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A Summary of Research Projects Sponsored
by the Office of Naval Research. Report for
the Period 1 October 1981 to 30 September 1982

Monterey, California. Naval Postgraduate School

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NAVAL POSTGRADUATE SCHOOL

Monterey, California



A SUMMARY OF RESEARCH PROJECTS SPONSORED BY
THE OFFICE OF NAVAL RESEARCH

Report for the Period

1 October 1981 to 30 September 1982

Title: Design, Analysis and Implementation of Multi-backend Database System

Investigators: A large number of faculty members and students are involved in this project.

Sponsor: Office of Naval Research and the Digital Equipment Corporation

Objective: To explore the use of multiple minicomputers in a parallel fashion to anticipate the database growth and performance gain.

Summary: This work is conducted in the Lab for Database Systems Research at the Ohio State University. The staff consists of two faculty members, three graduate students, and professional staff. The objective is to complete the implementation of an experimental system by June of 1983 and move the hardware and the software from Ohio State to the Naval Postgraduate School. Professor Douglas Kerr, the present Director of the lab, will be spending a year sabbatical at the Naval Postgraduate School and will continue the research work here. Two of the students on the research project may also join the Naval Postgraduate School as Visiting Scholars since they will be finishing their course work there towards Ph.D. candidacy.

Publications: David K. Hsiao, et. al, "The Implementation of a Multi-backend Database System (MDBS): Part I - An Exercise in Database Software Engineering", Proceedings of the International Workshop on Database Machines, San Diego, August 1982.

X. G. He, et. al, "The Implementation of a Multi-backend Database System (MDBS): Part II - The Design of a Prototype MDBS:", Proceedings of the International Workshop on Database Machines, San Diego, August 1982.

M. J. Menon and D. K. Hsiao, "Design and Analysis of Join Operations of Database Machines", Proceedings of the International Workshop on Database Machines, San Diego, August 1982.

Title: Programming Language Metrics

Investigator: Bruce J. MacLennan, Assistant Professor of Computer Science

Sponsor: Office of Naval Research

Objective: The purpose of this study is to: (1) develop ordinal, or qualitative, means of comparing languages according to some quality; these would allow ranking languages according to some quality, for instance, complexity; and (2) develop cardinal, or quantitative, means of evaluating languages; these would permit numeric measurement of specific language attributes.

Summary: Since programming languages are the primary tools used in the programming process, it is not surprising that the choice of programming language is an important element of the life-cycle cost of a software development project. For this reason it is necessary to be able to compare languages and judge their suitability for various applications. Unfortunately, language comparison and evaluation remains a mostly subjective art not unlike literary criticism. This is unsatisfactory for a tool of the importance of a programming language.

One promising approach to comparing languages is to compare the size of their grammars. Since a smaller, more regular language will tend to have a shorter grammar than a larger, less regular language, we can measure the size and regularity of a language by the size of its description in a grammar in an appropriate normal form.

To date these methods have been used to measure the total complexity of several well-known languages, to compare the relative size of the subsystems of several languages, to measure the complexity of the execution sequences of a number of control structures, and to measure the semantic complexity of several parts of several languages.

Publications: B. J. MacLennan, "Simple Metrics for Programming Languages," Information Processing and Management, forthcoming.

B. J. MacLennan, "Measuring Control Structure Complexity Through Execution Sequence Grammars," submitted to Transactions on Programming Languages and Systems.

B. J. MacLennan, "Measuring Control Structure Complexity Through Execution Sequence Grammars," NPS Technical Report, NPS52-81-015, November 1981.

B. J. MacLennan, Principles of Programming Languages: Design, Evaluation and Implementation, New York: Holt, Rinehart and Winston, forthcoming.

Title: Numerical Modelling of Transonic Flow Past Cascade Blades Via Higher Order Godunov Methods

Investigator: Raul Mendez, Adjunct Professor of Mathematics, S. Eidelman, NRC Postdoctoral Research Associate

Sponsor: NPS Foundation Research Program and Office of Naval Research

Objective: To develop a numerical scheme capable of simulating flow past cascade blades.

Summary: Design and testing of a numerical scheme for computing transonic flow past cascade blades. Numerical scheme is based on higher order approximations to the compressible Euler's equations. The scheme is based on Van Leer's monotonicity interpolation scheme as well as on Collela-Woodward's MUSCL scheme.

Publications: S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," Journal of Computational Physics, submitted for publication.

S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," NPS Technical Report, forthcoming.

Conference Presentation: S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," to be presented at AIAA Meeting, University of California, Davis, May 1983.

Title: An Investigation of Factors Affecting Financial Control in Navy Systems

Investigators: Meryl Louis, Associate Professor of Management, Administrative Sciences Department and Kenneth J. Kuske, Assistant Professor of Accounting, Administrative Sciences Department

Sponsor: Office of Naval Research

Objective: The objective is to investigate the effects of different environmental factors upon the degree of differentiation and integration necessary for an effective and efficient management control system.

Summary: The project as designed would take two years to complete. The project was designated to explore the factors important to the design and operation of financial control systems when mission and context are held constant. The project investigated organizations operating in the same environments, providing the same services but using different management control systems to determine the important factors in the design and operation of control systems. In addition evaluation criteria were to be refined so that control systems could be judged in relation to these factors.

Title: Evaluation of ONR Contractor COMNAVAIRPAC and COMNAVAIRLANT TAC D&E Program

Investigator: A. F. Andrus, Associate Professor of Operations Research and Statistics

Sponsor: Office of Naval Research

Objective: Evaluate FY-81 Contractor Support program in TAC D&E for ONR, Code 230. Evaluation to involve review and evaluation of contract deliverables; review and evaluation of contract task requirements; evaluation of program direction and accomplishments.

Summary: A total review and evaluation of the FY81 program was completed. The evaluation report included:

- a) Identification of contract requirements.
- b) Comparison of requirements and objectives.
- c) Determination of accomplishments.
- d) Quality of results.
- e) Utility of results.
- f) Recommended improvements.
- g) Problem of relating cost in improvements.

Publication: A. F. Andrus, "Review of 1981 ONR Contractor Support Air TAC D&E Program," ONR Technical Report, Code 230, 27 April 1982.

Title: Microcomputer Simulation Capabilities-Interactive Graphics

Investigator: A. F. Andrus, Associate Professor of Operations Research and Statistics

Sponsor: Office of Naval Research

Objective: Explore capabilities of standard microcomputer for wargaming analysis and Interactive Gaming/Graphics

Summary: Two APPLE III systems were purchased and used by students under direction of A. F. Andrus. Models were developed for Interactive Graphics/Tactical Analysis and Interactive Gaming.

Theses Directed: J. McCorkle, "Tactical Motion Analyses," Master's Thesis, September 1982.

C. Owens, "TEMPO: An Interactive Simulation for the APPLE III," Master's Thesis, September 1982.

J. Wilson, "An Interactive Model of the Air Battle Analyses for the APPLE III," Master's Thesis, September 1982.

Title: TAC D&E Technical Administration

Investigator: A. F. Andrus, Associate Professor of Operations Research and Statistics

Sponsor: Office of Naval Research

Objective: Technically administer and monitor ONR TAC D&E program for COMNAVAIRPAC.

Summary: During Quarter 4 my efforts were redirected to assume Scientific Officer technical responsibility for the TAC D&E program for COMNAVAIRPAC. This included:

- a) writing requests for proposals;
- b) evaluating contractor proposals;
- c) technically monitoring and evaluating current projects.

Title: Large-Scale Optimization

Investigators: Gerald G. Brown, Professor of Operations Research,
Gordon H. Bradley, Professor of Computer Science

Sponsor: Office of Naval Research

Objective: Develop theory and algorithms for solution of large-scale optimization models.

Summary: The Naval Postgraduate School research program in large-scale optimization has continued with progress on several fronts. Optimization of generalized networks, networks with gains, fixed charge networks, and imbedded networks, has received further attention. Such models can now be solved nearly as efficiently as pure networks. Large-scale nonlinear and mixed integer models can now be solved in real time, with model generation facilities and report extraction tools permitting rapid response to analyst queries. New decomposition and relaxation methods for very large models have yielded extremely efficient solutions of complex mixed integer problems. More important, new theoretical insight has been gained in the convergence properties of these approaches which helps explain our success, and two decades of failure by other researchers.

Awards: G. G. Brown and G. Graves, 1981 International Management Science Achievement Award, Honorable Mention.

G. G. Brown, Sigma Xi Research Award, Naval Postgraduate School, 1982.

Publications: G. G. Brown and B. O. Shubert, "On Random Binary Trees," Mathematics of Operations Research, forthcoming.

J. G. Taylor and G. G. Brown, "Annihilation Prediction for Lanchester-Type Models of Modern Warfare," Operations Research, forthcoming.

G. G. Brown and G. Graves, "Real-Time Dispatch of Petroleum Tank Trucks," Interfaces, forthcoming.

G. G. Brown and W. Wright, "Automatic Identification of Embedded Network Rows in Large-Scale Optimization Models," Mathematical Programming, forthcoming.

G. H. Bradley, G. G. Brown and G. Graves, "Structural Redundancy in Large-Scale Optimization Models," in Redundancy in Mathematical Programming, Springer Verlag, December 1982, forthcoming.

R. Goren, D. Bausch and G. Brown, "Determination of Optimal Aircraft Mix in an Air Force," NPS Technical Report, NPS55-81-025, December 1981.

G. Brown, G. Bradley and G. Graves, "Review of the Computational Aspects of the TBS Regulatory Analysis Financial Model," Electric Power Research Institute Technical Report, September 1981.

G. Brown, G. Graves and M. Honczarenko, "Large-Scale Facility and Equipment Location: An Application of Goal Programming in Multicommodity Decomposition," Technical Report, University of California, Los Angeles, September 1981, 24 pages.

G. Brown and R. McBride, "Extracting Embedded Generalized Network Problems from General LP Problems," Technical Report, School of Business, University of Southern California, September 1981, 11 pages.

G. Brown and R. McBride, "Efficient Solution of Generalized Network Problems," Technical Report, School of Business, University of Southern California, September 1981, 34 pages.

G. Brown and W. Wright, "Automatic Identification of Embedded Structure in Large-Scale Optimization Models," appears in Large-Scale Linear Programming, G. Dantzig, M. Dempster and M. Kallio, eds., International Institute for Applied Systems Analysis, Laxenburg, Austria, 1981, pp. 781-808.

G. Brown and D. Thomen, "Automatic Identification of Generalized Upper Bounds in Large-Scale Optimization Models," appears in Large-Scale Linear Programming, G. Dantzig, M. Dempster and M. Kallio, eds., International Institute for Applied Systems Analysis, Laxenburg, Austria, 1981, pp. 747-780.

Conference
Presentations:

G. Brown and G. Graves, "Real Time Dispatch of Petroleum Tank Trucks," International Management Science Achievement Award Competition, Detroit, 18 April 1982.

G. Brown, R. Duff and M. Finley, "Design and Demonstration of a Microcomputer-Based Network Optimization System," ORSA/TIMS National Meeting, Detroit, April 1982.

G. Brown and R. McBride, "Efficient Solution of Generalized Networks," ORSA/TIMS National Meeting, Detroit, 20 April 1982.

G. Brown, V. Bain and A. Toprak, "A Case Study in Facility and Equipment Planning: Crash Projects (and Modeling) Can Work," ORSA/TIMS National Meeting, Detroit, 21 April 1982.

G. Brown and G. Graves, "Application of a New Class of Decompositions to Problems of Production, Inventory and Distribution," International Mathematical Programming Society, Bonn, W. Germany, 26 August 1982.

G. Brown, G. Graves and R. McBride, "User Friendly Tools for Interactive Optimization," ORSA/TIMS National Conference, San Diego, 25 October 1982.

G. Bradley, G. Brown and A. Geoffrion, "Mathematical Programming Models for Multiperiod Production and Sales Planning," ORSA/TIMS National Conference, San Diego, 25 October 1982.

Theses Directed:

M. Finley, "An Extended Microcomputer-Based Network Optimization Package," Master's Thesis, October 1982.

D. Bausch, "Computational Advances in the Solution of Large-Scale Set Covering and Set Partitioning Problems," Master's Thesis, October 1982.

P. Lord, "An Examination of the United States Air Force Optimal Nonnuclear Munitions Procurement Model," Master's Thesis, October 1982.

Title: Stochastic Modeling and Data Analysis

Investigators: D. P. Gaver, Professor of Operations Research and Statistics
P. A. Jacobs, Associate Professor of Operations Research
J. P. Lehoczky, Professor of Statistics, Carnegie-Mellon University
G. Latouche, Professor of Computer Science, Free University of Brussels

Sponsor: Office of Naval Research

Objective: To develop and show how to apply statistical methods of data analysis and probability modeling to problems arising in the environment (weather, meteorology), communications, computer systems, military C³ and equipment reliability.

Summary: Investigations were conducted, and reports given on these topics:

- a) Statistical summarization and modeling of Arctic subsurface in ice roughness,
- b) The superposition of random loads on structures,
- c) The availability of failure-prone inspected standby equipment,
- d) Models for delays to processor-sharing computer systems,
- e) Use of interactive Markov chain models in manpower planning,
- f) Models for maintained system reliability and availability in "random environments,"
- g) Simple compact formulas for percent point of student's t (and other distributions of statistical importance),
- h) Stochastic control of economic processes.

Publications: D. P. Gaver and J. P. Lehoczky, "Channels that Cooperatively Service a Data Stream and Voice Messages," IEEE Transactions on Communications, Vol. COM-30, No. 5, pp. 1153-1161, 1982.

D. P. Gaver and R. G. Miller, "Jackknifing the Kaplan-Meier Survival Estimator for Censored Data," Communications in Statistics, A, forthcoming.

Publications:

D. P. Gaver and P. A. Jacobs, "Data Analysis and Modeling of Arctic Sea Ice Subsurface Roughness; A Summary," Proceedings of ONR Workshop Signal Processing in the Ocean Environment, Annapolis, May, 1982.

Title: Stochastic Analysis and Simulation

Investigator: P. A. W. Lewis, Professor of Operations Research and Statistics

Sponsor: Office of Naval Research

Objective: The purpose of this research is to develop models for the analysis of stochastic point processes and time series, develop new statistical methodology for use in the simulations which are required in mathematical statistics and in the analysis of stochastic systems, and to pursue stochastic modelling and data analysis for stochastic systems such as the Circadian sleep-wake process in mammals. This is a continuing program.

- Summary:
1. A structure in exponential variables which subsumes all previous work on exponential processes and gives second and third-order exponential autoregressive processes was delineated.
 2. The exponential time series work was applied to the delineation of simple multivariate exponential random variables.
 3. Work on the new Gamma time series model (GLARMA(p,q)) and solution of the problem of obtaining maximum likelihood estimates in the first-order case was completed.
 4. Analysis of 15 years of wind velocity data from Ship PAPA and modelling of this data with a non-stationary version of the Gamma model was completed.
 5. A method for doing residual analysis for non-normal time series with autoregressive correlation structure was discovered.
 6. A method for doing quantile estimation for systems simulation with dependent data was worked out.

Publications: P. A. W. Lewis and P. Heidelberger, "Quantile Estimation for Dependent Sequences," Operations Research, forthcoming.

P. A. W. Lewis and A. J. Lawrance, "Generation of Some First-Order Autoregressive Sequences of Positive Random Variables with Given Marginal Distributions," in Proceedings Applied Probability/Computer Science Conference, R. Disney, ed., forthcoming.

P. A. W. Lewis and A. J. Lawrance, "Simple Dependent Pairs of Exponential and Uniform Random Variables," Operations Research, forthcoming.

P. A. W. Lewis and P. A. Jacobs, "Stationary Discrete Autoregressive-Moving Average Time Series Generated by Mixtures," Journal of Time Series Analysis, forthcoming.

Publications:

P. A. W. Lewis and D. K. Hugus, "A New Gamma Process with Mixed Autoregressive-Moving Average Correlation Structure," in progress.

P. A. W. Lewis and D. K. Hugus, "An Analysis of Wind Velocity Data from Ship P," in progress.

P. A. W. Lewis, "A Residual Analysis for Non-Normal Time-Series with Autoregressive Correlation Structure," in progress.

P. A. W. Lewis and A. J. Lawrance, "An Exponential Structure for Time Series: Definition and Residual Analysis," in progress.

Conference Presentations:

P. A. W. Lewis, "Graphical and Statistical Methodology for Analysis of Circadian Rhythms in EEG States," Bay Area Biostatistics Colloquium, U.C. Berkeley, October 22, 1981.

P. A. W. Lewis, "Some Simple Models for Positive Valued Time Series," MIT Department of Civil Engineering, Hydrology Laboratories, December 3, 1981.

P. A. W. Lewis, "Graphical and Statistical Analysis of Sleep-Wake States in Mus Musculus," Harvard Biostatistics Department, December 4, 1981.

P. A. W. Lewis, "Graphical and Statistical Analysis of Sleep-Wake States in Mus Musculus," Office of Naval Research, December 7, 1981.

P. A. W. Lewis, "A New Exponential Time Series, NEAR(1)," North Carolina University, Joint Statistics/OR Seminar, December 8, 1981.

P. A. W. Lewis, "Simple Multivariate Time Series for Simulation of Complex Systems," 1981 Winter Simulation Conference, Atlanta, Georgia, December 10, 1981.

P. A. W. Lewis, "A Gamma Time Series Model, GLARMA(p,q), with an Application to the Analysis of Wind Velocity Data," Meteorology Department seminar, Naval Postgraduate School, April 13, 1982.

P. A. W. Lewis, "Quantile Estimation in Dependent Data," Operations Research Society of America Meeting, Detroit, Michigan, April 21, 1982.

P. A. W. Lewis, "Some Uses of Transformations in Simulation Studies," University of Birmingham-University of Wales Statistics Conference, Gregynog, Wales, April 25, 1982.

P. A. W. Lewis and A. J. Lawrance, "Simple Dependent Pairs of Exponential and Uniform Random Variables," Newark, New Jersey, May 1, 1982

P. A. W. Lewis, "A Gamma Time Series Model, GLARMA(p,q), with an Application to the Analysis of Wind Velocity Data," University of Paris, Institute of Statistics, May 3, 1982.

P. A. W. Lewis, "A Gamma Time Series Model, GLARMA(p,q), with an Application to the Analysis of Wind Velocity Data," IBM Research Center, Yorktown Heights, New York, May 24, 1982.

P. A. W. Lewis, "Some Simple Models for Positive Valued Time Series," IBM Systems Research Institute, New York, May 25, 1982.

P. A. W. Lewis, "A Gamma Time Series Model, GLARMA(p,q), with an Application to the Analysis of Wind Velocity Data," MIT Department of Civil Engineering, Hydrology Labs, May 26, 1982.

Thesis Directed: D. K. Hugus, "Extension of Some Models for Positive-Valued Time Series," Ph.D. Thesis, March 1982.

Title: Countered Minefield Planning: Area/Count Considerations

Investigator: Alan Washburn, Professor of Operations Research

Sponsor: Office of Naval Research

Objective: To investigate how the density of mines per unit area should depend on channel shape.

Summary: When the minefield is countered by sweeping, the density question cannot be separated from the question of mine count settings. It turns out that mines should be most dense and on the highest count settings at the narrowest part of the channel.

Publication: A. Washburn, "Countered Minefield Planning: Area/Count Considerations", NPS Technical Report, NPS55-82-013, April 1982.

Title: Research in Tactical Analysis

Investigators: A. R. Washburn, Professor of Operations Research, A. F. Andrus, Associate Professor of Operations Research, R. N. Forrest, Professor of Operations Research, P. A. Jacobs, Associate Professor of Operations Research, R. H. Shudde, Associate Professor of Operations Research

Sponsor: Office of Naval Research

Objective: To estimate the increase in the level of support of air HSW operations that would result from replacing the HP-67/97 programmable calculator system with a more advanced system.

Summary: The HP-41CV programmable calculator was one of the advanced systems studied. A LORAN-C position fixing algorithm was developed to take advantage of the advanced features of the HP-41CV system. This LORAN-C implementation was compared with an existing LORAN-C implementation for the HP-67/97 system. The LORAN-C algorithm was selected for this investigation because its massiveness is a critical test of the calculators' capabilities. A second evaluation was a student comparison of the HP-41CV and Casio FX702P systems.

Publications: R. H. Shudde, "Position Determination with LORAN-C Triplets and the Hewlett-Packard HP-41CV Programmable Calculator," NPS Technical Report, NPS55-82-022, September 1982.

R. H. Shudde, "A Comparison of the Hewlett-Packard HP-67 and HP-41CV Programmable Calculators," NPS Technical Report, NPS55-82-023, September 1982.

R. H. Shudde and R. N. Forrest, "A Comparison of the Hewlett-Packard HP-41CV and Casio FX702 Programmable Calculators," NPS Project Report, NPS55-82-025PR, September 1982.

Thesis Directed: W. D. Duym and E. S. Zapolski, "Comparison of the HP-41CV versus the HP-67," Master's Thesis, October 1982.

Title: Informal Progress Report on Cerenkov
Electron Beam Monitor Project at the Naval
Postgraduate School

Investigator: Fred R. Buskirk, Professor of Physics

Sponsor: Office of Naval Research

Objective: To develop microwave Cerenkov radiation
measurements as an electron beam monitor
for the Linac.

Summary: Preliminary experiments relating to this
project were started in Apr 1982 soon after
funding was received. The present
experiments measure the Cerenkov radiation
produced when electrons are moving faster
than the speed of radiation in a medium.
In this case the medium is air and the
radiation is at microwave frequencies
(almost all reported Cerenkov work has been
at optical frequencies).

The preliminary experiments indicate some
dependence of the signal on the bunch
length of the bunches of the electron beam
from the Linac.

To be useful as an electron beam monitor
for an FEL, the monitor should not degrade
the electron beam. Thus dielectric slab
detectors will be investigated later.

Thesis Directed: L. J. Brown, "Stimulated Cerenkov Radiation
Produced by 100 MeV Electrons", Master's
Thesis, December 1981.

Title: Reciprocity Calibration in Unconventional Geometries (Phase I)

Investigators: S. L. Garrett, Assistant Professor of Physics

Sponsor: Office of Naval Research

Objective: This project covers the first phase of a program designed to test extensions of the reciprocity method for absolute calibration of electroacoustic transducers beyond the traditional geometries. The first experiments will test both internal self-consistency and absolute accuracy of the method applied to plane wave resonators and travelling wave tubes.

Summary: At present, the initial contract has only been in operation for three months. During that time most of the equipment necessary for instrumentation, computer control, and the microphone translator has been ordered in anticipation of 1 Oct. 1982, when the contract will permit me to devote full time to this project. Substantial progress has already been made in the development of a computer controlled system which will acquire and process the electrical and acoustical signals for the reciprocity measurements. This system will measure and track resonance amplitudes, center frequencies, and quality factors automatically with far greater precision and reproducibility than possible with ordinary manual measurement procedures.

Conference Presentation: D. Conte, and S. Garrett, "Computerized Measurement and Tracking of Acoustical Resonances", Journal of Acoustical Society of America, 72, S82 (1982).

Title: Geomagnetic Field Fluctuations on the Ocean Floor

Investigators: O. Heinz, Professor of Physics, P. H. Moose, Associate Professor of Electrical Engineering, Dr. Michael Thomas, Postdoctoral Fellow

Sponsor: Office of Naval Research

Objective: The objective of this project is to obtain improved long term data and interpretations of the electromagnetic noise, particularly its spectral composition, spatial and temporal coherence and state of polarization.

Summary: Measurements of geomagnetic field fluctuations in the .01 to 10 Hz frequency range were carried out on the sea floor and on land using multicomponent coil magneto-meters. Data telemetry links allowed simultaneous recordings of PCM encoded data over 24 hour periods. Comparison of observed power spectral densities shows agreement with a simple model of the micropulsation field. The polarization characteristics of the observed field were analyzed in terms of Stokes parameters.

Theses Directed: M. P. Ames and L. M. Vehslage "Low Frequency Geomagnetic Flucations (.025 to 20 Hz) on the Floor of Monterey Bay," Master's Thesis, December 1981.

J. Schweiger "Evaluation of Geomagnetic Activity in MAD Frequency Band (.04 - .6 Hz)," Master's Thesis, September 1982.

Title: Collection System Performance Optimization Study

Investigator: Jeffrey B. Knorr, Professor of Electrical Engineering

Sponsor: Office of Naval Research

Objective: To determine the effects of emitter antenna characteristics on the intercept probability of a collection system.

Summary: A model for estimating intercept probability from system performance data has been developed. The gain statistics of various antennas have been investigated.

Publication: J. B. Knorr, "A Radiowave Receiving System Intercept Probability Model", IEEE Transactions on Aerospace and Electronic Systems, November 1982.

Theses Directed: Michael Scagnelli, "Computer Modeling of Reflector Antenna For Field Sidelobe Levels", Master's Thesis, December 1982.

Walter Varakin, "An Investigation of Antenna Gain Statistics", Master's Thesis, September 1982.

Title: Measurement of Natural Resonance Parameters for Radar Target Identification

Investigator: M. A. Morgan, Associate Professor of Electrical Engineering

Sponsor: Office of Naval Research

Objective: To advance the state-of-the-art in experimental and theoretical techniques for radar target identification through the use of natural resonances extracted from scattered echo signatures.

Summary: Theoretical and experimental work in the areas of target recognition and imaging via transient scattering responses has been an ongoing effort at the Naval Postgraduate School (NPS) for the past 3 years. This research was initially sponsored through the NPS Research Foundation and was first approached via direct target imaging. This continued effort, sponsored by ONR, utilizes natural resonances.

There are two particular aspects of this present endeavor. The first of these is the continued development and improvement of a computerized experimental facility which synthesizes wide-band resonance region radar returns, and then performs subsequent signal processing to stimulate the operations of proposed non-cooperative target recognition (NCTR) systems. A second important task will be to catalog the measured natural resonances of a wide variety of radar targets, which are of interest to the Navy, through the use of scale models.

Conference Presentations:

M. A. Morgan and C. W. Hammond, "Data Acquisition and Processing in Transient Scattering Measurements", 1981 IEEE/AP-S Symposium, Los Angeles, CA, June 1981.

M. A. Morgan and M. L. Van Blaricum, "Considerations of Resonance Extraction from Transient Scattering Measurements", 1982 National Radio Science Meeting, Boulder, CO, Jan 1983.

Theses Directed:

R. Davenport, "Natural Resonance Radar Target Identification", Master's Thesis, September 1982.

F. M. C. Manilha, "Investigation of Methods for Natural Resonance Radar Target Identification", Master's Thesis, December 1982.

Title: Reduced Order Characterization of Circuits and Systems/Nonlinear Fault Detection

Investigators: S. R. Parker, Professor of Electrical Engineering, C. W. Therrien, Visiting Professor MIT Lincoln Laboratories

Sponsor: Office of Naval Research

Objective: To investigate techniques for the macroscopic modeling of linear and nonlinear circuits and systems for purpose of performance analysis and fault detection.

Summary: During the report period research has been directed to the modeling of nonlinear systems using an adaptive Kalman identifier approach, and a discrete Volterra series approach. The latter approach has been shown to be contained within a two-dimensional impulse response solution, regardless of the order of the nonlinearity. This approach has been generalized using sensor notations and operations which are readily programmed. The research has also included the successful modeling and identification of a class of random processes, based upon a generalized likelihood ratio test involving a set of delay-lock loops. The latter problem is applicable to the identification of radar targets as well as other applications.

Publications: J. J. Thomas and S. R. Parker, "On the Analysis and Identification of Nonlinear Moving Average Systems", submitted to special issue of IEEE Transactions.

C. W. Therrien and S. R. Parker, "Discrimination of Random Delay Modulated Signals with Application to Target and System Identification", in progress.

S. R. Parker and A. Kayran, "Lattice Parameter Modeling of Two-Dimensional Signals", in progress.

Conference Presentations: S. R. Parker, "Multichannel Lattice Analysis and Synthesis Models", IFAC Symposium on Theory and Application of Digital Control, New Dehli, 1982, 6 pages.

J. J. Thomas and S. R. Parker, "Modeling Nonlinear Systems with a Discrete Volterra Series Expansion", Proceedings of the 25th Midwest Symposium on Circuits and Systems, Michigan Technology University, August 1982.

S. R. Parker, L. Mayoral and J. J. Thomas, "An Adaptive Kalman Identifier and Its Applications to Linear and Nonlinear ARMA Modeling", Proceedings of the 16th Int. Sciences and Systems Conference, Princeton, 1982, 6 pages.

C. W. Therrien, S. R. Parker and R. B. Leonard, "Discrimination of a Set of Delay Modulated Signals with Application to Radar Target Identification", Asilomar Conference on Circuits and Systems, November 1982.

Theses Directed:

A. I. Liaskos, "The Use of Transitional Formulations for Zero-Pole Modeling", Master's Thesis, March 1982.

R. B. Leonard, "Discrimination a Class of Nonstationary Signals", Master's Thesis, June 1982.

Title: Atmospheric Forcing on Ocean-Atmospheric Mixed Layer

Investigators: K. L. Davidson, Professor of Meteorology and
G. E. Schacher, Professor of Physics

Sponsor: Office of Naval Research

Objective: Couple micro-computer coded models for the ocean (OBL) and atmosphere (ABL) well mixed boundary layers and evaluate joint responses in each layer on basis of predicted radiation and kinetic energy transfer.

Summary: Separate ABL (Davidson, et al, 1983) and OBL (Garwood) micro-computer scaled models have been coded so they can be run simultaneously on a HP-9836 micro-computer. The primary identified effects of the coupled model prediction have been in the ocean regime wherein the radiation heating has a definite effect. The model has been tested on both clear and cloudy sky cases.

Thesis Directed: M. C. O'Loughlin, "Formulation of Coupled Ocean and Atmospheric Mixed Layer Model," Master's Thesis, December 1982.

Title: Relating Marine Aerosol Distribution to Oceanic Whitecaps

Investigators: K. L. Davidson, Professor of Meteorology, and G. E. Schacher, Professor of Physics

Sponsor: Office of Naval Research

Objective: To determine aerosol production per unit whitecap coverage on the basis of laboratory measurements and to relate open ocean aerosol data and whitecap coverage.

Summary: Analyses have been performed on data obtained in June 1980 over laboratory generated whitecaps at University College, Galway. Preliminary estimates were obtained of the produced aerosol size distributions as a function whitecap coverage (Monahan et al, 1982), based on data obtained in 1979. Aerosol size distributions obtained during JASIN (North Atlantic) experiment in 1978 have been interpreted relative to aerosol flux spectra (Fairall et al, 1982) and whitecap coverage (Monahan et al, 1983).

Publications: E. C. Monahan, K. L. Davidson, D. E. Spiel, "Whitecap Aerosol Productivity Deduced from Simulation Tank Measurements," Journal Geophysical Research, 87, 1982, 8898-8904.

C. W. Fairall, K. L. Davidson and G. E. Schacher, "An Analysis of the Surface Production of Sea Salt Aerosols," submitted to Tellus, 1982.

E. C. Monahan, C. W. Fairall, K. L. Davidson and P. J. Boyle, "Observed Inter-relationships amongst 10 m Elevation Winds, Oceanic Whitecaps and Marine Aerosols," submitted (revised) to Quarterly Journal Royal Meteorological Society, 1982.

Title: Oceanic Thermal Response to Atmospheric Forcing

Investigator: R. L. Elsberry, Professor of Meteorology

Sponsor: Office of Naval Research, Ocean Science Division

Objective: Understand and predict those changes in near-surface oceanic variables that are related to atmospheric forcing, especially on diurnal and synoptic time scales.

Summary: Oceanographic and meteorological observations and numerical simulations are used to understand the role of atmospheric forcing of the upper ocean layers. Initial tests with a data assimilation method appropriate for use with a bulk, oceanic mixed layer model have been published (Elsberry and Warrenfeltz, 1982). Estimates are being made of the errors in ocean thermal structure predictions at Ocean Weather Ship P due to incomplete or inaccurate initial data, and due to inaccurate atmospheric forcing. Ocean current measurements obtained by NAVOCEANO as hurricane Frederic passed have been compared with numerical simulations (Hopkins, Elsberry and Shay, 1982). Oceanic response to mid-latitude and equatorial atmospheric forcing has been demonstrated with Garwood's ocean model and a version of the UCLA general circulation model (Elsberry, Sandgathe and Winninghoff, 1982).

Publications: R. L. Elsberry and L. L. Warrenfeltz, "Data Assimilation Tests with an Oceanic Mixed Layer Model," Journal of Physical Oceanography, 12, 1982, 839-850.

R. L. Elsberry, S. A. Sandgathe and Francis J. Winninghoff, "Short-Term Oceanic Response Predicted by a Mixed Layer Model Forced with a Global Sector Atmospheric Model," 1982, submitted to Journal of Physical Oceanography.

Conference Presentations: D. Larsen and R. L. Elsberry, "Real-Data Tests of an Ocean Mixed Layer Model Assimilation Technique," Abstract, American Geophysical Union Annual Fall Meeting, San Francisco, December, 1981.

R. L. Elsberry and L. L. Warrenfeltz, "Analysis of Upper Ocean Thermal Structure Using a Data Assimilation Technique," Abstract, American

Geophysical Union Annual Fall Meeting, San Francisco, December, 1981.

C. K. Hopkins, R. L. Elsberry and L. K. Shay, "Ocean Current Response to Hurricane Passage," Abstract, American Meteorological Society Conference on Sea-Air Interaction, San Diego, CA, June, 1982.

S. A. Sandgathe, R. L. Elsberry and F. J. Winninghoff, "Ocean Thermal Response to a Global Sector Atmospheric Numerical Model," Abstract, American Meteorological Society Conference on Sea-Air Interaction, San Diego, CA, June, 1982.

Theses Directed:

D. G. Larsen, "Oceanic Data Assimilation Tests with a One-Dimensional Model," Master's Thesis, December, 1981.

C. K. Hopkins, "Ocean Response to Hurricane Forcing," Master's Thesis, June, 1982.

Title: Numerical Modeling of Large-Scale Ocean Variability

Investigator: R. L. Haney, Associate Professor of Meteorology

Sponsor: Office of Naval Research

Objective: To continually develop and improve a numerical model of the North Pacific Ocean circulation and to use the model to investigate large-scale variability in the upper ocean.

Summary: A ten-year hindcast of the large-scale temperature and currents in the Central Midlatitude North Pacific Ocean during 1969-78 has been carried out using a multi-level primitive equation ocean circulation model driven by observed (FNOG) winds and climatological heating. The results are being compared with the TRANSPAC temperature anomaly data and McNally's drifter data in order to investigate (1) the seasonal and interannual variability of the sea surface temperature, (2) the statistical relationship between the surface stress and the currents in the upper 200 m, and (3) the large-scale variability of temperature in the vicinity of the main thermocline.

Publications: D. Adamec, R. L. Elsberry, R. W. Garwood, Jr. and R. L. Haney, "An Embedded Mixed Layer-Ocean Circulation Model," Dynamic Atmosphere and Oceans, 5, 1981, 69-96.

R. L. Haney, M. S. Risch and G. C. Heise, "Wind Forcing Due to Synoptic Storm Activity over the North Pacific Ocean," Atmosphere-Ocean, 19, 1981, 128-147.

R. L. Haney, B. H. Houtman and W. H. Little, "The Relationship between Wind and Sea Surface Temperature Anomalies in the Midlatitude North Pacific Ocean," Atmosphere-Ocean, 21, 1983, forthcoming.

Conference Presentations: R. L. Haney and B. H. Houtman, "Wind and Sea Surface Temperature Anomalies in the North Pacific," American Geophysical Union Annual Fall Meeting, San Francisco, CA, December 7-11, 1981.

R. L. Haney, "Numerical Model Studies of the Mid-latitude North Pacific Ocean," Study Conference on Large-Scale Oceanographic Experiments in the World Climate Research Programme, Tokyo, May 10-21, 1982.

Title: Axial Compressor/Wave Rotor Studies

Investigator: Dr. R. P. Shreeve, Director, Turbopropulsion Laboratory Department of Aeronautics

Sponsor: Office of Naval Research

Objective: Two separate studies are involved: (i) to complete the development and application of a new experimental technique to measure the flow field from a high speed compressor rotor, and (ii) to examine the technology and potential of wave rotor devices for propulsion applications.

Summary: The "Dual Probe Digital Sampling" (or DPDS) techniques was successfully applied to map the velocity field at the rotor exit. With a second generation system of smaller probes it was shown from the redundancy inherent in the technique that the measurements were valid outside the unsteady rotor wakes and at the wake center. Methods to resolve the unknown uncertainty in regions of wake gradients and comparisons with LDV measurements are yet to be obtained. A Riemann program for preliminary design of wave rotor cycles was implemented.

The status of knowledge and methods for analyzing flows in wave rotors have been reviewed and will soon be reported.

Publications: R. P. Shreeve and F. Neuhoff, "Measurements of the Flow from a High Speed Compressor Rotor Using a Dual Probe Digital Sampling (DPDS) Technique," NPS Technical Report, NPS67-82-010, September 1982. (To be presented as a paper at the ASME 28th International Gas Turbine Conference, Phoenix, Arizona, March 27-31, 1983.)

S. Eidelman, A. Mathur, R. P. Shreeve and J. R. Erwin, "Application of Riemann Problem Solvers to Wave Machine Design," submitted to AIAA Journal for publication, August 1982.

Title: Studies of the Oceanic Planetary Boundary Layer

Investigator: Roland William Garwood, Jr., Associate Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To understand by means of numerical model studies in conjunction with data analyses the role of the oceanic planetary boundary layer (OPBL) in the distribution of energy, mass and momentum in the upper ocean.

Summary: Progress has been made in a number of areas: (i) A preliminary theoretical assessment has been made of the importance of planetary rotation on the redistribution of turbulent kinetic energy among directional components. This previously neglected process is believed to cause anomalous deepening/shallowing of the OPBL; (ii) Vertical mixing in the Bering Sea of biochemical tracers has been observed and simulated numerically in a prototype experiment. Future experiments of this type may provide valuable insight into the dynamics of turbulent mixing in the upper ocean; (iii) An initial attempt to incorporate satellite observations in modeling of the OPBL proved successful; (iv) Single-station forecasts of 1-D upper ocean thermal structure have been shown feasible on a desk-top computer. This should improve the ability of tactical environmental specialists to make real-time analyses and short-term forecasts for limited geographical areas; (v) An atmospheric planetary boundary layer model (APBL) has been coupled to the OPBL model in a collaborative effort with Professor Ken Davidson (Department of Meteorology).

Publications: R. W. Garwood, Jr., R. W. Fett, K. M. Rabe and H. W. Brandli, "Oceanic Frontal Formation Due to Shallow Water Cooling Effects as Observed by Satellite and Simulated by a Numerical Model," Journal of Geophysical Resources, 86 (C11), 11000-11012, 1981.

R. W. Garwood, Jr., and L. K. Coachman, 1982, "Entrainment of Nutrients and Tracers in the Surface Boundary Layer of the Bering Sea," Submitted to Journal of Physical Oceanography, 1982.

R. W. Garwood, Jr., "Use of a Desktop Computer for Local Upper Ocean Thermal Structure Forecasts,"

in Ocean Prediction--The Scientific Basis and the Navy's Needs, Ed. by C. N. K. Mooers, S. Piacsek and A. Robinson, 1982.

D. Adamec, R. L. Elsberry, R. W. Garwood, Jr., and R. L. Haney, "An Embedded Mixed Layer--Ocean Circulation Model," Dynamic Atmospheric Oceans, 6, 69-96, 1981.

Conference Presentations:

P. C. Gallacher and R. W. Garwood, Jr., "The Effects of Turbulent Mixing on SST Anomalies in the Central North Pacific," Fall Annual Meeting of the American Geophysical Union, San Francisco, December 1981.

P. C. Gallacher and R. W. Garwood, Jr., "A Study of Rotation Stress in the Turbulent Oceanic Planetary Boundary Layer," Fourth Conference on Ocean-Atmosphere Interaction of the American Meteorological Society, 1982.

Theses Directed:

W. A. Butler, "A Study of Sea Surface Temperature Variability," Master's Thesis, December 1981.

J. R. Burger, "Oceanic Mixed Layer Response to Tidal Period Internal Wave Motion," Master's Thesis, June 1982.

Title: Biology of Stone and Wood Boring Animals in the Monterey Submarine Canyon and the Deeper Waters off the Central California Coast

Investigator: E. C. Haderlie, Professor of Oceanography

Sponsor: Office of Naval Research

Objectives: To determine the vertical and horizontal distribution of stone and wood boring marine animals of the deeper waters of Monterey Bay and offshore, and to determine the rates of destruction of wood, stone, concrete and various plastics. To determine, if possible, the mechanisms used by bivalve molluscs in boring into hard stone.

Summary: During this past year arrays have been planted and retrieved from deeper water in the canyon. Wood borers are found in the deepest water sampled, yet living stone borers are limited to shallower water. Rates of growth have been monitored using radiography.

Publications: E. C. Haderlie, "Growth Rates of Penitella penita (Conrad, 1837), C. haceia ovoidea (Gould, 1851) (Bivalvia: Pholadidae) and Other Rock Boring Marine Bivalves in Monterey Bay," The Veliger, 24, October 1981, 109-114.

E. C. Haderlie, Fifth International Biodeterioration Symposium, Aberdeen, Scotland. Office of Naval Research, London, Conference Report C013-81 (December 1981).

Title: Dissipation of Kinetic Energy over the Slope off Vancouver Island

Investigators: Rolf G. Lueck, Adjunct Research Professor of Oceanography, William Crawford, Oceanographer, Tides and Currents, Institute of Ocean Sciences, Patricia Bay, British Columbia, Canada, and Thomas R. Osborn, Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To investigate the dissipation and intensity of turbulence over the continental slope and its relation to large scale--low frequency currents.

Summary: Thirteen profiles of the rate of dissipation of turbulent kinetic energy were made over the continental slope off Vancouver Island near the sites of current meters and tide gauges operated for the Coastal Ocean Dynamics Experiment (CODE). The general site is characterized by low levels of mean kinetic energy and shears. An examination of the current meter data demonstrates an absence or low level of eddies, tidal energy, mean currents, coastal waves, and large vertical scale shears. Below 300 meters, mean dissipation rates are the lowest ever observed and are dominated by sporadic events with vertical scales of less than 3 meters. The only identifiable energy source for the observed dissipation rates is the random super-position of internal waves. The observed internal wave energy spectrum agrees well with the 1975 model of Garrett and Munk and must have an e-folding time of approximately 40 days according to the dissipation rate observations.

Publication: Rolf G. Lueck, W. C. Crawford, and Thomas R. Osborn, "The Dissipation of Kinetic Energy over the Continental Slope," Submitted to the Journal of Physical Oceanography, 1980.

Title: Turbulent Dissipation around the North Pacific Subtropical Front

Investigators: Rolf G. Lueck, Adjunct Research of Oceanography and Thomas R. Osborn, Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To measure the three-dimensional distribution and intensity of turbulence as indicated by the rate of dissipation of kinetic energy, around the North Pacific Subtropical Front near 30°N and 154°W.

Summary: An intense survey of dissipation rates from the surface to 1100 meters depth was made around the subtropical front as a part of a multi-institutional study. The observations show the large horizontal gradients of heat, salt and density are converted into even larger but vertical gradients by the intrusion of denser surface water from the north side of the front under water on the south side of the front. The vertical depth of these intrusions appear to correspond to a maximum in the vertical wave-number spectrum of inertial oscillations implicating inertial waves as a mechanism for cross-frontal fluxes. The vertical turbulent diffusion of mass is being estimated from the dissipation rate observations to be compared (on an order of magnitude basis) against the cross-frontal fluxes.

Publication: Rolf G. Lueck, "Dissipation in the North Pacific Subtropical Front," Manuscript Report No. 38, Department of Oceanography, University of British Columbia.

Title: The Vertical Dissipation Profiler Camel IV

Investigator: Rolf G. Lueck, Adjunct Research Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To improve and further extend the capabilities of vertical turbulence profiling instruments known as CAMELS. In particular it is desired to have an instrument capable of obtaining CTD quality data in addition to turbulence measurements, that can record internally and telemeter digital data to the surface, and can profile to depths of 5000 meters. Such an instrument would be suitable for obtaining data in all oceanic environments particularly in the Gulf Stream where instrument limitations have in the past prohibited successful measurements.

Summary: The required electronics instrumentation has been developed and tested. It consists of a high speed 15 bit analog-to-digital converter, a hardwired controller that facilitates the multiplexing of 16 analog and 16 digital data channels and generates a RS-232 digital data stream for telemetry to the surface and/or internal recording on a portable stereo cassette recorder. A deck receiver for real-time monitoring of all data channels through digital-to-analog converters and communication with a DEC LSI-1123 computer in serial or parallel format. With the electronic design finalized the mechanical design of the pressure vessel, nose piece, ballast releases, launch and recovery mechanism is now in progress. A by-product of the development work to date is that the electronics are general enough to be used in a wide variety of data acquisition modes. In particular it will be transferred to T. Osborn for his work on horizontal profiling measurements.

Title: Eddies in the California Current System

Investigators: C. N. K. Mooers, Professor and Chairman of Oceanography, J. A. Smith, Research Adjunct Professor of Oceanography, and M. M. Rienecker, Research Adjunct Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To characterize synoptic scale eddies offshore of California.

Summary: Several oceanographic cruises have been undertaken to gather temperature and conductivity (salinity) data, with much finer station spacing than historical data in the region. Software for objective analysis and dynamic modelling are being developed for routine application in near-real time, both underway (as the data is gathered) and ashore (on the Naval Postgraduate School's IBM 3033 mainframe computer). The highly energetic, hitherto neglected mesoscale activity will be described, both statistically and by realization, and also the relationship with the larger-scale mean flow and topography should be brought to light.

Title: Horizontal Variability Effects on Optical Propagation in the Upper Ocean

Investigator: James L. Mueller, Adjunct Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To account for and test the effects of horizontal variability and advection in a model forecasting optical propagation in the upper ocean.

Summary: As part of the Office of Naval Research sponsored SRO project entitled, "Environmental Effects on Optical Propagation," the present project contributes a study of the effects of horizontal variability on predictions of downward vector irradiance propagation. A major goal of the parent program is the development and testing of an irradiance propagation forecast model for the upper ocean in support of the Navy's performance evaluation of the proposed Strategic Laser Communications (SLC) system. Efforts in 1982 emphasized acquisition and processing of CZCS data, and preparations for a major field experiment, the Optical Dynamics Experiment, to take place in the central NE Pacific ocean aboard the R/V ACANIA for 6 weeks in October-November 1982.

Title: Satellite Visualizations of Fronts and Eddies in the California Current

Investigator: James L. Mueller, Adjunct Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To understand how distributions of upper ocean optical properties, which produce visualizations of fronts and eddies in satellite images, are governed by ocean circulation and mixing processes in the California Current.

Summary: An ensemble of Coastal Zone Color Scanner (CZCS) images from the period May through November 1982 was acquired and is being processed into the form of derived maps of phytoplankton pigment (chlorophyll-a plus phaeopigments-a) concentrations and vector irradiance attenuation coefficients for the shelf-slope region between Pt. Arguello and Pt. Sur on the California Coast. Two cruises aboard the R/V ACANIA were used to gather preliminary optical, biological and physical oceanographic data to be used eventually for computing cross-correlations between sub-surface parameters and surface structure observed in satellite images.

Title: An Intercomparison of Horizontal and Vertical Turbulent Profiling

Investigators: Thomas R. Osborn, Professor of Oceanography, Rolf G. Lueck, Adjunct Research Professor of Oceanography, and Ann Gargett, Institute of Ocean Sciences, Patricia Bay, British Columbia, Canada

Sponsor: Office of Naval Research

Objective: To compare and contrast observations of the rate of dissipation of turbulent kinetic energy made by horizontal profiling using the USS DOLPHIN submarine and vertical profiling using the free fall vehicle CAMEL 11. To measure the horizontal coherence of turbulence features observed by vertical profiles and estimate the statistical reliability of vertical profiles.

Summary: Simultaneous observations of turbulence were made for 21 days in April 1982, about 20 miles off the California coast near San Diego. The USS DOLPHIN submarine was used to obtain horizontal profiles around the vertical profiles made by CAMEL 11 from the R/V ACANIA. The CAMEL was operated in a yo-yo mode; it was attached to the surface ship by a light-weight high-strength electro-mechanical kevlar cable. This facilitated frequent profiling (over 200) and real-time communication. Data analysis is in progress.

Title: Turbulence Measurements from U.S.S. DOLPHIN

Investigator: T. R. Osborn, Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To perform turbulence measurements from the U.S.S. Dolphin in conjunction with turbulence profiles from the R/V ACANIA. This work is designed to increase our knowledge of the role of turbulent processes in the ocean.

Summary: One month of joint operations with the DOLPHIN and ACANIA occurred in April 1982. Survey patterns from ACANIA using XBT's and a CTD were used to map the operational area off San Diego. Sixteen dives were made with the DOLPHIN and turbulence data corresponding to a linear distance of 200 miles was collected. When combined with the vertical profiles from ACANIA, we have a unique data set as well as the largest data set of ocean turbulence measurements. Analysis of the data is going well. The plan is to reduce the total data set while preparing initial publications on the system, salt fingers in the upper layer, and a selected series of frontal crossings.

Conference Presentation: T. R. Osborn, R. G. Lueck, and A. E. Gargett, "Turbulence Measurements from a Submarine," Joint Oceanographic Assembly, Halifax, Canada, August 1-14, 1982.

Title: Kinematics of Breaking Waves in the Surf Zone

Investigator: Edward B. Thornton, Professor of Oceanography

Sponsor: Office of Naval Research, Geography Branch

Objective: Basic studies are being made on the kinematics of breaking waves within the surf zone in the field. The specific objectives of the proposed research are: (1) determine breaking criterion as a function of depth, beach slope and wave frequency, and (2) determine the transformation of waves across the surf zone due to energy conversion and dissipation in the breaking process.

Summary: Research this past year emphasized the continued analysis of the results of the major field experiments at Torrey Pines, California and Santa Barbara, California, and the development of predictive models. A model describing the transformation of random wave heights was developed based on energy flux balance. Dissipation is considered due to wave breaking and bed friction. Wave breaking is characterized after periodic bores. The random nature of the wave heights is described starting with the Rayleigh distribution in deep water, but the modified distribution is itself the Rayleigh distribution. The model is compared both with laboratory results and an extensive set of field measurements collected at Torrey Pines Beach, California. The model is able to predict the increase in rms wave height due to shoaling and subsequent decrease due to wave breaking.

Publications: R. T. Guza, and E. B. Thornton, "Wave Set-up on a Natural Beach," Journal of Geophysical Research, 86, 4133-4137, 1981.

D. A. Huntley, R. T. Guza, and E. B. Thornton, "Field Observations of Surf Beat: Part 1, Progressive Edge Waves," Journal of Geophysical Research, 86, 1981.

E. B. Thornton, and R. T. Guza, "Longshore Currents and Bed Shear Stress," Proceedings of the Directional Wave Spectra Applications, '81 Conference, September 1981, pp. 238-256.

E. B. Thornton, and R. T. Guza, "Phase Speeds and Energy Saturation Measured on a Natural Beach," Journal of Geophysical Research, forthcoming.

E. B. Thornton, and R. T. Guza, "Transformation of Wave Height Distribution," submitted to the Journal of Geophysical Research.

R. T. Guza, and E. B. Thornton, "Velocity Moments in the Nearshore," submitted to the Journal of Coastal Engineering.

R. T. Guza, and E. B. Thornton, "Swash Oscillations on a Natural Beach," Journal of Geophysical Research, 87, p. 483-491, 1982.

Title: Satellite and Synoptic Studies of Chemical Fronts in the California Current and Coastal Upwelling Zone

Investigator: Eugene D. Traganza, Associate Professor of Oceanography

Sponsor: Office of Naval Research

Objectives: This project is part of a continuing research program in satellite and synoptic oceanography and ocean prediction. The objectives are: to describe and develop bio-chemical models of frontal systems in the upper ocean; to couple these models to remote sensing by satellites for the purpose of mapping and forecasting bio-chemical, acoustic and optical properties.

Summary: This year has been a period of transition following the culmination of several years of successful work which produced the discovery of coastal cyclonic upwelling systems and giant plumes off Pt. Sur, California, the first sea surface nutrient maps derived from satellite measurements, the first report of these chemical maps in combination with satellite-derived phytoplankton maps revealing a general relationship between chemical gradients and biomass in the upper ocean. During this year the project was without an assistant. However, Adjunct Professor Dr. D. G. Redalje was recruited at SIO where Dr. Traganza was on sabbatical. A sub-contract was let with Dr. John Van Leer, RSMAS to collaborate on the design of a 2nd generation towed ocean water sampling system (TOSS-2). TOSS-1 was used in a 3-D mapping experiment to investigate the extent to which surface information from satellites can be extrapolated over depth. The satellite depth was processed by Dr. Traganza at the Scripps Satellite Oceanography Facility. Continuing interest in the project was evidenced by invitations to speak at the IUGG in Hamburg, AGS in Seattle, NORDA in Bay St. Louis and to join the University of Rhode Island in a trace metal study off Peru in December 1983.

Publications: E. D. Traganza, V. M. Silva, D. M. Austin, W. E. Hanson and S. H. Bronsink, "Nutrient Distribution and Recurrence of Coastal Upwelling Centers by Satellite Remote Sensing: Implications to Primary Production and the Sediment Record," NATO Advanced

Research Conference on Coastal Upwelling: Its
Sediment Record, Plenum Press, 1982.

E. D. Traganza, "Design Requirements for a Towed Oceanwater Sampling System (TOSS)," NPS Technical Report, forthcoming.

Conference
Presentations:

E. D. Traganza, "Satellite and Synoptic Studies of Chemical Fronts," Invited Talk, Environmental Sciences Division, Naval Research Laboratory, Washington, D. C., October 1981.

E. D. Traganza, "Satellite and Synoptic Studies of Chemical Fronts," Invited Talk, Atlantic Meteorological and Oceanographic Laboratory, Virginia Key, Miami, Florida, December 1981.

E. D. Traganza, "Satellite and Synoptic Studies of Chemical Fronts," Invited Talk, Institute of Marine Resources, UCSD Scripps Institution of Oceanography, La Jolla, California, February 1982.

Thesis Directed:

V. M. Silva, "Thermal Calibration of Satellite Infrared Images and Correlation with Sea Surface Nutrient Distribution," Master's Thesis, June 1982.

Title: Countercurrents and Eddies in the California Current System

Investigator: A. J. Willmott, Assistant Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To understand how low frequency topographic Rossby waves contribute to the dynamics of eastern boundary current systems. Large scale bottom topographic features such as the Mendocino Escarpment act as an oceanic wave guide for topographic Rossby waves, and it is hoped to understand how the circulation is influenced by the presence of these waves.

Summary: A study of the flow past headlands, bays and multiple headlands and bays has been completed and accepted for publication. The dynamics of unforced trench waves in an ocean trench located on a mid-latitude beta-plane has also been completed. A model for the generation of the forced internal double Kelvin waves in a 2-layer ocean over Mendocino escarpment is near completion. An extension of this calculation involving a semi-infinite escarpment is underway with Prof. Latta (Mathematics, NPS) and Dr. M. Rienecker (Oceanography, NPS).

Publications: A. J. Willmott, "The Influence of a Coastal Headland on Oceanic Boundary Currents," Geophysical and Astrophysical Fluid Dynamics, Forthcoming.

A. J. Willmott, and A. A. Bird, "Freely Propagating Trench Waves on a Beta-plane," Submitted to Journal of Physical Oceanography.

A. J. Willmott, and A. A. Bird, "Freely Propagating Trench Waves on a Beta-plane," Ocean Modelling, Forthcoming.

Conference Presentations: A. J. Willmott, "The Influence of a Coastal Headland on Oceanic Boundary Currents," EPOC Meeting, Idyllwild, CA., October 29-31, 1981.

A. J. Willmott, "The Influence of a Coastal Headland on Oceanic Boundary Currents," Fall AGU Meeting, San Francisco, December 7-11, 1981.

A. J. Willmott, "Freely Propagating Trench Waves on a Beta-plane," 16th Annual Congress of CMOS, 26-28 May, 1982.

A. J. Willmott, "Freely Propagating Trench Waves on a Beta-plane," JOA, Halifax, Canada, 2-13 August, 1982.