41 serial multiplexer. The output from the multiplexer is attached to an RS-232 com port on the acquisition hardware.

D. Data Acquisition Hardware

The three main instrumentation elements are brought together at the data acquisition hardware. Here, the instruments are read, and in the case of the ADCP, also commanded, and their data are stored to hard drive files.

Data from the instruments and the ADCP are collected synchronously using a National Instruments PXI-8156b Real-Time controller, a PXI-6031e 64-channel analog-digital I/O, and a PXI-8420 8-port RS-232 card mounted in a PXI-1000 chassis, Figure 1.

The PXI-8156b controller is a complete, compact embedded computer system with an AMD 333 MHz K6-2 processor, 10BaseT Ethernet, 6 GB hard drive, and full peripheral support. LabVIEW RT loads atop the Windows-friendly Phar Lap real-time operating system.

To read the analog channels, the system includes a PXI-6031e multifunction I/O option. This board can be configured for up to 32 differential analog inputs at 16-bit resolution and 8 TTL lines. Twisted-pair, Cat-5 wire runs the signals from the ICP to an external wiring block, which in turn, is connected to the I/O board.

E. Acquisition Software

The data acquisition software is a real-time, hierarchical-based, modular, multi-process LabVIEW application. Two modules run in parallel: one that reads the data channels, and another that logs the data to the hard drive. Communica-

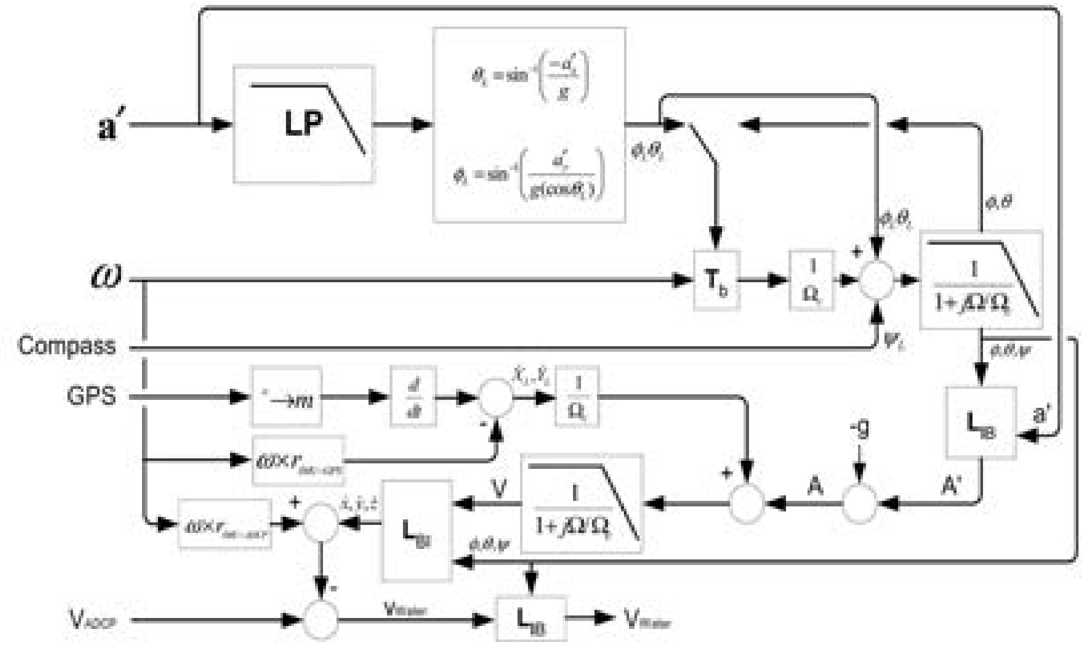

Figure 2. Inertial correction block diagram.

tion between the modules is accomplished through global variables and data are passed using a shared queuing system. Time sensitive tasks, such as IMU and ADCP fetches are performed using real-time priority convention, while less critical tasks are relegated to background priority.

The DAQ software must initialize all instruments, provide supervisory control, copy data from the different communications channels to system memory, then save the coordinated data to the hard drive. In the early development period, real-time performance could not be achieved when the data were sequentially read, then immediately logged to the hard drive. The hard drive write operation, which includes seek time and data throughput, was slower than the time allowed. As a result, buffers would eventually overflow, and the real time schedule would suffer. Separate, and concurrently running, data read and hard drive write applications were developed to solve this problem. The read operations were given high-priority and the write operation background priority.

Initialization requires preparation of the ADCP and IMU to begin capturing data. A command set, which specifies operating conditions and programming parameters for the current mission, is downloaded to the ADCP. For this work, the ADCP is configured to emit a single ping on command, apply no averaging, apply no coordinate transforms, and output the single-ping data from each of the four beams to the serial port in binary format. Finally, the IMU is initialized, or rather synchronized. Since the IMU is free running, it is necessary to clear the receive buffer and find the beginning of the IMU message cycle. Synchronization is achieved by continually dumping the buffer, while looking for the 44-byte IMU message. When a 44-byte message is received, the first byte is tested to see if it is the IMU's sync byte (decimal 165). If it is, then initialization is complete and the program drops immediately into acquisition mode.

An acquisition cycle begins with sending a ping command to the ADCP, while the ADCP issues the ping and receives the bin data, a parallel loop begins that reads X IMU messages, where X is the product of the ADCP ping interval and the IMU update frequency (100 Hz). Every ten IMU messages, the analog channels are read. An additional parallel loop reads the NMEA data as it becomes available. The ADCP generally finishes its ping cycle in approximately half a second (depth dependant); the balance of the user selected ping time is used to continue capturing IMU and analog messages.

Writing data to the hard drive between each IMU message was not possible, since the drive's, a Fujistu MHK2060AT, average seek time is 13 ms while the write needs to be completed during the IMU off-duty time, which is about seven ms. To overcome the seek time limitation; individual data samples are batched into larger data blocks. A triple buffering system in RAM was developed to create the batch save. Pairs of swapping FIFO queues are utilized to temporarily store the data captured from the IMU/analog and ADCP. At the beginning of an ADCP ping cycle, one queue of each pair becomes the active queue and the other inactive. The active queue holds the data as they are read from the channels. When the ADCP ping cycle completes, the active and inactive queues are swapped. The newly inactive IMU/analog and ADCP queues are concatenated into a second pair of alternating queues. These queues pass the data between the main acquisition application and file write (logging) application. This final level of queuing is swapped at designated times and the data are sent to the hard drive as a block. Coordination between the two applications is communicated via a Boolean global variable. This way, one of the queues is written to in the acquisition program, while the other is read by the logger.

III. Data Processing

The data captured by the LabVIEW programs are stored in two sequentially named, time synchronized files: high speed and low speed. Binary data from the IMU, analog channels, and ADCP are captured at 100 Hz, 20 Hz, and 1 Hz, respectively and stored to the high-speed files. The character-based NMEA data are captured, as they become available, and stored to the low-speed file set. A time-stamped header is inserted in each file at 30-second intervals for synchronization.

A. Data Fusion

After the data have been decoded from their native representation and combined synchronously, several processing steps are required to remove the ship motion contamination from the ADCP velocity records. These steps include rotating the individual instruments into a common reference frame, filtering and enhancing signals, and subtracting the inertial contamination from the ADCP record (Figure 2).

B. Euler angle transformations

The ship, like aircraft and spacecraft, moves in six degrees of freedom: surge, sway, heave, roll, pitch, and yaw. The goal is to measure these motions with the IMU and remove them from the ADCP measurements and ultimately calculate the water velocity. To accomplish this, the measurements need to be transformed between the ship fixed and the inertial reference frames. Premultiplying the measurements in the body frames by the rotation matrix L_{1B} transforms the data into the inertial frame. L_{1B} is constructed using three consecutive Euler angle rotations about the *z*, *y* and *x* axes, in that order. The rotation angles are defined as: ψ – yaw about *z*; θ – pitch about *y*; and ϕ – roll about *x* (Etkin, 1972).

$$L_{1B} = \begin{bmatrix} c\psi c\theta & c\psi s\theta s\phi - s\psi c\phi & c\psi s\theta c\phi + s\psi s\phi \\ s\psi c\theta & s\psi s\theta s\phi + c\psi c\phi & s\psi s\theta c\phi - c\psi s\phi \\ -s\theta & c\theta s\phi & c\phi c\theta \end{bmatrix} \quad (1)$$

$$s\cdot = \sin(\cdot) \qquad c\cdot = \cos(\cdot)$$

The Euler angles, $\beta = [\phi\theta\psi]^T$ were not directly measured. They were instead synthesised from an iterative fusion of the accelerometer, compass and rate gyro measurements. At very low frequencies ($f < 0.01Hz$), the inertial accelerations are very small and the gravitational acceleration g dominates, thus:

$$(a')_L \cong L_{BI}\, g \quad (2)$$

The low-pass filtered acceleration provides a low-frequency estimate of roll, ϕ_L and pitch, θ_L:

$$\theta_L = \sin^{-1}\left(\frac{-a'_x}{g}\right) \quad (3)$$

$$\phi_L = \sin^{-1}\left(\frac{a'_y}{g\cos(\theta_L)}\right) \quad (4)$$

The flux gate compass used has a time response of 20 ms and its high frequency component is not accurate. Thus, the low-frequency yaw estimate, λ_L, was obtained by low-pass filtering the compass heading, λ^c.

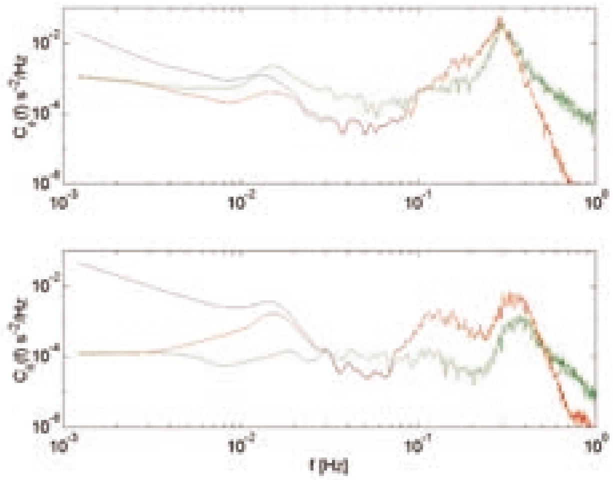

Figure 3. Spectra of the roll (pitch) rate from the ring laser gyro, blue, low frequency roll (pitch) from the accelerometers, green and the fused signal, red, in the upper (lower) figure.

Higher frequency information about the roll and pitch is provided by the gyros in terms of rotation rates. The time derivatives of the Euler angles were found according to (Etkin, 1972):

$$\dot{\beta} = T_B\omega \quad (5)$$

$$T_B = \begin{bmatrix} 1 & \sin(\phi)\tan(\theta) & \cos(\phi)\tan(\theta) \\ 0 & \cos(\phi) & -\sin(\phi) \\ 0 & \sin(\phi)\sec(\theta) & \cos(\phi)\sec(\theta) \end{bmatrix} \dot{\beta} = \begin{bmatrix} \phi \\ \theta \\ \psi \end{bmatrix} \quad (6)$$

where $\omega = [\omega_x \omega_y \omega_z]^T$ is the vector of angular velocities expressed in the IMU body-fixed frame. An iterative method is used to accurately calculate Euler rates. In the first iteration, T_B is calculated using ϕ_L and θ_L, and the resulting Euler rates are used to calculate the Euler angles. In subsequent iterations, T_B is recalculated using roll and pitch angles from the previous iteration. Using this method, the roll and pitch rates converge to 0.00001% of their final value after five iterations.

The enhanced (Mudge, 1994) roll $\phi_E(t)$, pitch $\theta_E(t)$ and yaw $\psi_E(t)$ were obtained by fusing the low-frequency roll ϕ_L, pitch θ_L and yaw ψ_L with the roll rate $\dot{\phi}$, pitch rate θ and yaw rate:

$$\phi_E = \phi_L + \frac{1}{\Omega_C}\dot{\phi};\ \theta_E = \theta_L + \frac{1}{\Omega_C}\dot{\theta};\ \psi_E = \psi_L + \frac{1}{\Omega_C}\dot{\psi} \quad (7)$$

where Ω_C is a filter cut off frequency. The roll, pitch, and yaw signals are recovered for all frequencies by low-pass filtering (deconvolving) the pre-emphasised signals with a single-pole low-pass with a cut-off at Ω_C (Mudge, 1994). Using this technique, information is preserved at all frequencies and the resulting signals are drift free.

The ring laser gyros have a very low drift rate and were fused with the low frequency roll and pitch at 0.005 Hz. At frequencies below 1/200 Hz, the spectra of ϕ_L and θ_L (from the accelerometers) and of the spectra of the fused signals are

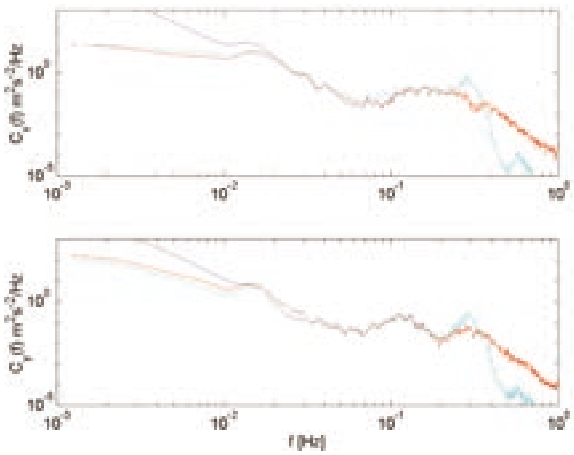

Figure 4. Spectra of the surge (sway) velocity from the accelerometers, blue, low frequency surge (sway) velocity from the DGPS, green and the fused signal, red, in the upper (lower) figure.

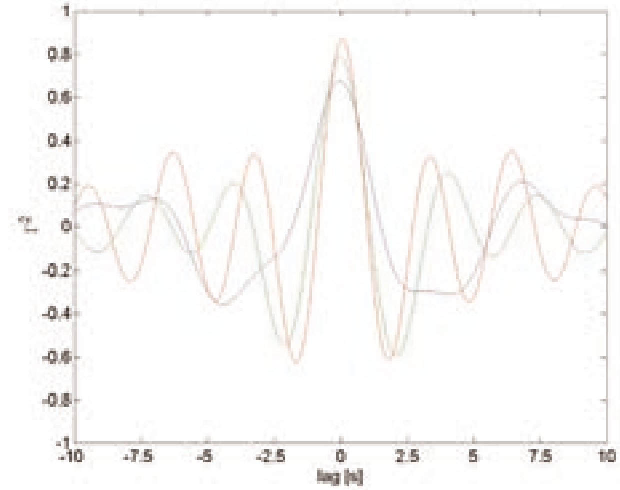

Figure 5. Coherence squared between the surge (blue), sway (green) and heave (red) velocities measured by the ADCP and fused inertial sensors.

equal (Figure 3). At frequencies higher than 1/200 Hz, the, the spectra of $\dot{\phi}$ and $\dot{\theta}$ (from the ring laser gyros) and the spectra of the fused signals are equal. There is a slight transition centred at 1/200 Hz, but this slight difference is negligible.

C. Translational Motion

The IMU frame rotates around all three axes of the inertial frame with respect to gravity and, as a result, the acceleration measurements are "contaminated" by gravitational acceleration. After transforming the accelerometer signals from the IMU frame to the inertial frame, the "contamination" only appears in the vertical component as a constant offset that is easily removed by subtraction.

$$A = L_{1B} a' - g \qquad g = [0,0,g]^T \tag{8}$$

where A is the translational acceleration vector in the inertial reference frame and g is the gravitational acceleration.

The velocity of the ship was calculated using the same technique to fuse the low-frequency Euler angles and the high-frequency Euler rates. The pre-emphasized velocity was obtained by fusing the low-frequency differentiated GPS position with the high frequency acceleration.

Again, the velocity signals are recovered for all frequencies by low-pass filtering (deconvolving) the pre-emphasised signals with a single-pole, low-pass with a cut-off at Ω_C. Using this technique, results in a drift free, full frequency measure of the ships velocity, V_S.

Unlike the ring laser gyros, the accelerometers have an appreciable drift rate and were fused with the low frequency velocity at 1/30 Hz. At frequencies below 1/30 Hz, the spectra of DGPS velocity and of the spectra of the fused signals are equal. At frequencies higher than 1/30 Hz, the, the spectra of velocity calculated from the accelerometers and the spectra of the fused signals are equal. There is a slight transition centred at 1/30 Hz, but this slight difference is negligible.

D. ADCP Correction

Two pairs of acoustic beams pointing in perpendicular planes are used to measure he velocity of the water relative to the ship. These planes are aligned with the axes of the ADCP frame and each pair points opposite azimuth angles in their respective planes. The three orthogonal relative water velocity components in the ADCP frame are resolved knowing that the azimuth angle:

$$\begin{aligned} u_i &= 1.4619(V_{i,1} - V_{i,4}) \\ v_i &= 1.4619(V_{i,4} - V_{i,3}) \\ w_i &= 0.2887(V_{i,1} + V_{i,2} + V_{i,3} - V_{i,4}) \end{aligned} \tag{9}$$

where u_i, v_i, and z_i are the relative velocity at bin *i* in the ADCP reference frame, and $V_{i,j}$ is the relative radial velocity at bin *i* in beam *j*. The earth fixed water velocity of bin *i* is calculated by transforming u_i, v_i, and z_i into the inertial frame and subtracting the measured ship motion:

$$V_i = L_{1B} \begin{bmatrix} u_i \\ v_i \\ w_i \end{bmatrix} - V_S \tag{10}$$

IV. Results

Data were collected with the aforementioned data acquisition system during two East-West transects of the Gulf Stream between Florida and the Bahamas along latitude 26° 11' N. This paper analyzes a short 1.7 hour section of the data.

Typical ADCP motion correction is limited to the subtraction of the ship velocity calculated from the differentiated GPS position. The low resolution and slow update rate of most GPS sensors necessitate averaging, thus, the GPS velocity does not contain signal at wave frequencies. By fusing the GPS velocity with the high frequency signal from inertial sensors, the ship velocity at wave frequencies can be calculated. A measure of the vessel motion contaminating the water velocity measurements is provided by the coherence between the water velocity measured by the ADCP and the velocity. Within the frequency of wave motion 0.03 - 0.3 Hz, the vessel surge,

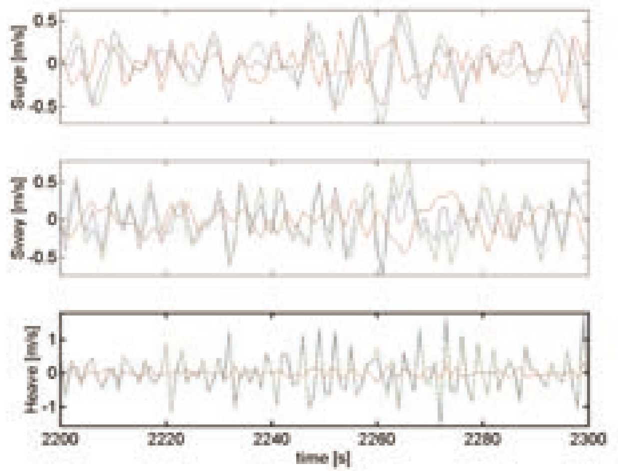

Figure 6. Comparison between ADCP velocity (green) and the fused velocity (blue) of the surge (upper figure), sway (middle figure) and heave (lower figure). The red is the difference of the fused and ADCP velocity.

sway and heave account for 68, 79 and 87% of the velocity measured by the ADCP, respectively (Figure 5).

Time series of the ADCP and fused velocities for wave induced ship motion are obtained by filtering the velocity time series with a band-pass of 0.03 to 0.3 Hz. The time series of the vertical velocities are very similar (Figure 6). The surge and sway of the vessel were small during this section of data, but exhibit some similarity between signals.

Subtraction of the fused velocity from the ADCP velocities yields the water velocity. In all cases, the variance of the measured water velocity is reduced when the fused velocity is subtracted. The best reduction is achieved for the heave velocity, which should be zero.

V. Conclusions

A real-time data acquisition system was developed to remove inertial platform contamination from ship-mounted acoustic Doppler current profiles. The inertial record was measured using a DGPS, tri-axis accelerometers, and tri-axis ring-laser gyros. Inherent low-frequency drift of the accelerometers was countered by fusing their signals with the high-frequency deficient DGPS to create a high-resolution, low-drift, hybrid signal. Drift of the gyros was corrected using a similar process.

The coherency between the enhanced inertial signal and the resolved ADCP velocity record is in high agreement, indicating considerable platform contamination in the water profiles. Subtraction of the platform's inertial velocities from the time-series velocities recorded at the ADCP in common reference frames yields reduced variance at ocean surface wave frequencies.

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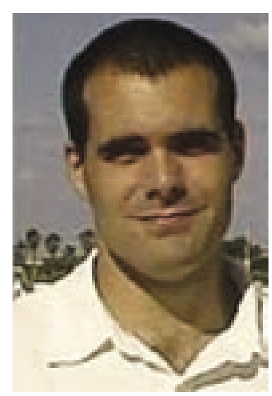
Robert E. Raye received his Bachelor's of Science in Ocean Engineering from Florida Atlantic University in May 2000, and will receive his M.S. in Ocean Engineering at FAU during the spring of 2002. His professional interests include measurement and characterization of ocean currents using acoustic Doppler methods, data acquisition systems, signal processing, structures, and mechanical design. In March 2002, he will begin work at Shell Global Solutions in Houston, TX.



Frederick R. Driscoll is a mechanical engineer with a background in physical oceanography. He received his Ph.D. at the University of Victoria, Canada. Currently, he is an assistant professor at Florida Atlantic University. His research interests include the dynamics of cable vehicle/platform systems, offshore structures, dynamics and control, autonomous and remotely controlled vehicles, field data acquisition and signal processing.

***Editor's Note*: Robert E. Raye received the First Place award in the Student Poster Program at the Oceans 2001 Conference in Hawaii.**

OCEANIC ENGINEERING SOCIETY BYLAWS CHANGES

At the AdCom meeting in Houston, April 29, 2001, it was voted to provide for “Permanent Membership” in the Society. Some polishing of the wording was done at the AdCom meeting in Honolulu, November 5, 2002. As a result, the following paragraph has been added to our Bylaws.

Paragraph 2.1 Permanent Membership - A member has the option of becoming a “permanent” member of the Society upon application and payment of a one-time membership fee that is set annually by the Administrative Committee. The Permanent Member retains membership in the Society without further payment of dues as long as the Permanent Member retains membership in IEEE."

In addition there are two corrections in paragraph 5.6.1:

5.6.1 c change to read “OCEANS Coordinating Committee” (11.3)
5.6.1 d change to read “Workshop Committee” (11.4)

Submitted by:

Norman D. Miller, P.E.
Vice President Professional Activities
IEEE/OES

Upcoming Conferences and Meetings

The Coastal Society 2002 Conference
May 19-22
Galveston, Texas
www.thecoastalsociety.org/conference.html

Seventh International Conference on Remote Sensing for Marine and Coastal Environments
May 20-22, 2002
Miami, Florida
http://www.veridan.com

IEEE Sensors 2002
June 12-14, 2002
Orlando, Florida
www.ieee.org/sensors

Subsea Controls & Data Acquisition (Sponsored by Society for Underwater Technology)
June 13 & 14, 2002
Paris, France
email:jeansut@sstg.demon.co.uk

Undersea Defense Technology Conference & Exhibition
June 18-20
La Spezia, Italy
www.udtnet.com/europe

AUV 2002
Automonous Underwater Vehicles A Workshop on AUV Energy Systems
June 20 & 21, 2002
Southwest Research Institute
San Antonio, Texas
http://www.AUV2002.swri.org

Oceans 2003
September 22-26, 2003
San Diego, CA
http://www.oceans2003.org

Third Ocean Technology Workshop
September 23-25, 2002
Plymouth, MA
www.motn.org

Oceans 2002 Conference & Exhibition
October 29-31, 2002
Mississippi Coast Coliseum & Convention Center
Biloxi, Mississippi
http://www.OCEANS2002.com

TECHNO-OCEAN 2002, 9th Techno-Ocean International Symposium and International Exhibition/Research Organizations Exhibition
November 20-22, 2002
Kobe International Exhibition Hall
Kobe Port Island, Japan
http://www.techno-ocean.com

RESULTS OF OES ADCOM ELECTION

The following candidates have been elected to serve on the IEEE Oceanic Engineering Society Administrative Committee for the term ending 31 December 2004:

William M. Carey

William M. Carey (M'85-SM'91-F'96) received a B.S. in Mechanical Engineering, a M.S. in Physics, and a Ph.D. of Engineering from The Catholic University of America, Washington, DC, in 1965, 1968, and 1974, respectively.

Presently, he is a Professor of Mechanical Engineering at Boston University and Editor Emeritus of the Journal of Oceanic Engineering. He also has Adjunct appointments as Professor of Applied Mathematics at the Rensselaer Polytechnic Institute, as a Scientist at the Woods Hole Oceanographic Institution, and as a Research Physicist with the Naval Undersea Warfare Center. Previously he was a Physicist with the Advanced Research Projects Agency and was assigned under the IPA to the MIT Department of Ocean Engineering. He has also been a Research Physicist and Engineer at the Naval Underwater Systems Center, The Naval Oceanographic Research and Development Activity, and the Naval Research Laboratory. At the University of Chicago's Argonne National Laboratory, he was a Scientist and Section Manager of acoustic surveillance of reactors. He has been a consultant to both industry and government in the areas of non-destructive testing, nuclear science/environmental measurements, and applied ocean acoustics.

Dr. Carey is a fellow of the Acoustical Society of America, a full member of Sigma Xi, a member of the Connecticut Academy of Science and Engineering, the Cosmos Club, a recipient of the IEEE/OES Distinguished Technical Award, and a recipient of an IEEE/OES Millennium Medal.

Christian De Moustier

Christian De Moustier (M'86) received the Ph.D. in Oceanography (Applied Ocean Science) at the University of California, San Diego in 1985. Between 1985 and 2001, he has worked at the Marine Physical Laboratory, Scripps Institution of Oceanography (SIO), conducting research in signal and image processing techniques applied to sonar data, and in underwater acoustics with emphasis on physics of bottom-interacting sound and sound reverberation in the ocean. He served as Academic Administrator for SIO's Ship Operations and Marine Technical Support, providing scientific direction and specifying engineering solutions for shipboard instrumentation needs (computers, sonars, underway sensors) and software programming requirements. In January 2002, he will join the faculty of the Electrical Engineering Department and the Center for Coastal and Ocean Mapping at the University of New Hampshire in Durham. He has been serving as Associate Editor for the IEEE Journal of Oceanic Engineering since 1990, for topics related to seafloor acoustic remote sensing, bathymetry mapping and surveying, and sonar image and signal processing applications. He served three terms on the Administrative Committee of the Oceanic Engineering Society (1990-1993, 1995-1997, 1998-2000). He is a member of the IEEE OES, and the American Geophysical Union. He is a Fellow of the Acoustical Society of America.

Diane E. DiMassa

Diane E. DiMassa joined the faculty of the University of Massachusetts Dartmouth (UMD) as an Assistant Professor of Mechanical Engineering in September 2000. She earned her Ph.D. in 1997 in Oceanographic Engineering from the Joint Program between MIT and the Woods Hole Oceanographic Institution (WHOI). Her doctoral research was in the field of terrain-relative navigation for autonomous underwater vehicles (AUVs). She earned her graduate-level Mechanical Engineer Degree from MIT for development of a hyperbolic navigation system for AUVs. Her BS and MS degrees are also from MIT in Mechanical Engineering. While a graduate student she was 1 of 9 students worldwide to be awarded a student research assistantship at the NATO SACLANT Undersea Research Center in La Spezia, Italy. Her research for this grant was in the area of testing fibrous cables for marine applications such as towing or mooring instrumentation.

Prior to joining the faculty of UMD, she was an engineer/scientist at the Woods Hole Group, a marine environmental consulting firm, and began studying hydroacoustics and working with ADCPs to obtain real-time current measurements for the oil industry. She continued this work with the Physical Oceanographic Real-Time System (PORTS) program in Narragansett Bay. She has also been working with ADCPs and digital echosounders for measuring and characterizing detritus suspended in the water column of estuaries.

Dr. DiMassa continues to work with oceanographic instrumentation as part of her graduate research program at UMD. Her current research is in conjunction with the Center for Marine Science and Technology to expand uses of oceanographic instrumentation to develop models that will aid the fishing industry. She also incorporates ocean engineering design projects into the undergraduate senior design class she facilitates. As a hands-on engineer, Dr. DiMassa has been on several research cruises, been part of a deep field Antarctic Exploration Team, and is always looking for real-world applications of oceanographic instrumentation.

Dr. DiMassa has been a Guest Investigator at WHOI in the Applied Ocean Physics and Engineering Department since 1997, is on the WHOI Scientific Diving Team, and still consults for the Woods Hole Group on an as needed basis. In addition to presenting papers at several Oceans Conferences, she has served as a session chair. She is also currently a member of the Publicity Committee of the IEEE Oceanic Engineering Society.

Ferial El-Hawary

Dr. El-Hawary continues to be involved in OCEANS Activities both technically and administratively as a past member of the IEEE Oceanic Engineering Society Administrative Committee (AdCom) having served as Vice-President International, and Past Chairman of the Membership Development Committee. She was nominated to serve as President of the Society. Ferial has been instrumental in establishing the Canadian Atlantic Chapters of Oceanic Engineering Society, and she is recognized for her leadership roles in establishing strong IEEE/ OES European Chapter based in France as well as the IEEE/OES Chapter based in Trondeheim, Norway. Ferial was heavily involved in the organizing Committees of OCEANS'87, OCEANS'97 Conferences, and CCECE'2000 in Canada and OCEANS'94, OCEANS'98 in France. Dr. El-Hawary is the current Chair of Eastern Canada Council of IEEE Canada, and a member of IEEE Committee on Women in Engineering, as well as a member of the Multi-Lingual Committee of the IEEE.

She has organized and chaired many Technical sessions as well as Panel Discussions at the OCEANS Conferences for the past two decades. Dr. El-Hawary served as Chair of the Tutorial Program for many OCEANS Conferences including OCEANS'2001. She has published widely, and was guest editor of a special sequence of issues for the IEEE Journal of Oceanic Engineering on Advanced Applications of Control and Signal Processing in the Oceans Environment. Also she is the Chief Editor of "The OCEANS Engineering Handbook" published in 2001 by IEEE & CRC Press. Currently she is an Associate Editor of the IEEE Journal of Oceanic Engineering Society (JOES).

She is a recipient of IEEE Third Millennium Medal, the 1999 RAB ACHIEVEMENT AWARD, 1997 IEEE/Oceanic Engineering Society DISTINGUISHED SERVICE AWARD. She is a Fellow of IEEE, Fellow of the Engineering Institute of Canada (EIC), and a Fellow of the Marine Technology Society (MTS).

Tom Wiener

Dr. Thomas F. Wiener is the President of the Oceanic Engineering Society, having been elected to office commencing in January 2001. He has been a member of the Administrative Committee since 1995. Dr. Wiener served a Treasurer of the OES for four years. While holding that post, he rationalized the budgeting activities of the Society. He has recently been elected to the IEEE Technical Activities Board Finance Committee.

Dr. Wiener's special technical expertise spans the fields of imaging and non-imaging sensors, data processing, inertial guidance and automatic control, ocean surveillance, acoustic and non-acoustic anti-submarine warfare, and C3I. He has recently retired from the Defense Advanced Research Projects Office and is now acts as Principal in The Forté Consultancy.

During his naval career of over twenty years, Dr. Wiener served in submarines, rising to command USS Jack, a nuclear-powered attack submarine. Following retirement from the Navy, Dr. Wiener was an engineer at TASC before coming to DARPA.

As an undergraduate, Dr. Wiener attended Brown University, where he received his Sc.B. in Engineering. He was commissioned as an Ensign in the Navy as a result of his NROTC participation, and after a year at sea on the world's first guided missile destroyer, he was selected for the first group of officers in the Junior Line Officers Advanced Scientific Educational (Burke) Program. He attended the Massachusetts Institute of Technology and studied Instrumentation at the Instrumentation Laboratory. His thesis was the first substantial work on strapdown guidance, and was the basis for the Apollo guidance system.

He has been elected a Member of Sigma Xi, Tau Beta Pi, and Sigma Gamma Tau. Dr. Wiener is a Senior Member of the IEEE and AIAA, and a Member of SPIE, USNI, USNSL, and SPEBSQSA.

Soundings

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

Attack of the Giant Spiders?

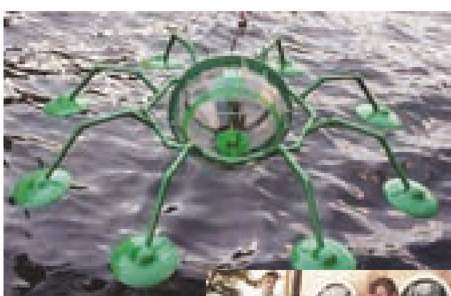
No, it's not a grade-B science fiction film, it's a production of the Robotics Art Club called "Dance of the Water Spiders." (http://www.remo.net/spiders/project/index.htm) Using a group of 6 thirty-five pound robotic spiders, with a 6 foot "footprint", the club has introduced the public to Cyberart as well as a bit of ocean engineering.

Elementary school students use a remote control system to steer the robot water spiders to the center of a performance area. Once initially positioned, the spiders execute a series of maneuvers that are quite visually appealing.

This year the club hopes to imbue the spiders with a simple "flocking" ability, similar to the organic waterfowl that watched the spiders performance from afar. Ultimately, the club hopes to have the spiders recognize and respond to the presence of people as well as be able to compose and play music.

The club is founded by Remo Campopiano, a conceptual artist living in Seekonk, Massachusetts with a studio in Johnston, Rhode Island. It is open people between the ages of 10 and 14 year old and membership is free.

The project was recently featured in Design News magazine (http://www.manufacturing.net/dn/index.asp?layout=articleWebzine&articleId=CA202579)



Deja-vu: Cold Fusion II

Sonoluminescence splashed back into mainstream media recently with an article in the march 8 issue of the prestigious journal "Science." Stirring up memories of "Cold Fusion," researchers have announced results from a series of experiments that have been dubbed "Sonofusion" meaning sound-triggered-fusion.

Sonoluminescence is the process of using ultrasound to create tiny bubbles in a liquid. The bubbles expand and then swiftly collapse, generating a flash of light in the process.

A team of engineers from Oak Ridge National Laboratory has discovered that by pumping ultrasound waves and a beam of neutrons into a modified form of acetone, a common solvent that's used in fingernail polish remover, a fusion reaction apparently occurs.

Much like the early days of the "Cold Fusion" discovery in 1989, a debate is raging about reproducibility and interpretation of results. For a non-physicist's explanation of all the details, the interested reader is referred to March 18 issue of Business Week online at http://www.businessweek.com/magazine/content/02_11/b3774095.htm

It's not only a sonar, it cleans clothes too!

Sonar technology (in particular, ultrasound) continues to expand beyond its ocean home. Sanyo Electronics Co. recently announced a washing machine that needs no detergent to clean lightly soiled clothes. The new product uses electrodes on opposite sides of the wash tub to electrolyze the water. The water is then ensonified using an ultrasound source.

The electrolyzed water then contains active oxygen in the form of hydrogen peroxide, ozone, and hypochlorous acid, which acts as a mild bleach. The bleaching action destroys bacteria and the active oxygen works to dissolve dirt. Sanyo reports that detergent can be added for heavily soiled items. List price is $1,100 USD.

So, when you're ready to retire your old sidescan system, you can convert it into a washing machine!

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

by John Irza

UNDERWATER INTERVENTION 2002 REFLECTS UPBEAT MOOD OF INDUSTRY

Underwater Intervention 2002 was held February 27 – March 2 in the Ernest N. Morial Convention Center in New Orleans, the largest, most prestigious venue in which the conference has yet been hosted. Exhibitors and attendees alike were enthusiastic about the enhanced function and prestige provided by the world-class facility, and New Orleans is historically a favorite location for the conference.

Underwater Intervention 2002 was co-sponsored by the Association of Diving Contractors International, Inc. (ADC) and the ROV Committee of the Marine Technology Society (MTS/ROV) for the tenth consecutive year. With 230 exhibit spaces filled, and 2,500 attendees, this year's show set a new benchmark for success in domestic underwater contracting conferences. The technical program was expanded to accommodate an increased number of paper and panel presentations, with a fourth track and an additional half-day of sessions being scheduled. The show was co-chaired by Drew Michel (MTS/ROV Committee) and Jim DorÈ (ADC). Ross Saxon (ADC) again acted as Vice Chairman for the event.

UI 2002's Early Bird Reception, held the first day of the conference, was a attended by a large, enthusiastic crowd. Louisiana Lieutenant Governor Kathleen Blanco, the state's second highest ranking official, spoke to attendees on the offshore service industry in the State of Louisiana.

The UI Technical Program opened at 1:30 p.m. on Wednesday and continued through the end of the day Saturday. The additional half-day was added at the beginning of the conference (exhibits didn't open until Thursday morning), and the sessions held Wednesday were well attended.

The UI Awards Luncheon was held on Thursday, and was highlighted by a keynote speech by Peter Canty, CEO, President and COO of Stone Energy Corporation. His speech, "The Gulf Coast Basin: A Bone Yard or a Boon Yard" demonstrated that through improved imaging technologies additional reserves of recoverable oil and gas are being detected in divable depths within the Gulf Coast Basin.

The luncheon also featured the presentation of a plaque by Leslie Leaney of the Historical Diving Society USA to the Association of Diving Contractors International for ten years of support. During that time the HDS has grown exponentially, and largely with the support of the commercial diving community.

Other Notable Sessions

- U.S. Coast Guard and Commercial Diving Safety Panel session, moderated by LCDR John Cushing: Coast Guard representatives discussed the regulatory landscape for commercial diving, including compliance and safety awareness.
- Minerals Management Service sessions: Donald C. Howard's presentation, "Gulf of Mexico MMS Prospective," which presented the status of MMS regulation of oil and gas activity in the Gulf of Mexico, and pending changes to the regulations which will affect diving inspection frequencie; and Tommy Laurendine's presentation, "Underwater Inspection Requirements," which covered CFR 30, Part 250, Subpart I, Section 900, which covers inspection of all platforms on the Outer Continental Shelf.
- AUV Track, coordinated by Track Chairman Brian Morr, which featured 18 papers and panels on subjects ranging from AUV insurance to current and future commercial prospects, with emphasis also being put on data communications and survey capabilities. The entire AUV track was characterized by standing-room-only attendance.
- Shipwreck Track, coordinated by Track Chairman Greg Stemm, which featured 15 papers and panels on shipwreck law and politics, technical tools for exploration, ROVs, underwater forensics, and recovery techniques.

[***Editors Note***: These are highlights from a report supplied by Howie Doyle Publisher, UnderWater Magazine http:// www. underwater.com Doyle Publishing Co., Inc., 15018 Mintz Lane, Houston, TX 77014 (281) 440-0278 – Fax (281) 440-4867 – hdoyle@doylepublishing.com]

HIGHLIGHTS FROM THE NEW BOSTON CHAPTER NEWSLETTER

The inaugural meeting of the Boston OES Chapter was held at the MIT Sea Grant building, November 2001, with guest speaker Frank van Mierlo from Bluefin Robotics presenting his thoughts on what it takes to make a high-tech startup successful in the ocean engineering business.

An OES Student Chapter has been started at MIT. Student Katy Croff has spearheaded a successful effort to spin-up this chapter with 12 students initially signed-up and more joining.

The Ocean Technology Job Fair was held in Cambridge, Massachusetts at MIT on Friday February 22, 2002 by the Marine and Oceanographic Technology Network This Fair is the largest recruiting event in New England for ocean engineering, marine technology, and naval architecture companies and students. Companies from across the nation participate, and students of all majors attend.

The National Ocean Science Bowl, a national competition for high schools on topics related to the study of the oceans has come to the Boston area. Managed by CORE, the Consortium for Oceanographic Research and Education, which represents 66 oceanographic institutions, universities and aquaria. This competition is intended to increase knowledge of the oceans on the part of high school students, their teachers and parents, as well as to raise the visibility and public understanding of the national investment in ocean-related research.

Oceans '02 MTS/IEEE

Mississippi Coast Coliseum and Convention Center

Executive Co-chairs
Rebecca A. Smith
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Audio Visual
Craig Cumbee
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Tutorials
Dr. Sharon Walker
Sharon.walker@usm.edu

Biloxi, Mississippi
October 29 - 31, 2002

The Mississippi Gulf Coast welcomes you to *Oceans 2002*! The exciting "Playground of the South" is located at the northern part of the Gulf of Mexico centered between Mobile, AL and New Orleans, LA. This central, coastal United States location has 26 miles of sugar-white beaches, and many cultural activities. The Gulf Coast offers a wide range of marine interest from the fishing industry, shipbuilding, oceanographic activities, marine education, remote sensing, and oil exploration. The Mississippi Gulf Coast is also the home of the world's largest group of Oceanographers located at Naval Oceanographic Office (*NAVOCEANO*) at the John C. Stennis Space Center in southern Mississippi. The Center is an advanced technology hub of over 5000 supporting the nation's rocket testing program, the Space Based Laser program, over 30 Federal and State agencies and industrial contractors, and one of the world's largest supercomputer centers.

The Mississippi Gulf Coast is home to many Federal, State, and local agencies, as well as a number of universities and learning centers. Many of these agencies and universities have the marine environment as their focus, and implement high-technology tools to study and model ocean, coastal, estuarine, and riverine properties and processes. Central to improving this capability is the Navy presence at Stennis Space Center, comprised of the Commander, Naval Oceanography and Meteorology Command (*COMNAVMETOCCOM*), the Naval Oceanographic Office (*NAVOCEANO*), and the Naval Research Laboratory (*NRL*). The Center for Higher Learning facilitates the coordination of many local Mississippi and Louisiana universities to meet the demanding and changing needs of a high-technology workforce.

Corporations supporting the Federal, State, and local Government activities in the Gulf Coast area are serving as sponsors for the MTS/IEEE Oceans '02 conference and exhibition. A list of the sponsoring companies and their role in the conference is provided below. Northrop Grumman Information Technology President and CEO, Mr. Herb Anderson will be serving as an Honorary Co-Chairman for Oceans '02. Additionally Northrop Grumman Information Technology will be assisting with overall conference coordination. Planning Systems Incorporated (*PSI*) will be providing promotional services to the Oceans '02 Conference. PSI is designing and printing conference materials, designed/hosted the pre-conference web page, and is assisting with overall conference coordination. Dynacon, Inc. will be sponsoring the entertainment at the OCEANS 2002 MTS/IEEE Gala. MCS and Harris will be co-sponsoring the Ice Breaker reception which will be on Monday, October 28.

AUV 2002

Autonomous Underwater Vehicles 2002

June 20 and 21, 2002
Southwest Research Institute™
San Antonio, Texas

General Chairman
Claude P. Brancart
NextFish
(207) 729-7873
C.Brancart@ieee.org

Technical Program Chairman
Jerry A. Henkener
Southwest Research Institute
(210) 522-3350
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Workshop Coordinator
Matthew James
Southwest Research Institute
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San Antonio, TX
78238-5166

E-Mail
AUV2002@ieee.org

Web Page
http://www.AUV2002.wsri.org

AUV 2002 will be a two-day event for engineers involved with autonomous underwater vehicles. The workshop will offer an opportunity for presenters and registrants to interact with each other. Existing and available energy systems, namely batteries, fuel cells and alternate energy systems, will be addressed relative to "where are we now" for components, systems, vehicles, and mission. Each session will be covered during a half-day time period. The last session, the second half of day two, will address the same subject relative to "where can we go" in the next 10+ years. Potential concepts will be identified, quantified, and discussed.

The Workshop has been finalized and the Agenda is presented below.

AGENDA

AUV 2002: A Workshop on AUV Energy Systems

Sponsored by
IEEE/Oceanic Engineering Society
And
Southwest Research Institute

Location

Southwest Research Institute
Building 189
6220 Culebra Road
San Antonio, Texas

Thursday, 20 June 2002

0800 Registration

0900 Welcome

Dan Bates, President, Southwest Research Institute
Claude P. Brancart, General Chairman, AUV 2002
Jerry Henkener, Technical Program Chairman, AUV 2002

0930 Session I: Batteries
Facilitator: Pat Imhof, BST Systems Inc.

AUV Energy Systems For FAU AUVs
Ed Henderson, T. Pantelakis, and Edgar An, Florida Atlantic University, Dania, FL

Lead-Acid Batteries For Use in Submarine Applications
Joe Szymborski, GNB

Energy Storage Systems for High Speed Large Scale Vehicles? Is Anything Better then Lead-Acid?
Karl R. Sette and John R. Spina, Large Scale Demonstrator Systems, Naval Surface Warfare Center Carderock Division, West Bethesda, MD

The Experience and Limitations of Manganese Alkaline Primary Cells in Large Operational AUV
Peter Stevenson and Gwyn Griffiths, Southampton Oceanographic Center, Southampton, UNITED KINGDOM

Silver Zinc Batteries For AUV Applications
Pat Imhof, BST Systems Inc., Plainfield, CT

Lithium Thionyl Chloride Battery For LMRS
Damian Drozd, The Boeing Company, Anaheim, CA

Lithium Ion Batteries for Autonomous Underwater Vehicles
J. Douglass Briscoe, N. Raman, and Mike Saft, Saft America Inc., Cockeysville, MD

The Development of a Magnesium-Hydrogen Peroxide Semi-Fuel Cell
M. G. Medeiros, C. J. Patrissi, S. P. Tucker, L. G. Carreiro, Naval Undersea Warfare Center, Newport, RI, and R. R. Bessette, University of Massachusetts Dartmouth, N. Dartmouth, MA

1230 Lunch

At the Southwest Research Institute Cafeteria

1330 Session II: Fuel Cells
Facilitator: Craig Wall, Fuel Cell Working Group,

Advance Vehicle Systems Group, Southwest Research Institute

Technical Issues and Solutions for Fuel Cell Development for AUVs
Karen E. Swider-Lyons, PhD, NRL, Washington DC, Richard T. Carlin, PhD, ONR, Robert L. Rosenfeld PhD, DARPA/TTO, and Robert J. Nowak, PhD, DARPA/DSO, Arlington, VA

PEM Fuel Cell Technology Status and Applicability For Propulsion of Autonomous Underwater Vehicles
Dr. Franco Barbir, Proton Energy Systems, Rocky Hill, CT

Benefits and Limitations of Fuel Cell Systems with Integrated Fuel Processor for UUV Applications
David J. Edlund, Eric Simpkins, and Gordon Gregory, IDA Tech, LLC, Bend, OR

Wave Energy Systems For Recharging AUV Power Supplies
George M. Hagerman, Jr., Virginia Polytechnic Institute and State University, Center for Energy and The Global Environment, Alexandria Research Institute, Alexandria, VA

Aluminum Energy Semi-Fuel Cell Systems For Underwater Applications: The State Of The Art And The Way Ahead
Michael Adams, MEng, P.Eng., PMP, Fuel Cell Technologies Ltd., Kingston, Ontario, CANADA

The Aluminium Hydrogen Peroxide Semi-Fuel Cell for the HUGIN 3000 Autonomous Underwater Vehicle
Oistein Hasvold, Principal Scientist and Kjell Havard Johansen, Norwegian Defence Research Establishment (FFI), Kjeller, NORWAY, and Karstein Vestgard, Kongsberg Simrad AS

1730 Adjournment

1800 and Beyond Get-Together at Cha-Cha?s
2026 Babcock Road, San Antonio
Tel: (210) 615-7000

Friday, 21 June 2002

0830 Checking In/Getting Ready

0900 Session III, Other Energy Systems

Facilitator: Dick Bloomquist, Director, Technology Transfer, Code 0117, Carderock Div., NAVSEA, West Bethesda, MD

Flywheel Batteries For Vehicles
Robert E. Hebner and Joseph H. Beno, The University of Texas at Austin, Austin, TX

Rechargeable Cryogenic Reactant Storage and Delivery Systems for Fuel Cell Powered Underwater Vehicle
Mark S. Haberbusch, Robert J. Stochl, Chinh T. Nguyen, Adam J. Culler, Sierra Lobo, Fremont, OH, Jesse S. Wainright, Case Western Reserve University, Cleveland, OH, and Mathew E. Moran, Isotherm Technologies, Brunswick, OH

A Next-Generation AUV Energy System Based on Aluminum-Seawater Combustion
Timothy F. Miller, Jeremy I. Walter, and Daniel H. Kiely, Applied Research Laboratory, The Pennsylvania State University, State College, PA

Hydrocarbon Fueled UUV Power Source
Daniel H. Kiely and James T. Moore, Applied Research Laboratory, The Pennsylvania State University, State College, PA

A Survey of Available Underwater Electric Propulsion Technologies and System Safety
Clinton Winchester, Justin Govar, Julie Banner, Tracey Squires, Naval Surface Warfare Center, Carderock Division, Power System Branch, Battery Technology Group, West Bethesda, MD

Solar Powered AUVs: How, When, Where, and Why
Claude P. Brancart, NextFish, Brunswick, ME

1230 Lunch
At the Southwest Research Institute Cafeteria

1330 Session IV: 20 Years From Now

Facilitator: Claude P. Brancart, NextFish, Brunswick, ME

A look ahead by the technology presenters, and some additional thoughts.

1600 Wrap-Up

All Facilitators and Presenters

1700 Adjournment

For registration and other information see website www.AUV2002.swri.org