1996-06

IEEE AUV 96 / Oceanic Engineering Society Institute of Electrical and Electronics Engineers Symposium on Autonomous Underwater Vehicle (AUV) Technology / June 2 -6, 1996 in Monterey, California

Monterey, California: Naval Postgraduate School.

IEEE AUV 96

[AUV 96 logo]

Oceanic Engineering Society
Institute of Electrical and Electronics Engineers (IEEE)

Symposium On
Autonomous Underwater Vehicle (AUV) Technology

June 2-6, 1996

Advance Program

Hosted by the Naval Postgraduate School at the
Hyatt Regency Hotel, Monterey California USA

AUV 96 home page: http://www.cs.nps.navy.mil/research/auv/auv_96.html

Electronic mail: oes-auv96@mail.ieee.org or auv@cs.nps.navy.mil

CONFERENCE COMMITTEE

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Tutorials
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Special Events
Gary Trimble
Lockheed Martin, CA

Local Arrangements and Registration
Bernadette C. Waugh
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CONFERON, INC

GENERAL INFORMATION

EARLY BIRD RECEPTION

On Sunday, early registration will be available from 3:00pm for both tutorial and conference attendees. Also, everyone is encouraged to take advantage of low airfares with the Saturday night stay over, this will provide an opportunity to mingle as well as register so that more free time is available for sightseeing in the Monterey area.

REGISTRATION INFORMATION

Take advantage of the early registration discounts and please complete the registration form in the center of this program. Also included is a registration form for the hotel. Please complete it as soon as possible to get the conference-negotiated rates. Conference and selected tutorial registration should be completed with payment made in a check, drawn on a US bank payable to 'AUV 96', or by accepted credit cards on the registration form.

REGISTRATION AND TUTORIAL FEES

Fees for tutorial and conference attendees are as follows:

Type of Registration	IEEE Members	Non Members
Advance	$260	$310
On-Site	$310	$360
One-Day	$125	$150
Student	$100	$100

Registration fees are $l25.00 per tutorial which include admission, printed handouts, and refreshments. Please indicate on the registration form which tutorial(s), I through VI, you will be attending.

The conference registration will include admission to all technical sessions, one proceedings book, one video, breaks, social events including the dinner at the Monterey Bay Aquarium and site visits. Student and One-Day registration includes admission to the technical sessions, and a copy of both printed & video proceedings.

CONFERENCE PROCEEDINGS

The conference proceedings will be distributed at registration to all except One-Day Attendees. Additional Proceedings volumes can be obtained for $60.00 per copy. Individual arrangements should be made with the US post office for direct shipment to overseas addresses.

ACCOMODATIONS

All technical sessions will be held at the Hyatt Regency Hotel in Monterey, CA. The Hyatt has extended a special discount to conference attendees and a block of rooms has been reserved at the rates shown in the hotel registration form in the center of this program. EARLY registration is strongly advised to obtain the availability of the special rates. Monterey is a very popular place for tourists in the summer, and hotel accommodations are at a premium. Stay extra days and turn the meeting into a vacation.

OFFICIAL AIRLINE INFORMATION

United Airlines is the official carrier for the Symposium. United will offer a 10% discount off the unrestricted coach fare or a 5% discount off the lowest applicable fare, including first class. This discount applies to domestic segments of United and United Express flights including Canada.

To obtain fare information or to make reservations, call the United Meeting Reservation Center at (800)-521-4041 (open seven days a week from 4:00am to 9:00pm Pacific Time) or your travel agent. The ID # 502IN must be referenced to receive the discount. Tickets will be mailed by United or can be picked

up at your travel agent.

Direct flights are available to and from Chicago, San Francisco, Los Angeles. Monterey can be reached by car (90mins) from the San Jose Airport. Come early and fly to San Francisco and take the famous Scenic drive down Highway 1.

DINNER AT THE MONTEREY BAY AQUARIUM

There will be a dinner party at the world-famous Monterey Bay Aquarium on Wednesday evening. The price is included in the full registration fee. It includes transportation to and from the hotel, the aquarium and one complimentary drink. Extra dinner tickets may be purchased at the registration desk at $70.00 per person. The dinner buses will depart from the Hotel at 6:30pm. Buses will return to the Hotel at 10:00 pm. The aquarium has just opened a new million-gallon tank with live exhibits of Outer Bay sea life in a near-natural habitat. The conference dinner attendees will have exclusive access to the facility and will listen to a after-dinner presentation by Peter Brewer, Director of the Monterey Bay Aquarium Research Institute (MBARI). Dr. Brewer presentation will include current challenges in oceanographic research relevant to AUVs.

TUTORIALS

Tutorial sessions will take place on Monday, 3 June, at the Hyatt Regency in Monterey. Please register for any one or a morning/afternoon pair on the registration form.

TUTORIAL I

Monday, June 3, 1996 - 8.30a.m. - 12.00a.m.

Hydrodynamics, Dynamics and Control of AUVs

Douglas E. Humphreys (Vehicle Control Technologies, Inc.)

This tutorial will emphasize the practical aspects of hydrodynamics, dynamics and control of AUVs. The scope of this tutorial is to survey the current modeling methodology and yet provide a detailed treatment of undersea vehicle dynamics. Attendees will come away with a better understanding of the concepts and the current methodology used in modeling and simulation of undersea vehicles. Attendees will gain an understanding of the interrelation-ships of the hydrodynamic coefficients, both linear and nonlinear. Approaches for estimating coefficients for hulls, fins and fin-hull combinations will be covered. Use of Bode plots and root locus to gain insight into AUV design trends will be demonstrated. The interrelationship between stability and control will be discussed along with examples that show typical tradeoffs.

TUTORIAL II

Monday, June 3, 1996 - 8.30a.m. - 12.00a.m.

The Kalman Filter: An Introduction to Concepts

Peter S. Maybeck (Air Force Institute of Technology)

The Kalman filter is discussed as an optimal recursive data processing algorithm, used to estimate variables of interest on the basis of incomplete and noise-corrupted data and mathematical models of both system structure and uncertainties. After the fundamental concepts are presented and discussed from a practical standpoint, a simple navigation problem is used to demonstrate how the filter operates. Throughout the presentation, physical and geometrical insights are emphasized. Design, performance analysis, and practical aspects of implementation are then discussed in detail. Topics to be developed include filter tuning, reduction of order and complexity, sensitivity analyses, numerical problems (and solutions) due to finite word length, residual monitoring, adaptive filtering, extended Kalman filtering, and practical experience with operational filter algorithms.

TUTORIAL III

Monday, June 3, 1996 - 8.30a.m. - 12.00a.m.

Onboard Acoustic Sensors

by Frederick H. Maltz (Engineering Consultant)

This tutorial focuses on the simulation of onboard AUV sonar returns in shallow water. In particular, statistical models and algorithms are discussed for targets and reverberation from rough sea surface and bottom. Sea surface height is modeled as a Markov Random Field followed by a nonlinear transformation. The bottom terrain height field is created from plasma fractals. The tutorial includes an introduction to the fundamentals of high frequency sonar and acoustic scattering from rough surfaces. Side Look Sonar for object search and Forward Look Sonar for obstacle avoidance are discussed in the context of signal generation, beamforming, and ray acoustics. The tutorial also includes an overview of the statistical principles used to describe the physical environment with computer simulation examples illustrating the application of these statistical models.

TUTORIAL IV

Monday, June 3, 1996 - 2.00p.m. - 5:30p.m.

Three-Dimensional Ray Acoustics

Lawrence J. Ziomek (Naval Postgraduate School)

Discussion of the fundamentals of ray acoustics for three-dimensional speeds of sound, including the derivation and formal solution of the eikonal and transport equations, and the derivation of the ray equations. Introduction to and discussion of the Recursive Ray Acoustics (RRA) Algorithm for 3-D speeds of sound. The RRA Algorithm is a simple, fast, and accurate algorithm that can be used to find eigenrays and to compute the position, angles of propagation, travel time, phase, and path length along a ray path and to draw ray trace plots for speeds of sound that are functions of all three spatial variables. In addition, the RRA Algorithm can compute the sound-pressure level (SPL) along individual ray paths for arbitrary, one-dimensional, depth-dependent speeds of sound.

TUTORIAL V

Monday, June 3, 1996 - 2.00p.m. - 5:30p.m.

Statistical Signal Processing

Charles W. Therrien (Naval Postgraduate School)

This tutorial is a brief introduction to modern statistical methods of signal processing. The tutorial will begin with an outline of methods for characterizing and processing random signals and the linear algebra ideas used in modern signal processing. It will then focus on methods for optimal signal processing such as Wiener filtering, linear prediction and related ideas. A final segment will discuss algebraic subspace methods such as MUSIC and the application of all of these methods to modern spectral analysis. To derive the most benefit attendees should have a basic knowledge of linear systems in the time and frequency domain and be comfortable with basic probability and the use of matrix and vector notation. Otherwise no knowledge of signal processing methods is necessary.

TUTORIAL VI

Monday, June 3, 1996 - 2.00p.m. - 5:30p.m.

Using an Underwater Virtual World for AUV Design and Development

Donald P. Brutzman (Naval Postgraduate School)

An underwater virtual world can comprehensively model all salient functional characteristics of the real world in real time. This virtual world is designed from the perspective of the robot, enabling realistic AUV evaluation and testing in the laboratory. 3D real-time graphics are our window into that virtual world. Visualization of robot interactions within a virtual world permits sophisticated analyses of robot performance that are otherwise unavailable. Sonar visualization permits researchers to accurately "look over the robot's shoulder" or even "see through the robot's eyes" to intuitively understand sensor-environment interactions. Distribution of underwater virtual world components enables scalability and real-time response. The IEEE Distributed Interactive Simulation (DIS) protocol is used for compatible live interaction with other virtual worlds. Network access allows individuals remote access. This is demonstrated via Multicast Backbone (MBone) collaboration with others and World-Wide Web (WWW) access to pertinent archived images, papers, data sets, software, sound clips, text and any other computer- storable media. This tutorial will show you how to access, use and adapt our 3D real-time graphics software for underwater robotics modeling, hydrodynamics testing, sonar visualization and worldwide scientific collaboration. For further information see http://www.stl.nps.navy.mil/~auv/

LOCAL TOURS

Lunchtime local tours of area laboratories performing research on AUVs will be offered from 12:00 to 1:00 pm each day. Tour groups will be limited to 20 people each, Sign up will be at the registration desk on a first-come first-served basis. Tours will be arranged for the:

* NPS Center for Autonomous Underwater Vehicles Research during lunch periods Tuesday and Wednesday (box lunch provided).
* Monterey Bay Aquarium Research Institute (MBA) in Moss Landing on

Thursday afternoon.

AUTHORS / SESSION CHAIRS COORDINATION

It is essential that all session chairs coordinate the session with their authors prior to the meeting. At the same time, all authors must communicate with their respective chair to discuss visual aids requirements etc. At the meeting, a breakfast will be provided for the presenter of each paper and session chair which will enable the session chairpersons to coordinate once more with the presenters on the particular day. Breakfast will be from 7:00am to 8:00 am each day .

VIDEO PROCEEDINGS

The video proceedings will be available included in the price of registration and distributed at the registration desk together with the bound volume of the Conference Proceedings papers.

PLENARY SPEAKER

Captain Young NAVSEA PMS 403 will discuss the programs in UUVs being considered by the US Navy in an address titled:

U.S. Navy Unmanned Undersea Vehicle Program
Tuesday 0830 - 0900, June 4 1996

AUV'96 CONFERENCE REGISTRATION

This registration form is also available at
http://www.cs.nps.navy.mil/research/auv/registration.txt

Last Name First Name

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Full Registration -
Includes Proceedings, Video and 1 Dinner Ticket

Fees Prior to May15		Fees After May 15	
[ ] Member IEEE	$260.00	[ ] Member IEEE	$310.00
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One Day Registration-Technical Sessions Only Plus Proceedings
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WORKSHOP (Tutorial) Fees:
Tutorial # [ ], [ ], [ ], [ ]
$
TOTAL REGISTRATION FEES $

Additional Proceedings@$60.0 / copy $
(Available at the Conference)
Additional Aquarium Tickets
Tickets @ $70.00 ea. $

TOTAL ADDITIONAL COSTS $

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HOTEL RESERVATION FORM
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Symposium
June 2-6, 1996
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AUV 96 Technical Program

Tuesday, June 4

0800-0900 Plenary Session - Charlie Young, Anthony Healey, Claude Brancart

0900-1030 Vehicles, Session IA

The Optimal Control of a Flexible Hull Robotic Undersea Vehicle Propelled by an Oscillating Foil
David Barrett, Mark Grosenbaugh, Michael Triantafyllou

Autonomous Underwater Vehicle AQUA EXPLORER 1000 for Inspection of

Underwater Cables
Kenichi Asakawa, Junichi Kojima, Yoshihiko Ito, Satoru Takagi, Yuichi Shirasaki, Naomi Kato

Design of a Small, Cheap UUV for Under-Ship Inspection and Salvage
David P. Miller

1030 - 1100 Break

1100 - 1230 Vehicles, Session IIA

Autonomous Operation of the Explosive Ordnance Disposal Robotic Work Package Using the CETUS Untethered Underwater Vehicle
G. M. Trimble

Miniaturized and Reconfiguable Instrumentation for Multipurpose Survey with a Mini Autonomous Underwater Vehicle MAUVE - Project
Alain Carof

Exploration of Mono Lake with an ROV: A Prototype Experiment for the Maps AUV Program
C.R. Stoker, D. Barch, J. Farmer, M. Flagg, T. Healey, T. Tengdin, H. Thomas, K. Schwer, D. Stakes

1230-1330 Lunch, Site Visit NPS Center for AUV Research

1330 - 1500 Vehicle Control, Session IIIA

Local Area Navigation Using Sonar Feature Extraction and Model Based Predictive Control
D. B. Marco, A. J. Healey

Non-Linear Controller with Switched Control Law for Tracking Control of Non-Cruising AUV
Wan Chung Lam and Tamaki Ura

Gradient Search with Autonomous Underwater Vehicles Using Scalar Measurements
Erik Burian, Dana Yoerger, Albert Bradley, Hanumant Singh

1500 - 1530 Break

1530 - 1700 Vehicle Control, Session IVA

NPS Phoenix AUV Software Integration and In-Water Testing
Don Brutzman, Mike Burns, Mike Campbell, Duane Davis, Tony Healey, Mike Holden, Brad Leonhardt, Dave Marco, Dave McClarin, Bob McGhee, Russ Whalen

A Survey and Experimental Study of Neural Network AUV Control
Jorgen Lorentz and J. Yuh

Performance Results of a Fuzzy Behavioral Altitude Flight Controller and Rendezvous and Docking of an Autonomous Underwater Vehicle with Fuzzy Control
K. A. White, S. M. Smith, K. Ganesan, D. Kronen, G. J. S. Rae, R. M. Langenbach

Strategic Level Mission Control - An Evaluation of CORAL and PROLOG Implementations for Mission Control Specifications
A. J. Healey, D. B. Marco, P. Oliveira, A. Pascoal, V. Silva, C. Silvestre

1730 - 1830 Video Proceedings, Session V

2000 - late Discussion Roundtable: AUV Research Priorities

0930 - 1030 Sonar, Session IB

0930 - 1030 Sonar, Session IB

Exploratory Development Minehunting Sensors for Unmanned Vehicles
Stephen F. Castelin, Robert A. Manning, Candace J. Robertson, Lisa J. Tubridy, Phillip J. Bernstein

Sensors for a Forward-Looking High Resolution AUV Sonar
Fred Nussbaum, Gerald T. Stevens, James G. Kelly

Electronically Steered and Focused Forward-Looking Scan Sonar
Lester R. LeBlanc, Joseph M. Cuschieri, Matthew R. Singer, Pierre-Philippe J. Beaujean

1030 - 1100 Break

1100 - 1230 Sonar, Session IIB

A Side Scan Sonar System for Autonomous Underwater Vehicles
James M. Glynn, Martin Buffman

Multi-Frequency Shift Key and Differential Phase Shift Key for Acoustic Modem
Lester R. LeBlanc, Pierre-Philipe Beaujean

Multi-Sensor Data Fusion for Seafloor Mapping and Ordnance Location
John Wright, Ken Scott, Tien-Hsin Chao, Brian Lau

1230 - 1330 Lunch, Site Visit NPS Center for AUV Research

1330 - 1500 Sonar Signal Processing, Session IIIB

Significance for Envelope Detection in Underwater Acoustic Imaging Systems
Andrea Trucco, Vittorio Murino

High Resolution Array Signal Processing for AUV's
Michael R. Medieros, Robert Carpenter

Subspace Stability in High Resolution Direction Finding and Signal Enumeration
M. E. Kotanchek, J. E. Dzielski

1500 - 1530 Break

1530 - 1700 Vehicles, Session IVB

Autonomous Legged Underwater Vehicles for Near Land Warfare
Helen Greiner, Art Shectman, Chikyung Won, Richard Elsley, Per Beith

Pectoral Fin Model for Maneuver of Underwater Vehicles
Naomi Kato, Motonori Furushima

Control Surface and Actuator Design for a Low Drag, Laminar Flow AUV
S. L. Merry, M. J. Large, T. J. Whitten, M. R. Wilkinson, R. J. Babb

Near-Term Mine Reconnaissance System Vehicle: An NDI Reconnaissance UUV for Littoral Regions
Todd Harland-White, Paul Dunn

Wednesday, June 5

0830 - 1000 Software Architecture, Session IA

Development and Validation of the Texas A&M University Autonomous Underwater Vehicle Controller
Eric Nelson, Stephen McClaran, David Barnett, Make McDermott, Glen Williams

A Pragmatic Software Architecture for UUV's
K. Ganesan, S. M. Smith, K. White, T. Flanigan

Conditional Sequencing for Land, Space and Sea
Erann Gat

1000 - 1030 Break

1030 - 1230 Software Architecture, Session IIA

A General Control Archictecture for Mulitple AUV's
J. Borges Sousa, F. Lobo Pereira, E. Pereira da Silva

Architecture of the Texas A&M Autonomous Vehicle Controller
David Barnett, Stephen McClaran, Eric Nelson, Make McDermott, Glen Williams

Architecture for an Autonomous Reconfigureable Intelligent Control System (ARICS)
Arie Yavnai

1230 - 1330 Lunch, Site Visit NPS Center for AUV Research

1330 - 1500 Navigation, Session IIIA

New Experimental Results on GPS/INS Navigation for Ocean Voyager II AUV
P. E. An, A. J. Healey, S. M. Smith, S. E. Dunn

The Development of an Integrated GPS/INS/Sonar Navigation System for Autonomous Underwater Vehicle Navigation
M. Bennamoun, B. Boashash, F. Faruqi, M. Dunbar

A Precision Navigation System for Autonomous Undersea Vehicles
Dan G. White, Frank Psota

1500 - 1530 Break

1530 - 1700 Navigation, Session IVA

Evaluation of an Integrated GPS/INS System for Shallow-Water AUV Navigation (SANS)
E. R. Bachmann, R. B. McGhee, R. H. Whalen, R. Steven, R. G. Walker, J. R. Clynch, A. J. Healey, X. P. Yin

Determination and Influence of the Main Parameters for the Launch and Recovery of an Unmanned Underwater Vehicle From a Submarine
Denis Chapuis, Caroline Deltheil, Didier Leandri

The Flow in and Around the Launchway Cavities of an SSN 688 Submarine
Steven M. Wells, David W. Coder

Wednesday, June 5

0800 - 1000 Mosaicking, Session IB

Video Mosaicking Along Arbitrary Vehicle Paths
Stephen D. Fleisher, Howard H. Wang, Stephen M. Rock

Clustering and Feature Extraction in a 3D Real-Time Echo Management Framework
Per G. Auran, Kjell E. Malvig

Mosaicking of the Ocean Floor in the Presence of Three-Dimensional Occlusions in Visual and Side-Scan Sonar Images
Sanjay Tiwari

1000 - 1030 Break

1030 - 1230 Acoustic Imaging, Session IIB

Sonar Image Interpretation and Modeling
George T. Russell, Judith M. Bell, Patrik O'B. Holt, Stuart J. Clarke

Study of Aperture Area Reduction and Resolution Improvement of Underwater Ultrasonic Imaging System
Shen-Wen Cheng, Min-Kang Chao

An Integrated Environment for Fast Development and Performance Assessment of Sonar Image Processing Algorithms - SSIE
Lars Henriksen

1230 - 1330 Lunch, Site Visit NPS Center for AUV Research

1330 - 1500 Visual Imaging, Session IIIB

Detecting Linear Motion of an Object in a Sequence of Monocular Underwater Images
Petter Lagstad

Acoustic Video-signal Transmission System for Autonomous Underwater Vehicle
Junichi Kojima, Yuichi Shirasaki

A Color Texture Based Visual Monitoring System for Automated Surveillance
George Paschos, Kimon P. Valavanis

1500 - 1530 Break

1530 - 1700 Modeling & Simulation, Session IVB

AUV Test Using Real/Virtual Synthetic World
Yoji Kuroda, Koji Aramaki, Tamaki Ura

A Simplified Dynamics Model for Autonomous Underwater Vehicles
Meyer Nahon

Visualization for AUV Non-Traditional Navigation Algorithm Development
S. T. Tuohy, D. Bruening, N. M. Patrikalakis

Thursday, June 6

0800 - 1000 Ocean Networks, Session IA

Optimizing AUV Oceanographic Surveys
James G. Bellingham, J. Scott Willcox

AUV System Requirements for Coastal Oceanography
F. Lobo Pereira, J. Borges Sousa, C. Gil Martins, E. Pereira da Silva

Organization and Reorganizing of Autonomous Oceanographic Sampling Networks
Roy M. Turner, Elise H. Turner

1000 - 1030 Break

1030 - 1100 AOSN Sensors, Session IIA

Turbulence and Optics Sampling From an Autonomous Underwater Vehicle
Edward R. Levine, Rolf G. Lueck, Percy L. Donaghay, Donald N. Connors, Ted Gagliardi, Robert C. Hanson, Richard R. Shell

Ocean Flow Measurement Using an Autonomous Underwater Vehicle
Ken Holappa, Manhar Dhanak, Samuel Smith, Edgar An

Validation of the Installation of CTD Sensors on an AUV
James W. Bales

Thursday, June 6

0800 - 1000 Energy & Propulsion, Session IB

Development Efforts in Rechargeable Batteries for Underwater Vehicles
Patricia H. Smith, Stanley D. James, Peter B. Keller

High Energy Density Permanent Magnetic Motors for Underwater Systems
William P. Krol, Jr., C. Peter Cho

Solid Lithium Hydride as a Hydrogen Source for Fuel Cells
Gerald K. Pitcher

1000 - 1030 Break

1030 - 1230 Motion Control, Session IIB

Experiments in the Hydrodynamic Modeling of an Underwater Manipulator
Timothy W. McLain, Stephen M. Rock

Geometric Methods for Robust Stabilization of Autonomous Underwater Vehicles

Naomi Ehrich Leonard

A Motion Planning Method for an AUV
Shinji Arinaga, Shoji Nakajima, Hideo Okabe, Akira Ono, Yutaka Kanayama

1400 - 1800 Possible classified workshop at NPS Engineer's Auditorium:
U.S. Navy Unmanned Underwater Vehicles (UUVs).
Point of contact: Alan Beam, NUWC/ARL Keyport WA.

This page is available at
http://www.cs.nps.navy.mil/research/auv/auv96advanceprogram.txt

and the registration form is also available at
http://www.cs.nps.navy.mil/research/auv/auv96registration.txt

Your comments are welcome. For further information:

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