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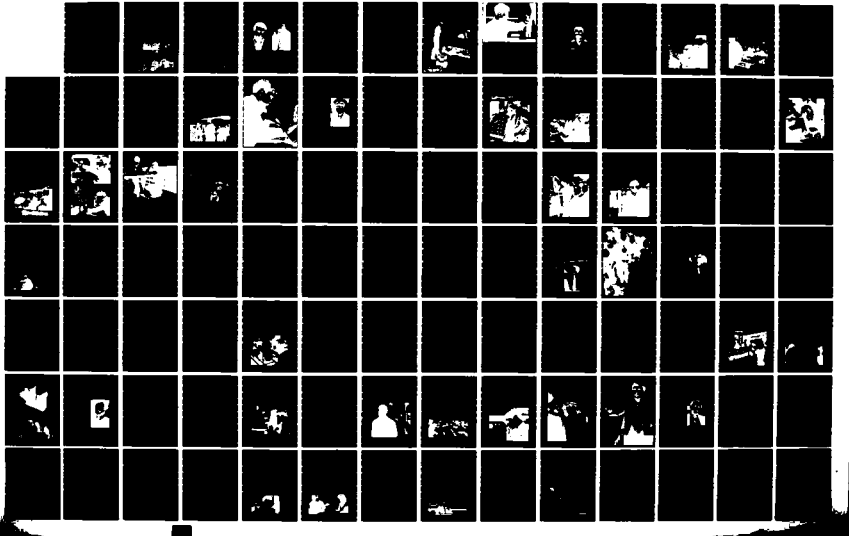

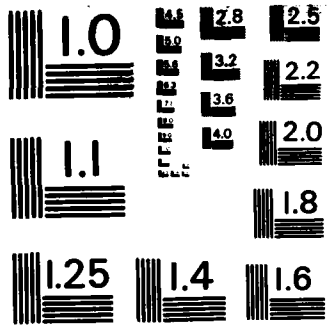

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SUMMARY OF RESEARCH

ACADEMIC DEPARTMENTS

1982 - 1983

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1982 - 1983

COMPILED AND EDITED

BY

PROFESSOR WILSON L. HEFLIN

ENGLISH DEPARTMENT

OCTOBER 1983

UNITED STATES NAVAL ACADEMY

ANNAPOLIS, MARYLAND

21402

BRUCE M. DAVIDSON
Academic Dean

RICHARD D. MATHIEU
Director of Research/
Associate Dean

Foreword

The academic excellence of an educational institution is measured by the achievements of its faculty in teaching, research, and related scholarly endeavors. It is the policy of the Naval Academy to provide and maintain an environment in which research activities that contribute to the professional growth of the faculty and outstanding midshipmen may flourish.

The research activities of the faculty range from very applied cooperative studies with the Navy research and development community to very fundamental investigations concerned with extending the frontiers of knowledge. The broad scope of research described in this annual report reflects the interests and expertise of the participating faculty and midshipmen, as well as the availability of laboratory, library, and computer facilities.

This publication was compiled to acquaint the reader with faculty and midshipmen research efforts being done behind the classroom scene. Research results are published in manuscripts, reports, and prestigious journals as well as presented at important professional meetings and conferences. In addition to their teaching and research, the faculty contribute to their profession through participation in professional societies and consulting activities. This publication contains summaries of completed and on-going faculty projects, midshipmen research course projects including the Trident Scholar Program, and lists of presentations and publications. The work reported on was conducted during the period July 1982 through June 1983.

External support continues to increase significantly. This is undoubtedly due to the additional opportunities provided by new laboratory facilities and the initiative of the well-qualified civilian and military members of the faculty. It is important to acknowledge the strong and continuous support provided by the Chief of Naval Research, Director of Navy Laboratories and the numerous activities of the Naval Material Command, without which such progress could not be possible.

Comments and suggestions related to the research efforts will be gratefully received and sincerely appreciated.

Bruce McDavidson

BRUCE M. DAVIDSON
Academic Dean

Richard D Mathieu

RICHARD D. MATHIEU
Director of Research/Associate Dean

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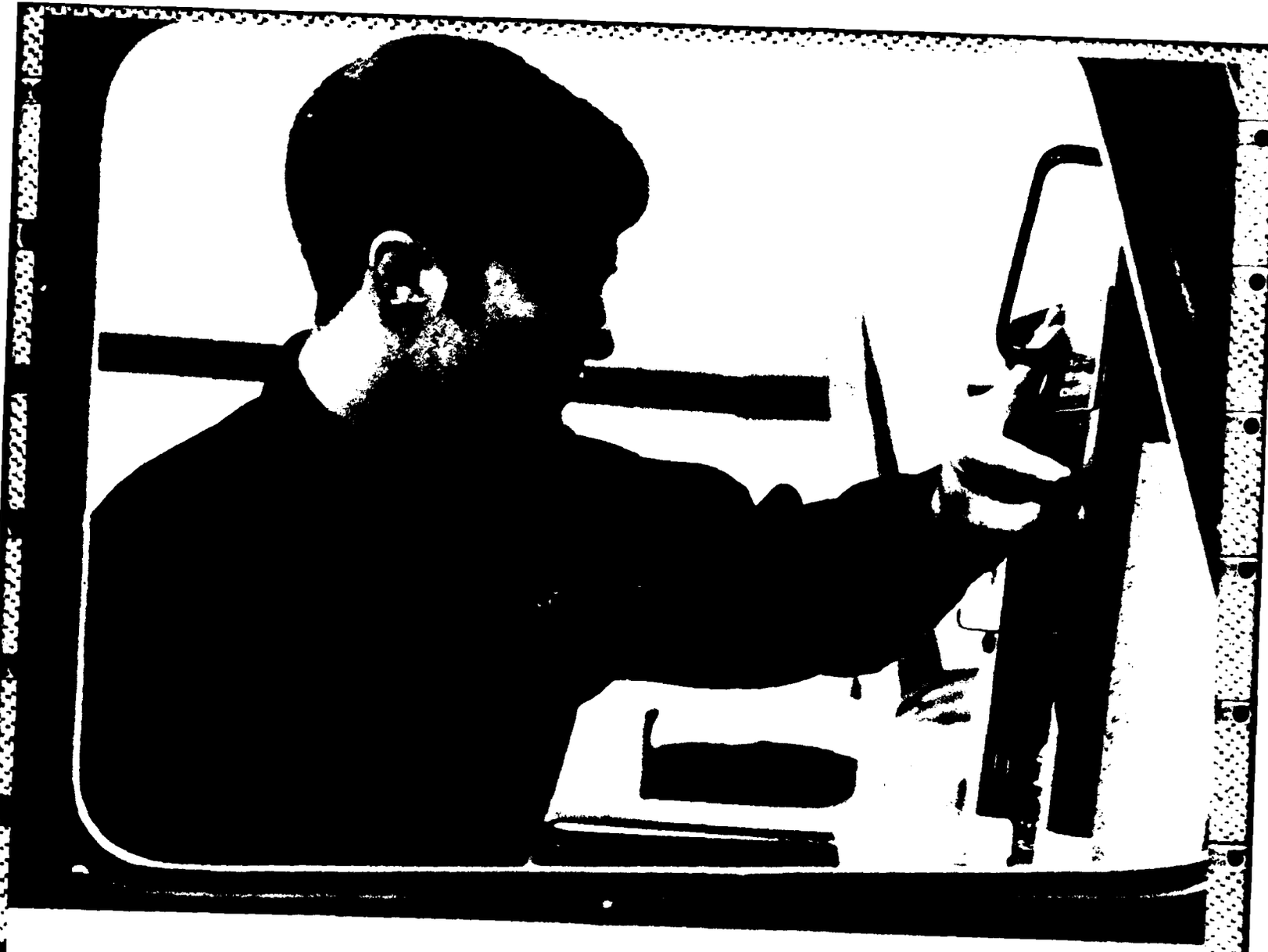
Engineering



DEPARTMENT OF

Aerospace Engineering

COMMANDER PAUL B. SCHLEIN, USN
CHAIRMAN

Research is an important element of the Aerospace Engineering Department and Major. It is necessary to maintain the faculty's vigor and quality. Further, it allows the Academy to show its mettle in professional and academic forums. Finally, research brings the process of education into a full circle of experience, frustration and, occasionally, discovery.

Much of this department's research is supported by the Naval Air Systems Command in a continuing program of that command's interest in the quality of the education to which the young naval officer is exposed.

Sponsored Research

Non-Linear Finite Element Structural Analysis

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM J. BAGARIA
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The non-linear finite element structural analysis program GIST is currently under development. This research involves the mathematical modeling of several structures using the GIST program. The math model is then used to predict buckling loads. These buckling loads are then compared to other analysis techniques and to testing of small scale test articles. Currently, the GIST program is being used to model submarine hulls and aircraft fuselages.

Modeling techniques were developed in order to efficiently input the data into the GIST program.

Computer Aided Hull Design and Model System

RESEARCHER: PROFESSOR DAVID F. ROGERS
SPONSOR: U. S. COAST GUARD

A Computer Aided Design/Computer Aided Manufacturing (CADCAM) system for the design of ship hulls and the production of towing tank models is being developed. The design portion of the system is implemented on and supported by a three-dimensional interactive graphics device and a minicomputer. A microprocessor-based stand-alone graphics device simply, directly, and inexpensively interfaced to the CNC controller on the shop floor is used to provide support for the manufacturing portion of the system. A program running in the microprocessor based graphics system provides all postprocessing, a graphical display for the machine operator, and drives the machining center. All functions are accomplished on-the-fly in real time. All hardware components of the system are off the shelf items. Experiences with actual use of the system in both design and production are discussed.

Model Propeller Production

RESEARCHER: PROFESSOR DAVID F. ROGERS
SPONSOR: U. S. COAST GUARD

A CAD/CAM system used in the manufacture of airfoil type blades, such as those used for turbines for propellers, is being developed. Computer Graphics is used to define the blade. Computer Graphics is used 'on-line' during the acutal Numerically Controlled (NC) Milling of the blade. A number of techniques for cutting a set of complex three-dimensional contour shapes (blades) attached to a central hub as a single unit using a three-axis milling machine are being investigated. The use of a small desk-top computer with both storage tube and limited refresh graphics capabilities (Tektronix 4054) both in the design and in the direct computer control of the numerically controlled milling machine is being investigated. During the design phase, data suitable for the creation of a "wire frame drawing" is generated. This "wire frame" data is used as the

input for the manufacturing phase; no separate part programming is used. From the output of the design phase, which is stored on a small magnetic tape cartridge, the 'on-line' post-processor calculates the tool paths including the necessary checks for "hidden planes" required to drive the NC milling machine. The 'on-line' post-processor also performs all other traditional numerical control post-processor functions. The computer sends commands directly to the NC machine while graphically displaying the part drawing and the next tool movement. This application is typical of a model shop in a research and development environment where fast turn-around and accuracy are required.

Mastless Sails

RESEARCHER: PROFESSOR MAIDO SAARLAS
SPONSOR: NAVAL SEA SYSTEMS COMMAND

A feasibility and proof-of-concept study was carried out to determine the ability of parafoils and parafoil-sail combinations to provide both propulsive and payload lifting capability. This concept can be useful in enhancing search and rescue efforts of downed pilots or sailors in life rafts or small boats and also provide motive power for small boats. The results indicate that such a parafoil-sail system is entirely useful and practical. Additional work is needed to determine the practical range of usefulness of this system.

Independent Research

Non-Linear Glider Buckling

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM J. BAGARIA

Scale model aircraft fuselage cylinders are being fabricated and tested to determine their buckling behavior. The test results are being correlated with the predictions from the non-linear finite element program GIST. The purpose is to determine if the non-linear programs can accurately predict the actual buckling modes and collapse loads.

Subsonic Wind Tunnel Turbulence Survey

RESEARCHER: ENSIGN THOMAS L. MASCOLO
ADVISER: ASSISTANT PROFESSOR JOHN E. ALLEN

The purpose of this work was to document the operation of the Subsonic, Closed-Circuit Wind Tunnel in the Aerospace Engineering Laboratory. The feasibility of participating in the "ONR Low Reynolds Number (.5 x 10) Aerodynamics" program using this tunnel is being investigated. A velocity profile and turbulence distribution were needed from the tunnel test section. The primary objective of this work was, therefore, to obtain accurate values of velocity and turbulence at several grid points in the test section.

Research Course Projects

A Wind Tunnel Image System for Wake Studies

RESEARCHER: MIDSHIPMAN 1/C MICHAEL J. EDDY
ADVISER: ASSISTANT PROFESSOR JOHN E. ALLEN

To further improve the capabilities of the Subsonic Wind Tunnel, a mechanism was designed and built to permit the externally controlled measurement of local flow field parameters. At nine discrete streamwise locations, the tunnel can be transversed in two-foot-square grids. Software was developed to automatically position the probes used and reduce the resulting measurements. A total head survey of the tunnel test section was completed to show that the probe system does not disturb the flow characteristics, and representative results were obtained to validate the system's application.

Low Speed Analysis of An "X-Wing" Aircraft

RESEARCHER: MIDSHIPMAN 1/C KENNETH C. FITZPATRICK
ADVISER: ASSOCIATE PROFESSOR VADYM V. UTGOFF

This project is designed to investigate the lift, drag, and moment characteristics of an X-wing design model, with two forward-swept wings (negative dihedral) and two aft-swept wings (positive dihedral). Also, these characteristics are used to determine whether the design is statically stable in the pitch model. A theoretical estimate is made on the lift characteristics, and the model was found to be within 67 percent of this theoretical estimate. The model can be made statically stable by locating the center of gravity approximately 7 inches aft of the datum (the nose). However, the reader should be aware that the initial calculations for the wing areas are too large by a factor of 12; thus all lift, drag and moment coefficients are too small by a factor of 12.

Computational Fluid Mechanics

RESEARCHERS: MIDSHIPMEN 1/C RAYMOND HERB AND THOMAS SPRIESTERBACH
ADVISER: ASSISTANT PROFESSOR JOHN E. ALLEN

A Navier Stokes finite difference Code "Teach-T" was obtained from Imperial College and adapted to the Naval Academy Time Sharing System and Computer Aided Design Interactive Graphics Group UNIX systems. The program allows for calculations of the field details for 2-D and axisymetric recirculating flows. During the semester the necessary modifications and documentation were completed to give a general purpose program, which can be used by other researchers for numerical parametric flow field studies. Also developed were output diagnostic plots which utilize the computer graphic capabilities of CADIG to greatly enhance the understanding of the flow phenomena.

The Effect of Pneumatic End Caps on Rotor Efficiency

RESEARCHER: MIDSHIPMAN 1/C FREDERIC LASTAR
ADVISER: LIEUTENANT COMMANDER RICHARD A. EVERETT, USN

The project was to develop a pneumatic tip cap system for a rotor blade that had the capability of readily changing nozzle configurations. Then a method of using the laser doppler anemometer to map the static velocity profile about the nozzles was to be found, and the velocity profiles explored. The tip cap system was developed. The laser to be used was found to be too weak to measure the velocity profiles at the nozzles, and a pitot rake was used instead. The system was tested at a pressure of 50 psi. The velocity profiles were compared to those that were predicted for that pressure. It was found that the mass flow limited the velocities greatly, and, if further exploration into this system is to be done, some means of greatly increasing the mass flow must be found.

Innovative Design and Structural Analysis of A Delta Wing

RESEARCHER: MIDSHIPMAN 1/C CAMERON A. SEN
ADVISERS: ASSOCIATE PROFESSORS WILLIAM J. BAGARIA AND VADYM V. UTGOFF

The purpose of this project was to use rational engineering methods to determine the aerodynamic performance and structural integrity of a new delta wing hang glider. Some of the aerodynamics design parameters investigated were: a. wing area, b. plan form shape, c. stall speed, d. minimum single speed, and e. glide ratio.

A stress analysis was conducted in order to size the structural members.

An Analysis of The Performance of Static Stability of Kites

RESEARCHER: MIDSHIPMAN 1/C WALLACE DEAN SMITH
ADVISER: ASSOCIATE PROFESSOR VADYM V. UTGOFF

An analysis of the performance and static stability of kites has been made. Kites have been classified into four basic configurations, with the effect of set modifications on these configuration and their influence on stability being evaluated. Finally, these modified configurations are rated on stability, as defined by lateral and directional stability derivatives, versus performance, as defined by a maximized lift-to-drag ratio.

Publications

ALLEN, John E., Assistant Professor, and Eugene L. KEATING, Associate Professor (Mechanical Engineering), "**Diesel Fuel Saver Test and Evaluation**," Division of Engineering and Weapons Report EW-19-82, August 1982.

A short test and evaluation sequence was conducted on a thermal fuel preconditioning system to evaluate its usefulness in enhancing the fuel economy of the Navy's diesel engines. Results were presented for tests run using a modified single-cylinder CFR engine and a two-cylinder, two-stroke GM 2-71 diesel engine. At relatively high coolant operating temperatures, brake specific fuel consumption would be reduced on the order of 4-5% with no significant loss in power output. Further studies were found to be necessary in assessing the long-term effects of such operating conditions on engine wear and performance.

POURING, Andrew A., Professor, and Eugene L. KEATING, Associate Professor (Mechanical Engineering), "**Internal Regenerative Air Standard I.C. Engine Cycle Performance**," AIAA Paper No. 82-1281, June 1982.

The limited success of thermodynamic regenerative gas power cycles is well known and is due, in part, to the heat transfer performance of the required external regenerator. In this work the thermodynamic characteristics of internal regeneration occurring within a piston-cylinder geometry is considered. By use of a constant temperature internal regenerative reservoir, heat can be absorbed from the hot gases and later be rejected to the cooler intake charge. The parametric study considered the influence assumed regeneration mechanisms have on the predicted indicated engine performance. Values for the cycle state points, as well as mean effective pressure and thermal efficiency, were obtained from the analysis as a function of variations in compression ratio, heat input, and regeneration mode.

POURING, Andrew A., Professor, and Bruce H. RANKIN, Professor (Naval Systems Engineering), "**Time Dependent Analytical and Optical Studies of Heat Balance Internal Combustion Engine Flow Fields**," AIAA Paper No. 82-1283, June 1982.

Comparison is made of the nonsteady combustion and flow processes predicted by the method of characteristics for time-dependent compressible flow in a heat balanced engine (divided combustion chamber), with flow fields observed by high-speed Fastex Schlieren and holographic interferometry. Pressure exchange and the accompanying mass transport are demonstrated analytically and observed optically. Qualitative agreement between the initial top dead center calculations and photographic evidence is seen. Schlieren and interferometer records give typical combustion flow-field interactions through all strokes of an operating four-stroke, glass-walled, two-dimensional engine. At least four modes of time-dependent combustion are identified over the entire power stroke and the influence of geometry on the control of combustion chamber pressure and temperature is discussed.

POURING, Andrew A., Professor, John E. ALLEN, Assistant Professor, and Eugene L. KEATING, Associate Professor, (Mechanical Engineering), "**Heat Balanced I.C. Engine Transition Studies**," AIAA Paper No. 82-1116, June 1982.

A spark ignition cooperative fuel research engine was used to extend previous gasoline parametric studies of the heat balanced piston engine concept to operation using both JP-5 (jet fuel) and diesel fuel. The limits of stable spark ignition operation were explored over a range of compression ratio, RPM and air/fuel ratio. Transition to carbureted compression ignition combustion was encountered with results mapped for optimum operation as well as limits located for the performance envelope. These carbureted results at relatively low compression ratios indicate the possibility of compression ignition operation using the heat balanced piston when adapted to a direct injection engine.

ROGERS, David F., Professor, co-author, "**Color Graphics and Ship Hull Surface Curvature**," *ICCAS 82 Proceedings*, June 1982.

B-Spline surfaces are often used as a mathematical representation of surfaces for computer-aided ship design. Determining the fairness of such surfaces is an important aspect of hull design. The Gaussian curvature of a surface has been suggested as a useful measure of surface fairness. This paper describes a method for using color computer graphics to display the Gaussian curvature of B-spline surfaces. Expressions for computing the required partial derivatives are given, along with examples both for test surfaces and for ship hulls. The method appears to be an effective means for analyzing surface behavior and, thus, has potential as a useful design tool.

ROGERS, David F., Professor, and Steven G. SATTERFIELD, Computer Systems Analyst "**Dynamic B-Spline Surfaces**," *ICCAS 82 Proceedings*, June 1982.

B-Spline surface descriptions for ship hulls are powerful and flexible. Both smooth surfaces and surfaces with discontinuities (knuckles or hard chines) may be described. Interactive techniques for generating and modifying these surfaces in real time are of interest. A fast incremental algorithm for generating a new B-spline surface from a defining polygon net is described. The algorithm allows dynamic real time rubber sheeting of moderately complex B-spline surfaces. Techniques for automatically fitting B-spline surfaces to known data are also of interest. A simple method is presented. The method cannot automatically generate surfaces with discontinuities. However, it is useful as a starting point for subsequent interactive modification using dynamic real time rubber sheeting.

ROGERS, David F., Professor, Steven G. SATTERFIELD, and Francisco A. RODRIGUEZ (both, CADIG Group), "**Shiphulls, B-Spline Surfaces and CADCAM**," *Intergraphics 83 Proceedings*, April 1983.

A Computer-Aided Design/Computer-Aided Manufacturing (CADCAM) system for the design of ship hulls and the production of towing tank models is described. The design portion of the system is implemented on and supported by a three-dimensional interactive graphics device and a minicomputer.

The hull surface is modeled using B-spline surfaces. Both smooth surfaces and surfaces with internal discontinuities (knuckles and hard chines) may be modeled. The use of a fast incremental algorithm for modifying these surfaces dynamically in real time (rubber sheeting) is described for real ships. The use of color graphics to display the Gaussian curvature of the surface for fairness determination is described for real ships. A simple algorithm for obtaining accurate sections or contours of B-spline surfaces is described. Its use on real ship hulls in a towing tank model production environment is described.

A microprocessor driven, stand-alone graphics device simply, directly, and inexpensively interfaced to the CNC controller on the shop floor is used to provide support for the manufacturing portion of the system. A program running in the microprocessor-based graphics system provides all post-processing, producing a graphical display for the machine operator and drives the machine center. All functions are accomplished on-the-fly in real time.

The integration of these systems into a computer integrated manufacturing system for the production of wooden towing tank models is described.

SAARLAS, Maido, Professor, and Sidney E. VEAZEY, Captain, USN (Naval Systems Engineering), "**Mastless Sails**," Division of Engineering and Weapons Report EW-11-83, December 1982.

This proof-of-concept endeavor demonstrates the feasibility of using a parafoil, sometimes in combination with a balloon, to raise spinnaker sails to significant altitudes to reach the stronger winds. The Arab oil crisis in 1973 stimulated the ideas for these mastless sails. Early experiments using a ballon and a small spinnaker indicated that these concepts would work. In 1982, funds were obtained from Naval Sea Systems Command and the Navy Energy Office to pursue further proof of concept tests and seek improvements with these mastless sails. Several parafoils of the type used by sports parachutists were used as a vertical lifting device under which a spinnaker sail or regular parachute was hoisted to give a sailboat or a power boat propulsion. This system can be used as an emergency propulsion system for a boat or a ship as well as an auxiliary propulsion system to use when the wind speeds are strong and steady such as on a trade wind route. Furthermore, the parafoil can be used to hoist various recognition and signaling devices in times of emergencies. Testing was carried out using a catamaran, a 32-foot sailboat, Navy 36-foot mine sweeper light (MSL), a houseboat, a lift raft and a yard patrol craft (YP).

Presentations

POURING, Andrew A., Professor, John E. ALLEN, Assistant Professor, and Eugene L. KEATING, Associate Professor (Mechanical Engineering), "**Heat Balanced I.C. Engine Transition Studies**," Paper No. 82-1116, AIAA SAE ASME 18th Joint Propulsion Conference, Cleveland, Ohio, 21-23 June 1982.

POURING, Andrew A., Professor, and Bruce H. RANKIN, Professor (Naval Systems Engineering), "**Time Dependent Analytical and Optical Studies of Heat Balanced Internal Combustion Engine Flow Fields**," AIAA Paper No. 82-1283, AIAA SAE ASME 18th Joint Propulsion Conference, Cleveland, Ohio, 21-23 June 1982.

POURING, Andrew, A., Professor, and Eugene L. KEATING, Associate Professor (Mechanical Engineering), "**Internal Regenerative Air Standard I.C. Engine Cycle Performance**," AIAA Paper No. 82-1281, AIAA/SAE ASME 18th Joint Propulsion Conference, Cleveland, Ohio, 21-23 June 1982.

ROGERS, David F., Professor, "**Dynamic B-Spline Surfaces**," International Conference on Computer Applications in the Automation of Shipyard Operation and Ship Design (ICCAS '82), Annapolis, Maryland, 7-10 June 1982.

ROGERS, David F., Professor, co-author, "**Color Graphics and Ship Hull Surface Curvature**," International Conference on Computer Applications in the Automation of Shipyard Operation and Ship Design (ICCAS '82), Annapolis, Maryland, 7-10 June 1982.

ROGERS, David F., Professor, "**Shiphulls, B-Spline Surfaces and CADCAM**," Japan Computer Graphics International Conference and Exhibition (Intergraphics 83), Tokyo, Japan, 11-14 April 1983.

UTGOFF, Vadym V., Associate Professor, "**The Anelastic Compliant Rotor — An Analytic and Experimental Investigation**," Eighth European Rotorcraft Forum, Aix-en-Provence, France, 31 August - 3 September 1982.

DEPARTMENT OF

Electrical Engineering

COMMANDER DAVID L. LUCK, USN
CHAIRMAN

Provision of a technically current education in any academic discipline requires that the faculty be professionally active and currently contributing to the general body of knowledge in their field. This is particularly true in a fast developing technical area such as electrical engineering. The research program serves to keep the faculty actively involved in the development of the discipline and therefore contributes directly to the quality of electrical engineering education for midshipmen. A related benefit is the opportunity for some midshipmen to participate directly in research projects under faculty guidance.

Sponsored research within the department is supported by Naval Research Laboratory (NRL), David Taylor Naval Ship Research and Development Center (DTNSRDC), and internally within the Academy. Not noted within this year's abstracts is the receipt of two AN/UYK-20 computers, plus required peripherals from PSM-408, and the arrangements for loan of the Canadian Forces data bus system. This combination of equipment will provide a basis for significant research next year and in the future. The availability of this system will likewise benefit the midshipman undergraduate program in electrical engineering through introduction of an actual fleet computer system.

The general character of research problems currently being investigated by the faculty is related directly to existing fleet problems. The results of these efforts contribute directly to our operating forces and introduce midshipmen to relevant topics which benefit their professional as well as academic development.

Sponsored Research

Ultrasonic Nondestructive Testing

RESEARCHER: VISITING RESEARCH PROFESSOR RODNEY J. BARNHART
SPONSOR: NAVAL RESEARCH LABORATORY

The researcher was a participant in a multi-faculty research effort to develop an ultrasonic transducer, signal acquisition and processing, and color graphics display of pipe mechanical characteristics (thickness, deformities, irregularities) to provide a nondestructive means to analyze and predict expected wear and life for use in boilers of naval propulsion systems. Duties included development of display system software and publication of test and analysis results and procedures. Approximately half of his time was spent in this task.

Transducer Impedance Measurement System

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM E. BENNETT
SPONSOR: NAVAL RESEARCH LABORATORY

The objective in this research project was to design a computer-controlled system to measure the impedance of transducers. The impedance measurement was carried out by sampling various input signals to the transducer and calculating the impedance with the aid of a fast Fourier transform. A primary research effort for this system required the design of a high speed data acquisition system operating at a sampling rate of 30 MHz. This data acquisition system was designed using Schottky TLL logic gates and a TRW flash A/D converter. A variable data window was included to store in a RAM a particular segment of 1024 data samples.

CAD for Advanced Concept Motors

RESEARCHER: PROFESSOR FRANCIS J. EBERHARDT
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

This project was related to advanced concept propulsion machine design. The objective was to convert the existing design program to be user interactive to facilitate use by engineers not involved in software development. This was accomplished. Future work will be developing new design programs.

Wear Particle Detection By On-Line Ultrasonics

RESEARCHER: LIEUTENANT COMMANDER SAMUEL E. GIUOCO, USNR
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

The researcher was involved in non-destructive testing research. The main objective was to develop a sensor to detect wear particles in lubricating and hydraulic oils while on-line. This sensor would require no equipment shutdown and would allow constant monitoring of any wear particles that might show up in all lubricating, hydraulic, and cooling systems on any ship. Development and implementation of this sensor on Navy ships would reduce maintenance costs for a large percentage of auxiliary machinery by over 30%.

Measurement of Driving-Point Impedance of Ultrasonic Transducers using a 16-bit Microcomputer

RESEARCHER: ASSOCIATE PROFESSOR DAVID S. HARDING
SPONSOR: NAVAL RESEARCH LABORATORY

The purpose of this research was to provide a better method of quality control and standardization of the ultrasonic transducers which are to be used in shipyards for flaw detection in pipes, etc. The feasibility of this method has been demonstrated, but a field operational system has not yet been developed.

Radiation Testing of IC Chips

RESEARCHER: ASSOCIATE PROFESSOR TIAN S. LIM
SPONSOR: NAVAL RESEARCH LABORATORY

This project is the design of a microprocessor-controlled circuit used to test and evaluate the radiation effects of D flip-flop integrated circuit chips. Components include: (1) SKD-85 single board microcomputer, (2) the DUT (device under test) board containing the device under test and its interface to the SDK-85, and (3) a driver board connected to SDK-85 through a 40-pin connector. An 8085 assembly language program was written and used to exercise the input and output ports of the D flip-flops under radiation tests. Doses of radiation from cobalt 60 were applied in steps at increasing quantities until the IC chip finally failed to toggle.

Computer-Augmented Video Education (CAVE) Development

RESEARCHER: PROFESSOR RALPH P. SANTORO
SPONSOR: ACADEMIC COMPUTING CENTER

A controller that interfaces the Pioneer PR-7820 video disc player to the Naval Academy Time Sharing System has been completed through the final engineering tests; this controller is ready for the operational CAVE environment. Plans for the coming year include the construction of a second controller and the integration of a text to speech synthesizer into the CAVE system.

A Computer Controlled Automatic Calibration System for Ultrasonic Transducers

RESEARCHERS: ASSOCIATE PROFESSORS ANTAL A. SARKADY, WILLIAM E. BENNETT, AND RAYMOND WASTA; ASSISTANT PROFESSOR DAVID S. HARDING; VISITING RESEARCH PROFESSOR RODNEY J. BARNHART
SPONSOR: NAVAL RESEARCH LABORATORY

The purpose of this research was to develop a computer-controlled automatic calibration system which characterized the electrical and electro-mechanical parameters of ultrasonic transducers. The instrument was designed, constructed and evaluated. Three papers were published during the last year on this work.

Nondestructive Pipe Condition Monitoring

RESEARCHER: ASSOCIATE PROFESSOR ANTAL A. SARKADY
SPONSORS: NAVAL RESEARCH LABORATORY AND DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

The goal of this research was to develop a portable instrument which can be used to access (nondestructively) flaws in pipes used in naval boilers and condensers. The ultrasonic sensor was defined and evaluated. In addition, a color display system was constructed. This summer the effort will be concentrated on incorporating this detector into an automated pusher-puller pipe positioner.

Evaluation of Ultrasonic Transducers

RESEARCHER: ASSOCIATE PROFESSOR RAYMOND WASTA
SPONSOR: NAVAL RESEARCH LABORATORY

The summer of 1982 was spent on the continuation of the project begun during the summer of 1981. Under the direction of Associate Professor Antal A. Sarkady, a team consisting of Associate Professors Herbert M. Neustadt, Raymond Wasta, William E. Bennett, and Assistant Professor David S. Harding worked on various phases of an ultrasonic transducer evaluation. This portion of the research resulted in a unique bipolar high-voltage pulser and a publication. This device has been built and tested and will be incorporated into the complete system this summer.

Independent Research

Cancelling Cusps on the Peaks of Shaped Sine Waves

RESEARCHER: PROFESSOR STEPHEN H. BURNS

Since the development of the inexpensive integrated-circuit, operational amplifier, there has appeared a corresponding class of inexpensive function generators. These instruments "generate" square and triangular waves, and from the latter a sine wave is obtained by a nonlinear circuit called a "shaper." It is tricky to make a shaper that will convert a triangular wave into a sine wave without at least a trace of a cusp at the peaks. This research studied the feasibility of deliberately shaping the sum quantity (sine wave + small triangular wave) and then subtracting the triangular wave component from this sum.

The theoretical part of this study consisted of computing several groups of straight-line tangents that would best fit a sine curve. Tangents rather than chords, etc., were chosen because practical shapers were expected to round down the corners (where the straight lines join) towards the sine wave below. With the slopes and breakpoints in hand, it was simple to construct the desired sum wave and a piecewise-linear circuit to realize it.

The experimental part of this study consisted of building and testing several shapers, including one of the piecewise-linear, diode shapers implied above. Also tested were a shaper based on the I-V characteristics of a JFET and a shaper based on a BJT differential amplifier. While it was possible to cancel the cusp with all three shapers, the latter had the purest sinusoidal output and the greatest bandwidth.

Research Course Projects

Speech Synthesis using the Volvax SC-01A Chip

RESEARCHER: MIDSHIPMAN 1/C MICHAEL D. BOEHLE
ADVISER: PROFESSOR RALPH P. SANTORO

The purpose of this research project was to design and build a speaking-message device. This device will independently output spoken warnings or routine messages. Fifteen input lines are constantly monitored. If any one of them is activated, the device will produce the message associated with that line.

Development System Peripherals for the VIC-20 Computer

RESEARCHER: MIDSHIPMAN 1/C NORBERT DOERRY
ADVISER: PROFESSOR RALPH P. SANTORO

The VIC-20 is an inexpensive personal computer based on the 6502 microprocessor. Although designed for programming with a BASIC interpreter, the VIC-20 makes an excellent base for a development system. It has an easily accessible expansion port available for memory expansion and other peripherals. This project will add several features of a development system to the VIC-20. First, a 6-slot expansion port constructed last semester will be modified to correct transmission line effects. Second, a 16K static RAM/EPROM expansion board will be constructed. Finally, an assembler program will be modified so that it can run on the VIC-20. This project will greatly increase the flexibility and power of the VIC-20 by allowing assembly language programming and increasing the storage capability.

If time permits, an EPROM simulator consisting of a 4K block of RAM that can be switched between the VIC-20 and another system will be constructed along with a EPROM burner. This addition will allow the VIC-20 to develop the operating software or "firmware" of 6502 based control systems.

System Expansion Design for a VIC-20 Computer

RESEARCHER: MIDSHIPMAN 1/C ROBERT J. FIELDS
ADVISER: PROFESSOR RICHARD L. MARTIN

Several peripherals for a Commodore VIC-20 home computer were designed and constructed. First, a six slot combination memory expansion buffer board/power supply, which is required for the other items, was built. Then a 24K RAM/ROM memory expansion was designed and constructed. Two unique peripherals, an EPROM programmer board and a 12-bit digital-to-analog converter board was also designed and built. A software routine, using the 12-bit D to A to accomplish 12-bit A to D conversion, was written. Software to convert Timeshare BASIC to VIC-20 CBM BASIC was also written.

Diver Navigation System

RESEARCHER: MIDSHIPMAN 1/C MARK R. KALMBACH
ADVISER: LIEUTENANT COMMANDER A. J. SARICH, USN (NAVAL SYSTEMS ENGINEERING)

The purpose of this research project is to design and construct an underwater navigation system for use by the U. S. Navy SEAL Teams. The research that has been done this semester determined the best underwater navigation system design, taking into account feasibility, cost efficiency, and the "need of the Navy." From this research, two systems have emerged as possible projects for next semester. These two designs are a long range position location system and a hand-held doppler navigation system. Both designs are extensions of current underwater navigation devices in use by the U. S. Navy today.

Underwater Position Location Scheme

RESEARCHER: MIDSHIPMAN 1/C MARK R. KALMBACH
ADVISER: ASSOCIATE PROFESSOR HERBERT M. NEUSTADT

Incredible as it may seem, there are electronic systems in use today that allow a person with the necessary equipment to ascertain his position with respect to the known locations of several transmitting stations. These stations are primarily employed in long-range navigation applications for mariners and pilots as they ply the world's trade routes. Specifically, LORAN, Omega, and Decca are well-known aids for the prudent navigator. These networks consist of transmitters spread many miles apart, so that there is a fairly easily measurable time delay between signal generation and signal reception at the receiver. The identification of these time delays from the various transmitters is accomplished by either frequency separation of the signals or by initial design which ensures a certain order of reception anywhere within the operating range. The time delays, and their origins, are sent to a mathematical function machine which generates an output which indicates a position relative to the transmitters. If desired, this relative position can be coupled with the knowledge of the transmitter locations to obtain an absolute terrestrial position.

Implementing Effective Instrumentation in a Varactor FM Tuner

RESEARCHER: MIDSHIPMAN 1/C DARRELL PAGE
ADVISER: PROFESSOR RALPH P. SANTORO

The research project planned this semester is a further development of a more basic project completed in EE423 Project Lab last semester. In that laboratory-class, an FM tuner based on varactor-controlled tuning was built and tested satisfactorily. The original project was initially designed to incorporate a digital tuning control system compatible with varactor tuning, but unfortunately the integrated circuits in this system were not available at that time. The goals of this research project are: (1) to install and test the digital tuning-control system as planned in the original project when it becomes available, (2) to build and install an LED off-station tuning indicator for the tuner, (3) to build and install an LED signal-strength meter for the project, (4) to add a solid state stereo decoder/noise reduction circuit compatible with the tuning system, and (5) experimentally measure the tuning characteristics and output audio quality of the completed project.

An Interactive Color Display Software for TI-9900 Signal Processor

RESEARCHER: MIDSHIPMAN 1/C ROBERT M. RUSSELL
ADVISERS: ASSOCIATE PROFESSOR ANTAL A. SARKADY AND VISITING RESEARCH PROFESSOR RODNEY J. BARNHART

The goal of this research project was to develop a software package which can be used to display high-resolution color plots and images on the Chromatics CGC7900 color terminal.

A Two-Port Random Access Memory for the Apple II Computer

RESEARCHER: MIDSHIPMAN 1/C LANCE L. ZAHM
ADVISER: PROFESSOR RALPH P. SANTORO

The Apple II computer used in the digital track (EE461/462) is an extremely versatile development tool. This research project will increase its power by providing a peripheral card that will function like RAM to the Apple II and EPROM to an external target controller that is under development. This peripheral card will reside in any of the expansion slots 1 through 7 and provide 2K of RAM to the Apple and behave like a 2K 2616 type EPROM to the target machine. The major advantage of this project will be to increase the productivity of the software design and debugging process for controller oriented software.

Publications

BENNETT, William E., Associate Professor, and Antal A. SARKADY, Associate Professor, "**A Microcomputer Based 30 MHz Data Acquisition System and Digital Thickness Gate for Ultrasonic Measurements**," *Non-Destructive Evaluation Conference Proceedings*, (April 1983).

A high speed analog-to-digital converter and data acquisition system that interfaces to a TM990/101M microcomputer for ultrasonic testing is presented. An important element in this system is a 30 MHz TRW "flash type" analog-to-digital converter. This converter provides an eight-bit parallel output, thus allowing 256 quantization levels. In addition, the converter's input impedance and input voltage range are controllable, enabling operation with many types of transducers and amplifiers. The digitized data is stored in RAM to be later transferred to the computer. Transfer of the data is controlled directly by the computer using memory-mapped control lines.

BURNS, Stephen H., Professor, "**Cancelling Cusps on the Peaks of Shaped Sine Waves**," *Electronics*, (28 July 1982), 110.

This short article reports on the design of a circuit that obtains a sine-wave output from a triangular-wave input. The shaper subcircuit is deliberately designed to include a small amount of triangular wave in its output. This design is much easier to realize in practice than a design that does not. After the shaper, an operational amplifier is used to subtract just enough of the input triangular wave from the shaped wave to produce a pure sine wave at *its* output. Results are given for a piecewise-linear, four-diode shaper, for a JFET shaper, and for a differential-amplifier shaper. The last has only 0.4% harmonic distortion at low frequencies and only 2% distortion at 200 KHz.

HARDING, David S., Antal A. SARKADY, Herbert M. NEUSTADT, and Raymond WASTA, Associate Professors, "**Measurement of Driving-Point Impedance of Ultrasonic Transducers Using a 16-Bit Microcomputer**," *Non-Destructive Evaluation Conference Proceedings*, (April 1983).

A measurement system, based on a 16-bit microcomputer was developed to measure the complex electrical driving-point impedance of ultrasonic transducers in the range of 0 to 10 MHz. The impedance (Z) is computed from the fast Fourier transforms (FFT's) of the output voltage from a pulse generator under three different loads: (1) open circuit, (2) loaded with a standard resistor, and (3) loaded with a transducer. Computation of complex impedance at 64 different frequencies takes about 10 seconds. The computer program can plot the magnitude and phase of Z versus frequency, and thus evaluate resonances and their bandwidths. The measurement system consists of a TI9900 based microcomputer, a pulser unit, a 21.334 MHz analog-to-digital converter (ADC), relays, and a printer. The main program is written in BASIC and calls several assembly language subroutines. The measurements are limited by the pulse amplitude and bandwidth, by the sampling rate and quantization of the ADC, and by the source impedance of the pulser unit. The measurement errors due to these limitations are discussed. A driving pulse-width as short as 40 ns and a sampling rate of approximately 25 MHz are feasible.

LIM, Tian S., Associate Professor, "**Microprocessor-Controlled Radiation Testing Circuit Design**," *Proceedings of IEEE Southeast Conference*, (April 1983), 13-17.

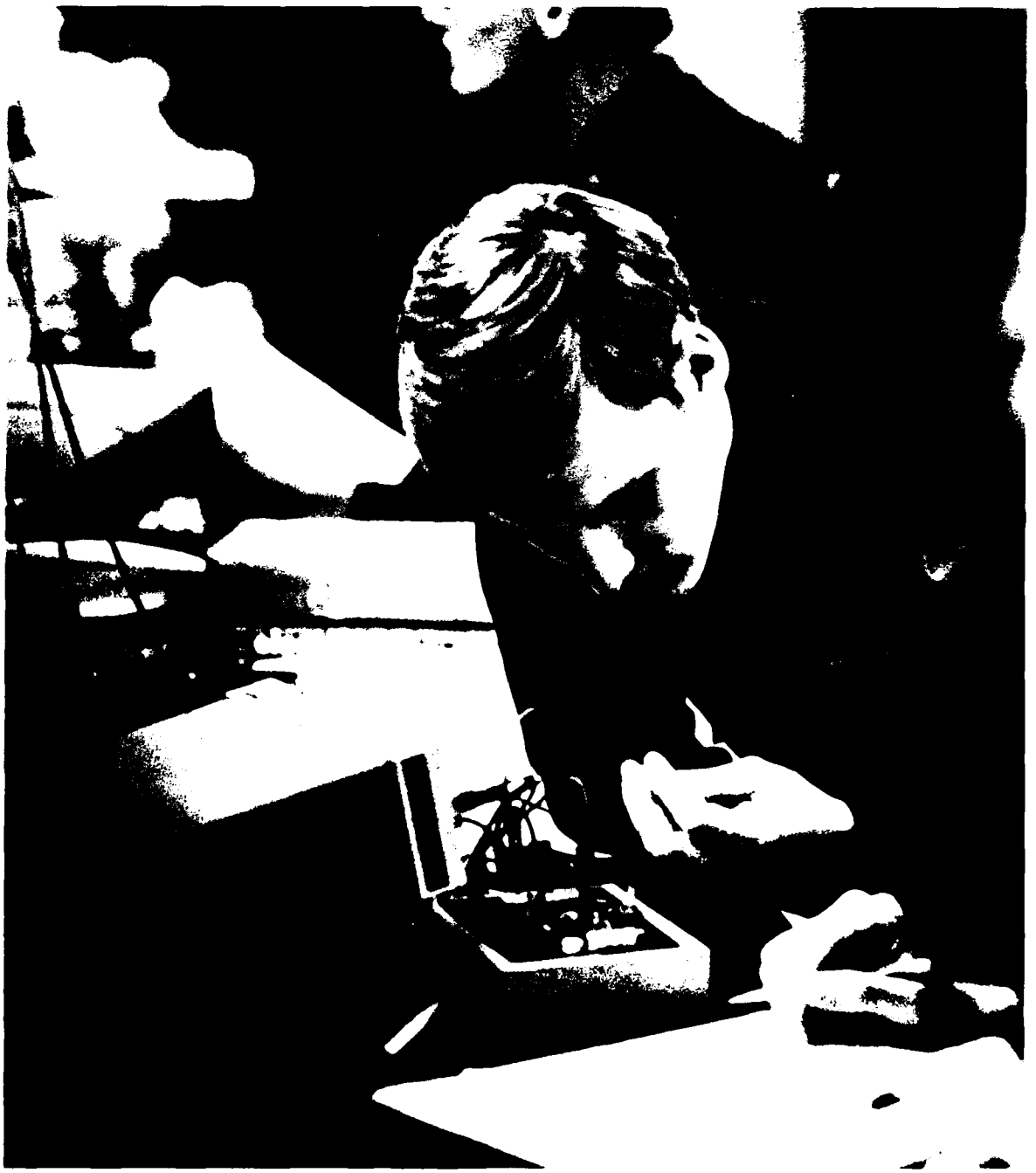
This paper describes a project to design a microprocessor-controlled circuit used to test and evaluate the radiation effects of D flip-flop integrated circuit chips. Components include: (1) SDK-85 single board microcomputer, (2) the DUT (device under test) board containing the device under test and its interface to the SDK-85, and (3) a driver board connected to SDK-85 through a 40-pin connector. An 8085 assembly language program was written and used to exercise the input and output ports of the D flip-flops under radiation tests. Doses of radiation from Cobalt 60 were applied in steps at increasing quantities until the IC chip finally failed to toggle.

MARTIN, Richard L., Professor, "**Enhanced Radiation Effects on Submicron Narrow Channel NMOS**," *IEEE Transactions on Nuclear Science*, NS-29 (December 1982), 1681-1684.

An enhanced radiation sensitivity for narrow channel NMOS has been observed. The radiation induced threshold shift increases rapidly as the channel width decreases below 4 microns. This geometry dependence can be explained qualitatively by two-dimensional potential calculations. These calculations, showing the fringing field influence on threshold voltage, are reduced after radiation, leading to a larger total shift for the narrow channel devices.

WASTA, Raymond and Antal A. SARKADY, Associate Professors, "**A Fast-Recovery High-Voltage Pulser for Ultrasonic Transducers**," *Non-Destructive Evaluation Conference Proceedings*. (April 1983).

A computer-controlled bipolar high-voltage pulser was developed for driving ultrasonic transducers. The circuit utilizes the fast turn-on time (15 nanoseconds) of an N-channel HEXFET to generate both positive and negative pulses with pulse durations of 100 nanoseconds or less. Unipolar or bipolar pulse sequences can be produced and coherence is maintained among sequences. Pulse amplitude is controllable in the range of ± 150 to ± 400 volts. The computer selects the sequence length, the pulse amplitude, the pulse duration, the pulse separation, and initiates the pulse sequence. The circuit has been designed to minimize the DC build-up problem when the pulser is used in the burst mode. The resulting fast-recovery time allows a pulse sequence of 5 or more cycles with a burst frequency of at least 5 Mz.



Presentations

ALLEY, Reuben E., Jr., Professor, "**Physics and Art**," Zone Meeting of Society of Physics Students, Baltimore, Maryland, November 1982.

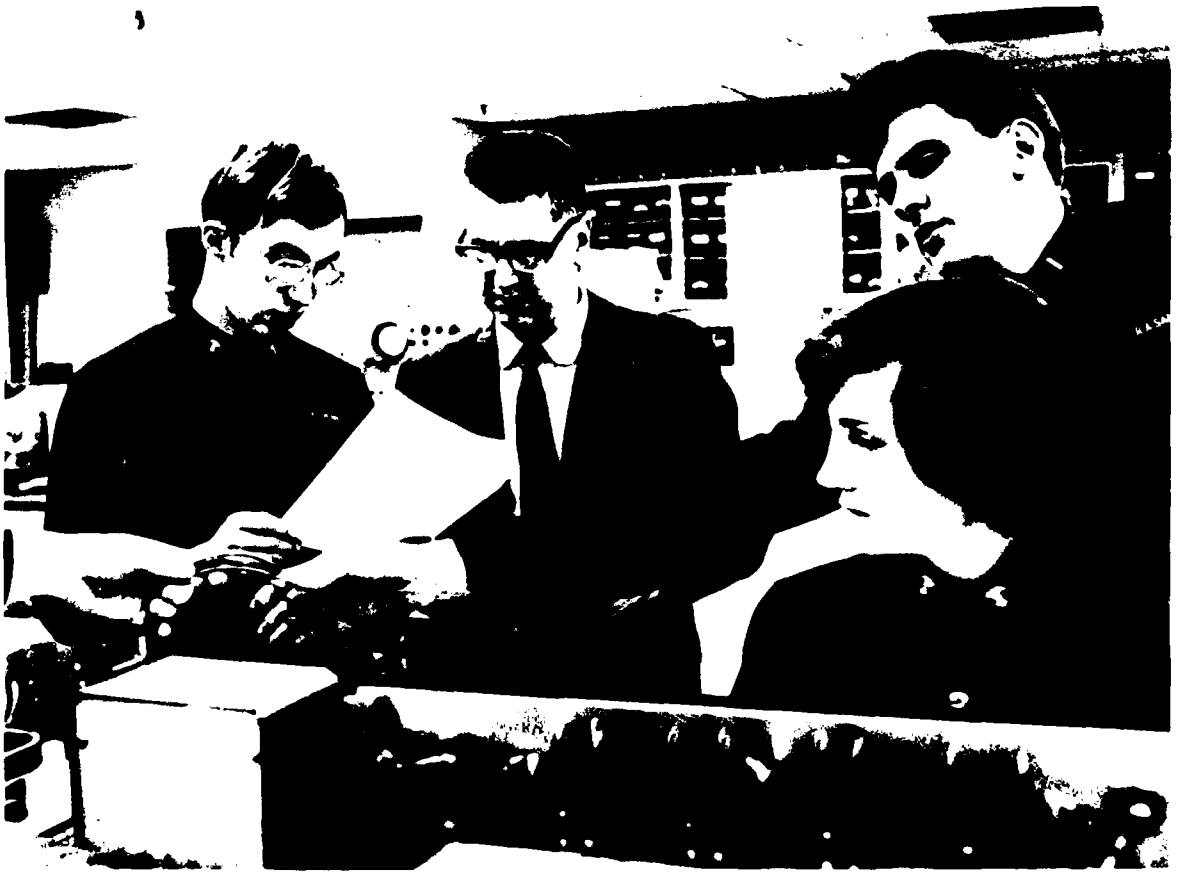
ALLEY, Reuben E., Jr., Professor, "**Watermills**," Winter Meeting, American Association of Physics Teachers, New York, January 1983.

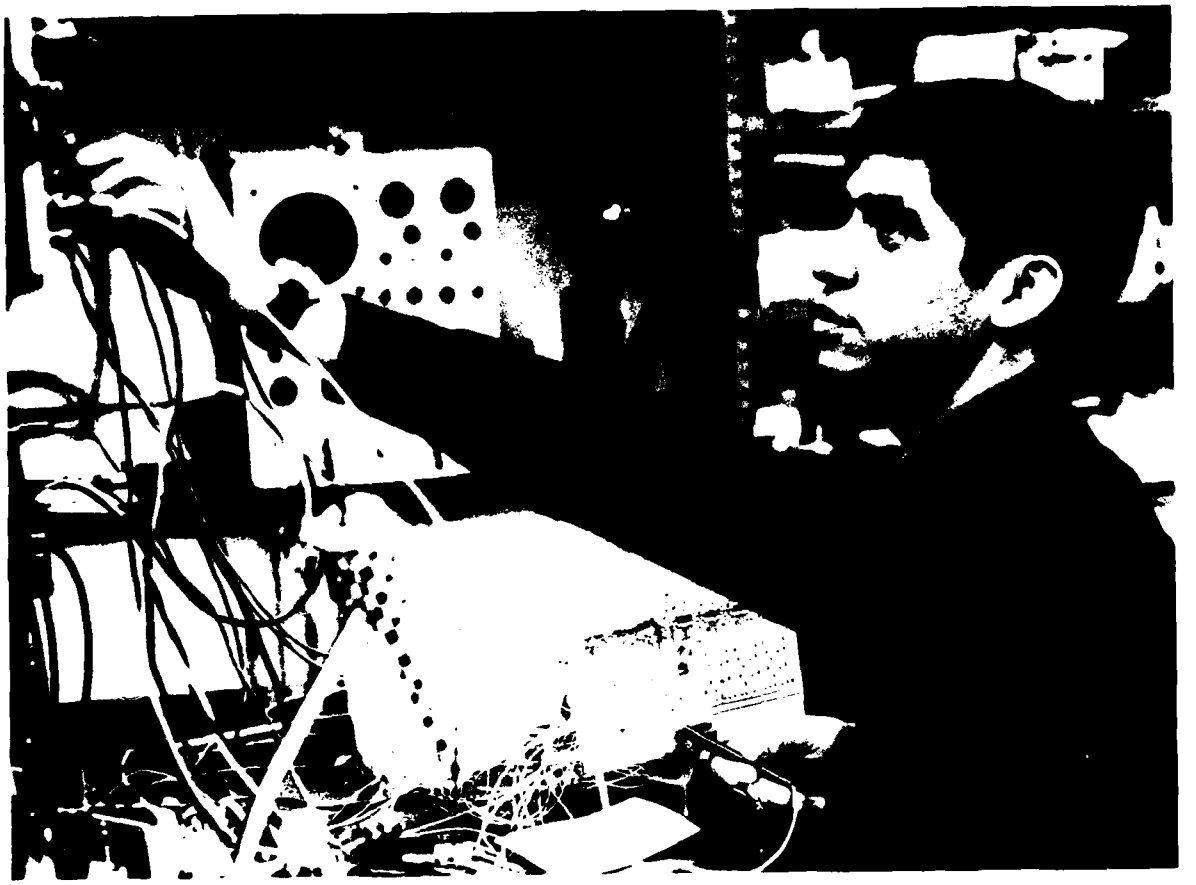
BENNETT, William E., Associate Professor, "**A Microcomputer-Based 30 MHz Data Acquisition System and Digital Thickness Gate for Ultrasonic Measurements**," 14th Symposium on Non-Destructive Evaluation, San Antonio, Texas, April 1983.

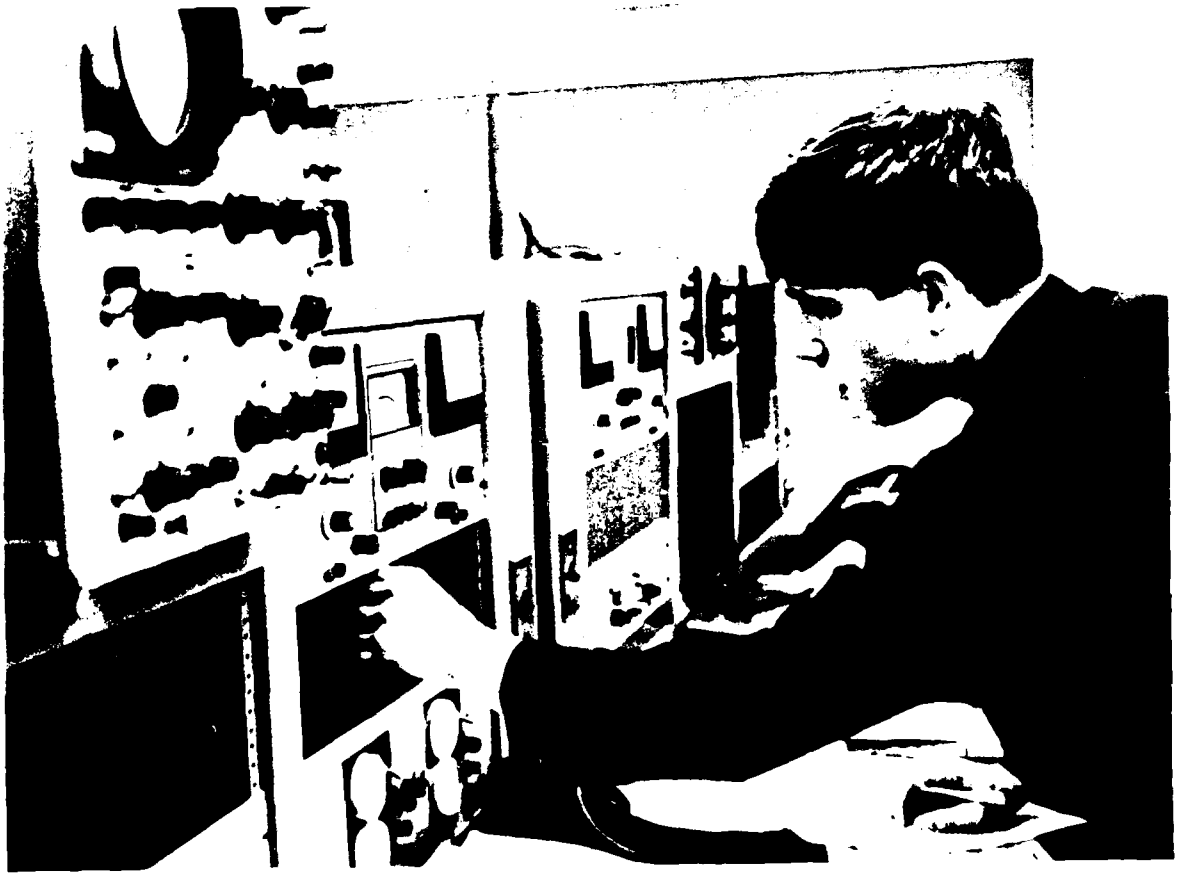
HARDING, David S., Assistant Professor, "**Measurement of Driving-Point Impedance of Ultrasonic Transducers Using a 16-Bit Microcomputer**," 14th Symposium on Non-Destructive Evaluation, San Antonio, Texas, April 1983.

LIM, Tian S., Associate Professor, "**Microcomputer Controlled Radiation Testing Circuit Design**," IEEE Southeast Conference, Orlando, Florida, April 1983.

WASTA, Raymond, Associate Professor, "**A Fast Recovery High-Voltage Pulser for Ultrasonic Transducers**," 14th Symposium on Non-Destructive Evaluation, San Antonio, Texas, April 1983.







DEPARTMENT OF

Mechanical Engineering

ASSOCIATE PROFESSOR JACK H. SMITH
CHAIRMAN

Faculty and midshipmen research in the Mechanical Engineering Department covers many of the areas of specialization in mechanical engineering. These include research in direct energy conversion, combustion, fluid mechanics, heat transfer, solid mechanics, acoustics, dynamic effects, lubrication, corrosion, fracture mechanics, composite materials, welding and design, and computer-aided graphics.

Research is supported mainly through funds from government agencies with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, providing opportunities for several faculty members to work on projects during the intersessional period. Additionally, some faculty members have undertaken independent research in their areas of expertise. Sixteen civilians and one military faculty member have been active in the reported research of the department this year which follows.

An important part of the department's research effort each year is the involvement of midshipmen in independent research, design, and development projects. There were eleven such midshipmen/faculty projects this year. Current midshipmen interests include: composite materials, computer graphics, kinematics, combustion, heat transfer, rockets, mechanical testing, and many aspects of fluid mechanics.

Supporting the research effort in mechanical engineering are the extensive laboratory facilities located in Rickover Hall. The department maintains facilities for performing experimental research in several areas: fluid mechanics, solid mechanics, materials science, experimental-stress analysis, control systems, mechanical vibrations, heat transfer, and thermodynamics.

The primary driving force behind the department's research is the need for the faculty to stay abreast of developments in many diversified areas of mechanical engineering, thereby enabling them to be more effective classroom teachers.

Sponsored Research

A CAD/CAM System for Fan Blades

RESEARCHER: PROFESSOR J. ALAN ADAMS
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

An effective parametric, experimental investigation of turbo-machinery performance requires the ability to rapidly produce models of various sizes and shapes. This on-going research effort concerns the development of a computer-aided design software package to define the data base for fan blades of various configurations. The data base is then used as input to a second software package which computes N/C cutter path positions for machining the hub and blades on a numerically controlled milling machine.

The blade cross-sections are defined, using either digitized data or standard NACA airfoil sections. This 2-D information is then transformed to a 3-D definition and orthographic projections are created. Inputs such as hub diameter, blade length, and twist angle are supplied by the user in an interactive manner. Once a design has been chosen data is sent to an N/C milling machine and at the same time the cutter path is displayed on TEKTRONIX 4051 storage tube graphics display unit.

To date only partial models have been made from wood to demonstrate the feasibility of the approach. Further refinements and improvements are currently underway.

Light Weight Armor Materials Testing

RESEARCHER: PROFESSOR THOMAS W. BUTLER
SPONSOR: NAVAL SURFACE WEAPONS CENTER, WHITE OAK LABORATORY

This continuing project involves development of innovative testing techniques for materials being considered for use as lightweight armor. Three point bend tests, fatigue tests, and tension tests have been performed and will be continued as specimens are made available for testing.

Summation Drive

RESEARCHER: ASSOCIATE PROFESSOR ELLIOTT E. DODSON
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

This project involved the preliminary design of a summation drive for a 14-ton tracked amphibious vehicle.

The design conceived was a simple planetary drive train, whose three shafts were free to rotate (three-shaft transmission with two degrees of freedom). Inputs were to the ring gear and the sun gear, and output was from the carrier. (By "simple" planetary drive train is meant-one planet carrier, one or more planets, one ring gear and one sun gear.)

Design calculations were incorporated into design trials in which an attempt was made to match a drive with hydraulic motors and these, in combination, with the diesel engine output and vehicle sprocket demand.

After many trials, a design was arrived at which utilized a high-speed, low-torque input to the sun gear and a low-speed, high-torque input to the ring gear and provided a good match of diesel engine, hydraulic motors, summation drive and vehicle drive sprocket.

Investigation of Vortex/Control Fin Interactions

RESEARCHER: ASSOCIATE PROFESSOR JOSEPH D. GILLERLAIN, JR.
SPONSORS: NAVAL SURFACE WEAPONS CENTER, WHITE OAK LABORATORY, AND NAVAL AIR SYSTEMS COMMAND

The objective of this investigation is to develop predictive methods for the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces. Detailed knowledge of the three-dimensional viscous flow field, as determined from wind-tunnel experiments, is required in order to model the vortex-fin interaction and to develop predictive methods.

The experimental measurements will be made in the U. S. Naval Academy Aerodynamics Laboratory subsonic wind-tunnel. A pressure distribution model, consisting of a rectangular fin with a cylindrical leading edge, has been built. The fin is adjustable for angle-of-attack.

Non-intrusive flow measurement and flow visualization techniques will be used, to include three-dimensional laser Doppler velocimetry (LDV) and the fluorescent mini-tuft method, respectively. The pressure distribution data will be integrated to obtain aerodynamic forces, which will be compared with force balance data. Results of various conventional methods of wing/fin analysis will be compared to the measured aerodynamic loads.

Design and Construction of A Research Recirculating Water Tunnel

RESEARCHER: PROFESSOR ROBERT A. GRANGER
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

There were three major objectives accomplished during the research: 1. experimental measurement of the velocity distribution past a flat plate; 2. comparison of experimental measurements with analytic solutions for turbulent flow; 3. modification of the tunnel to obtain uniform flow in the test section. Use of hot-film anemometry was not as successful as use of a one-component LDV system. The measurements proved the possibility of adapting the one-dimensional LDV system to the USNA recirculating water channel. All the data taken were consistent and repeatable.

The primary experiment involved measuring a one-dimensional velocity profile in an open channel by using the forward-scatter system. The signal processing was effected using frequency trackers. Dimensionless RMS profiles were obtained. The mean and turbulence data, as well as coefficients for the cross correlation of the forward-scatter signals were calculated.

The power spectra versus frequency at a fixed depth reveal a large source of white noise, partly due to incoherent background illumination and partly due to the random phase fluctuations of scattered light.

Special test rigs had to be designed and constructed to support the LDV system so that structure-borne vibration would not interfere with the LDV measurements of the flow velocity. Once the instantaneous velocities were measured, use of a local data analyzer ("wave-water system") gave the RMS of the velocity fluctuation which in turn was used to calculate the turbulence intensity.

Pig-Tailed Towed Submersible

RESEARCHER: PROFESSOR ROBERT A. GRANGER
SPONSOR: NAVAL COASTAL SYSTEMS CENTER

Funds were provided to the U. S. Naval Academy by NCSC to perform an experimental analysis of the motions of a towed submersible vehicle resulting from external excitation of surge and heave. In particular, the USNA was to construct a half-scale model of a NCSC vehicle, the towing device to tow the vehicle at a fixed depth of 10-feet below the free surface in the USNA High Performance Tow Tank, the vertical excitation apparatus, and the horizontal excitation apparatus to simulate heave and surge up to ± 1.0 foot amplitudes with variable frequencies. Rates of pitch, roll, and yaw, plus longitudinal motions and depth fluctuations are to be measured for assorted frequencies and amplitudes of heave and surge, assorted tow speeds up to 14 knots, various tow lengths, assorted fin geometries, and various vehicle longitudinal c.g. c.b. locations.

The first set of experimental measurements are excellent. After lengthy design, construction, testing, set-up and tear-down procedures were thoroughly investigated, a complete set of runs was made. The data obtained shows a large range of results. The results clearly indicate that the USNA Tow Tank now has the ability to conduct meaningful towed submersible experiments. A final report is being prepared that covers the three year contracted study.

Fracture Toughness of Stress Relief Embrittled HY 80 Steel Cast Materials

RESEARCHER: ASSOCIATE PROFESSOR DENNIS F. HASSON
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The following program of work is being undertaken in this research: prepare test matrix, evaluate data, and prepare report on the results. Metallographic and fractographic analyses will be made to analyze stress relief embrittlement behavior of HY80 steel cast materials. Coordination of heat treatments and K_{I_c} fracture toughness CVN — energy versus temperature, and tensile test programs will be completed.

Properties of Metal Matrix Composite Materials

RESEARCHER: ASSOCIATE PROFESSOR DENNIS F. HASSON
SPONSOR: NAVAL SURFACE WEAPONS CENTER, WHITE OAK LABORATORY

The following program of work is being undertaken in this research: coordination and evaluation of K_{I_c} fracture toughness behavior of extruded A1-6061-T6/SiC whisher reinforced composite materials and correlation with CVN energy test results. Fractographic analysis will be performed.

The morphological characteristics of fatigued composite materials will be determined and x-ray evaluation of welded composite materials will be made to determine concentration distribution of Al_4C_3.

Dynamic Key Curve Testing Method Development

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE
SPONSOR: NUCLEAR REGULATORY COMMISSION

The objectives of this research are: (1) to utilize Key Curve Method technique to develop J-R curves at 100 in/sec loading rate for moderate toughness ferritic steels, (2) to continue development of potential drop methods as an alternate technique at dynamic loading rates, and (3) to complete carry over project to develop conditions for tearing instability arrest in a compliant system with variable inertia.

The researcher will: (1) machine and test 1T and ½T three point bend bars using static, 10 in/sec hydraulic, and 100 in/sec drop weight test procedures. Using unloading compliance on the static test and key curve analysis on the high tests, J-R curves and J_{I_c} values will be obtained. Three materials will be used, namely an HY80 alloy, an A302 pressure vessel steel and an A106 pipe steel. Multiple ½T tests will be run to define the material variability and for obtaining an average key curve; this will hopefully allow the researcher to handle the expected variability of the A106 steel. Multispecimen tests will be run to validate the J-R curves obtained in each instance. (2) For the potential drop methods the maximum velocity to be used will be about 2 in/sec in a hydraulic machine. Even at this rate unexplained problems have given unusable potential drop records, and the elimination of these problems or determination of their source will be the objective of this task: (3) Compact specimens will be loaded in a compliant test machine and an instability initiated. A high rate data acquisition system will take load and displacement data during the instability. Analysis of this data will define the conditions present at the instability arrest point. Application of various system inertia properties will allow evaluation of the effect of test system inertia on the instability arrest conditions.

Elastic/Plastic Characterization of Low Cycle Fatigue Crack Growth

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The objective of this research is to extend the fatigue crack growth characterization of ductile structural alloys into the low-cycle regime beyond the validity restrictions of linear elastic crack mechanics.

The state-of-the-art of approaches to analysis of low-cycle fatigue crack growth of ductile metals will be assessed, and methods amenable to simple test procedure and to crack growth prediction will be selected for study. Low-cycle fatigue crack growth tests of HY steels and Ti-100 will be conducted using several specimen crack configurations and loading modes. The results will be analyzed for selection of the optimum characterization method. A structural element test will be designed and evaluated to demonstrate predictive capabilities. An elastic/plastic fatigue crack growth test method will be documented.

Software for data acquisition has been developed to obtain crack growth rate as a function of the applied J range. Compact specimens of HY80 and HY130 have been tested and analyzed up to thicknesses of 1-inch. Tests on 2-inch thick specimens are now underway. Work is continuing on center-cracked panels as well as an improved data analysis software.

Dynamic Fracture Toughness of HY Steels and Ti 100

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The objective is: (1) to evaluate fracture toughness of HY steels and Ti-100 under dynamic loading conditions in terms of elastic-plastic fracture mechanics (EPFM) characterization parameters; (2) to evaluate the role of loading rate on fracture toughness levels and fracture toughness/temperature transition behavior of these alloys; and (3) to evaluate the applicability of J_{Ic}, T and other elastic-plastic characterization parameters under loading conditions ranging from static (10^{-4} in/in/sec) to explosive impact (10^{4} in/in/sec) strain rate regimes.

The approach is: (1) to develop test methods to evaluate J_{Ic} and the J_I-R curve under dynamic loading rates ($J > 10^{6}$ in-lb/in^{2}sec) and under impact loading rates using HY steels and Ti-100; (2) to evaluate the fracture toughness of HY steels and Ti-100 using J_{Ic}, T and possibly other EPFM characterization parameters at ambient and cryogenic temperatures for static and dynamic loading rates; and (3) to compare and correlate static and dynamic elastic-plastic fracture toughness properties of HY steels and Ti-100.

J-R curves have now been obtained on bend bars loaded in a drop tower at 100 in/sec velocity. The analysis method used was that of the Key Curve Method developed previously at the U.S. Naval Academy. Additional tests on tougher materials is now underway as is work on potential drop methods of crack length determination, a complementary method of J-R curve evaluation.

Waste Heat Utilization

RESEARCHER: PROFESSOR VINCENT J. LOPARDO
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

This paper summarizes several Navy documents and presents the energy needs of the various auxiliary heating systems in the DD963, DDG51, DDG47, and the FFG-7 class of ships. It also compares the two leading options for suppling energy: the all-elective system and the gas turbine generator waste heat recovery system. Emphasis is placed on previous studies. Particular attention is focused on the effect of gas turbine waste heat utilization on the suppression of infrared radiation and ship endurance. Recommendations are made for areas of future investigation.

Finite Element Modeling Approximation for Constrained Damping Structures

RESEARCHER: VISITING RESEARCH PROFESSOR YEH PEI LU
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

It has been recognized for years that structural noise and vibration can be reduced by using layers of viscoelastic shear damping material to dissipate energy within vibrating numbers. For the purpose of reducing noise and vibration of naval structures, structural damping treatments are used extensively on machinery foundations and hull surfaces. Because of the importance of damping applications, researchers in recent years have developed various analyses of layered damped structures.

To date, finite element approaches developed by both the Navy and the Air Force are too complicated to be used in practical applications. This research will develop a simple and accurate predictive method for the responses of constrained layer, damped structural systems. Although the plate composite is used for demonstration purposes, it can be applied for other composite structures, e.g., continuously or discontinuously, full or partially covered constrained damped structures.

Finite element solutions and experimental results will be presented for the transverse driving point mechanical impedances as well as for the transfer impedances of damped plate composite structures made up of a thin viscoelastic layer sandwich between two elastic layers.

Analytical Development for the Partially Covered Stave Damped Pipes

RESEARCHER: VISITING RESEARCH PROFESSOR YEH PEI LU
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

It is well known that the utilization of shear-damping material is an effective method to reduce or suppress resonant noise. In the past decade, the application of such damping treatment to naval shipboard machinery structural systems, such as damped pipes and damped foundations, has been demonstrated to be effective in reducing structure borne noise. The stave-damped treatment is a method whereby dual sided pressure sensitive viscoelastic tape is applied to the pipe and then steel stock is banded to the pipe in a stave-like fashion. The purpose of these treatments is to make effective damping possible over a wide range of frequencies for given engineering requirements and applications.

The partially covered, stave-damped piping system is a very important concept in naval applications as far as weight saving is concerned. In coping with modern design of submarine machinery systems and to study the feasibility and its performance, it is highly desirable to develop analytical prediction method for such a partially covered stave-damped piping system.

Analytical solutions and their corresponding experiment results will be presented and compared for the responses of such partially covered stave-damped pipes.

Impact Characteristics of Boxing Gloves with Various Fillers

RESEARCHER: ASSOCIATE PROFESSOR JACK H. SMITH
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Experimental apparatus was developed and constructed. Initial data were taken in 1982. Problems with the experimental setup necessitated extensive redesign. This work has almost been completed and additional data will be taken in the summer of 1983.

Dynamic Modelling and Experimental Investigations of Flow Induced Noise in Submarine Piping Systems

RESEARCHER: PROFESSOR J. PAUL ULDRICK

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The objectives of this research are: (1) to develop fundamental principles to characterize and predict the vibrational excitation mechanisms and system response characteristics of fluid conveying piping systems on modern submarines, and (2) to design and construct an experimental mechanical system to test the validity of coherence analysis in source indentification.

The plan of investigation is to design and implement experimental configurations for laboratory and sea trial measurements and to develop digital time series analysis techniques to characterize and model known and unknown excitation mechanisms in submarine piping systems.

Independent Research

Determining Traffic Accident Severity from Police Reported Data

RESEARCHER: PROFESSOR RUSSELL A. SMITH

It is desirable in accident research to express the injury outcome of an accident as a function of the relevant parameters, such as occupant, age, seat belt use and vehicle acceleration. The latter variable, acceleration, is very important but impossible to obtain directly; however, this work seeks to define and obtain a surrogate measure for acceleration, referred to as a severity index.

A surrogate measure that combines the effects of vehicle mass, collision type and vehicle damage has been defined. Efforts are in progress to test the validity of this proposed variable by reference to results of staged collisions. Subsequent work if feasible will include the review of an entire state accident file for severity distribution.

Research Course Projects

Fatigue of an SiC/AL Metal Matrix Composite

RESEARCHER: MIDSHIPMAN 1/C JAMES R. BOORUIY
ADVISER: ASSOCIATE PROFESSOR DENNIS F. HASSON

The SiC/AL composite tested in this investigation had better fatigue characteristics than material of lower ultimate strength and Young's modulus previously reported by Crowe and Hasson. Hardness data and v/o SiC data show that the distribution of SiC is not uniform. The composite has a surface which is much rougher than that of comparable 6061-T6 aluminum. The low cycle fatigue samples failed soon after crack initiation and experienced little or no propagation. The high cycle fatigue samples experienced propagation after the crack was initiated. The propagation took place in steps, and did not exhibit classical striation behavior.

A Review of Proposed Auxiliary Heating Systems for the DDG-51

RESEARCHER: MIDSHIPMAN 1/C BRIAN T. DONEGAN
ADVISER: PROFESSOR VINCENT J. LOPARDO

The purpose of this research was to examine the advantages and disadvantages of the proposed all electric and gas turbine generator waste heat recovery auxiliary heating systems for the DDG-51. A review of the specified design criteria and the results of previous analysis was conducted. Emphasis was placed on identifying and examining areas which have not been fully investigated in previous studies. Particular attention was focused on the effect of gas turbine waste heat on the suppression of infrared radiation and ship endurance. Recommendations were made for areas of future investigation.

The Effects of Side-Grooves in the Determination of the Dynamic Fracture Toughness of High Yield Steels

RESEARCHER: MIDSHIPMAN 1/C KARLHEINZ HEIMERL
ADVISER: ASSOCIATE PROFESSOR DENNIS F. HASSON

This investigation was conducted to determine the validity of dynamic fracture toughness data derived from side-grooved Charpy V notch specimens. Ductile-to-brittle transition behavior curves were constructed for HY80, HY100, and HY130 steels for both side-grooved and non side-grooved specimens. These specimens were tested on an instrumented Charpy impact tester.

It was found that the implementation of side-grooves did indeed enhance the validity of J_{Id} values without any adverse effect on the material properties of the steels. Test criteria were more easily met through the use of side-grooves and toughness data approached J_{max} value.

No variation in the transition temperature of the steels was observed as a result of adding the side-grooves. Scanning electron microscopy revealed no changes in the appearance of the fracture surface of the specimens.

Coherence Analysis in Source Identification

RESEARCHER: MIDSHIPMAN 1/C KARL R. HERZOG
ADVISER: PROFESSOR J. PAUL ULDRICK

The purpose of this research was to investigate the practical use of coherence analysis in locating noise sources in naval ships.

The objective of the study was to design, construct, instrument, and synthesize computer techniques for employing coherence analysis in source identification experiments.

The plan of the investigation consisted of the following: 1. design a simple two input/one output structure mechanical system; 2. instrument the system to measure vibration levels on the structure at three locations; and 3. develop procedures to identify the predominate excitation mechanisms on the structure.

The final design of the structural system consisted of three small aluminum I-beams, configured as cantilever beams interconnected using springs and dash pots. For the two excitation mechanisms, small variable speed electric drills were mounted on two of the I-beams. Care was taken to isolate the base supports such that energy paths would not exist through the supporting structure. One accelerometer was mounted on each I-beam with two of the accelerometers being mounted near the excitation motors and the third on the I-beam.

A computer program compatible with a Tektronics 4057 was developed to sample the time data and perform Fourier transform analysis on each signal. From this frequency data, algorithms were written to compute and plot the frequency response function and the coherence function between each of the three accelerometer signals.

The system is in place in the vibration laboratory for use in teaching basic vibrations theory in the coming years. With some refinement in both hardware and software, the technique can be useful as an aid in locating unknown vibration mechanisms found on naval ships.

The Turbulence Intensity of the USNA Recirculating Water Tunnel

RESEARCHER: MIDSHIPMAN 1/C MICHAEL R. HUFFMAN
ADVISER: PROFESSOR ROBERT A. GRANGER

The primary emphasis of the project was the measurement of the level of turbulence within the test section of the channel. The greatest amount of effort was spent developing a system in which the ability of the laser doppler anemometer to accurately measure instantaneous velocity could be utilized to build a grid with a horizontal and vertical transversing scheme. These grids allowed comparison of turbulence intensities for various flow conditions. The goal is nearly uniform with minimal turbulence.

Small Engine Dynamometer Test Facility Development

RESEARCHER: MIDSHIPMAN 1/C WILLIAM D. JONES
ADVISER: ASSOCIATE PROFESSOR EUGENE L. KEATING

A 0-100 hp small engine portable engine dynamometer test facility has been designed and fabricated for use in the Division of Engineering and Weapons. The facility is compatible with low power high rpm two and/or four-stroke engines and is presently available for future student and/or faculty research. A unique frame design allows various engine geometries to be adopted to the universal support base. A Go Power Model DA 516 water-brake absorption dynamometer head was incorporated in the portable engine test bed.

Kinematic Animation of Mechanical Linkages

RESEARCHER: MIDSHIPMAN 1/C HARRY H. KEITH, III
ADVISER: PROFESSOR J. ALAN ADAMS

This project is a continuation of earlier work. It is a software system which animates kinematic linkages on the Evans & Sutherland Picture System I refresh graphics display. It is expected that future students will continue the project.

The programs create non-dimensional performance data in the form of kinematic motion, velocity, and acceleration curves for various linkages. The data can easily be converted to dimensional results for application to a particular mechanism design.

Five major programs currently exist. The first is a menu type front-end to allow the user to easily select any of the available linkages. The remaining four animate a four-bar linkage, a crank slider mechanism, a rocker linkage, and a Whitworth quick return.

A user's manual is available to students and instructors. It explains how to operate the programs, interpret the results, and apply these results to a physical real linkage. Also available is a guide for future programmers which explains how to convert the four existing programs into programs for additional linkages. Using this guide, it is expected that a programmer unfamiliar with the system or Fortran could in a week or two easily add another linkage to the system.

The final project report contains a well-documented listing of all software needed for the animation. This consists of five main programs and 46 subroutines written in RT-11 Fortran. Typical graphical output and sample analysis is also given in the report.

Hydrodynamic Coefficients for a Submarine in Turning Flow

RESEARCHER: MIDSHIPMAN 1/C DAVID F. KELLEY
ADVISER: PROFESSOR ROBERT A. GRANGER

The purpose of this project is to calculate the pressure distribution surrounding a slender body of revolution which is turning in cu. ved flow. Since no theory exists that calculates the pressure distribution for a slender body in curved flow, the body was transformed to a curved body resembling the free stream flow in curved flow. A computer program based on the F.A. Woodward potential flow theory was used to calculate the pressure distribution for the transformed body geometry, for a variety of flow parameters. The data will be compared to experimental data gathered by DTNSRDC, Carderock, for a slender body in the rotating area facility.

Design and Build a Liquid Propellant Rocket

RESEARCHER: MIDSHIPMAN 1/C BENITO LOYOLA, JR.
ADVISER: ASSOCIATE PROFESSOR JAMES A. JOYCE

The objective of this project was to design and assemble a liquid propellant rocket of 500 lbs. thrust, to static fire the engine, and then to fire the rocket. The engine design was relatively standard except that the nozzle geometry was calculated via a numerical method of characteristics approach generating a digital file which was then utilized along with a numerically controlled lathe to cut the nozzle geometry.

With the aid of financial and technical assistance from the Rocketdyne Corporation, NASA, Andrews Air Force Base, and the U.S. Naval Academy, a rocket engine was assembled and static test fired in March of 1983. Since that time the rocket engine has been assembled into a rocket including a parachute recovery system, and it will be fired from White Sands New Mexico in June 1983.

A paper was presented at the spring AIAA Mid-Atlantic Regional Student Conference in April 1983 describing this project and was awarded an "Honorable Mention" in the competition.

Trouble Shooting in the Recirculating Water Tank

RESEARCHER: MIDSHIPMAN 1/C JOSEPH G. SCHOPPY
ADVISER: PROFESSOR ROBERT A. GRANGER

Two primary goals were pursued in this project: 1. achieve smooth uniform flow in the test section by proper modification of the facility, and 2. measure the intensity of turbulence in the test section for a range of test parameters. To accomplish these tasks, use of a laser Doppler velocimeter was adapted for the U.S. Naval Academy's recirculating water channel. Once the tunnel was properly modified and turbulence intensity measurements known, measurement of the velocity field and calculation of the temperature field were made for a range of water channel velocities. The temperature and velocity fields were compared against theoretical calculations.

Phase Changes in Containing Volumes

RESEARCHER: MIDSHIPMAN 1/C STEVEN YOUNG
ADVISER: PROFESSOR THOMAS W. BUTLER

Freezing of water in copper pipes is a well known-phenomenon. In order to be able to carefully study the interaction of the water-to-solid phase change and effects due to the elastic-plastic copper "container", experimental apparatus was assembled which consisted of: a. 20 gallon water-ethylene glycol bath, b. refrigeration coil in the water to gradually and uniformly decrease the temperature, c. mixing apparatus, d. 6-inch long, ½ diameter, copper pipe specimens with valves on both ends, and with resistance strain gauges, e. temperature monitoring and controlling apparatus, and f. strain and temperature recording apparatus.

Due to the effects of pressure on phase changes in water, when distilled water in a closed volume is cooled, freezing does not take place at 0 C. Increased pressure causes a decrease in freezing point. The exact change is not simple to calculate because the volume is not constant, since copper pipe is not rigid. Elastic deformation occurs, as does eventual plastic deformation, and finally, rupture.

In the tests performed, as the temperature decreased below 0 C, there was a gradual increase in circumferential strain until a temperature of -10.2 C was reached. For the parameters of these tests, the pressure (as indicated by the change in circumferential strain) increased by about 6,600 psi very rapidly (less than ½ second). Further decreases in temperature increased the pressure at a rate of approximately 12,700 psi per °C.

Publications

GEREMIA, John O., Professor, co-author "**Analysis of Flammability Properties of Electrical Cables,**" published as "**Cable Fire Studies: Progress Report in Evaluation of Release Rate Apparatus**" DTNSRDC-PAS-83 1; also in *Proceedings of the 32nd International Wire Cable Symposium*, November 1983 "**Cable Fire Studies Using the Ohio State University Filecase Rate Apparatus.**"

This report analyzes data taken according to test plans designed by the researcher and presented in an earlier report. There are four independent and five dependent variables to contend with. A test plan of 27 runs with repetitions was devised and executed. The data from those tests was then analyzed by regression analysis and contour plots to determine: a. The effects of each variable and their interactions, b. one equation expressing all the above effects, c. an optimum operating range for the independent variables, and d. the feasibility of using the tests devised for this research as a method for setting standards for electrical cables used on ships.

GEREMIA, John O., Professor, "**Stepwise Regression Analysis of On-Board Data for Project LINEAR CHAIR (U) Report on Linear Chair Test Results,**" Report DTNSRDC S-PAS-82-33 (SECRET).

Confidential Report

GRANGER, Robert A., Professor, "**A Problem with Modified Mathieu Functions in Unsteady Subsonic Compressible Aerodynamics,**" Division of Engineering and Weapons Report EW-10-83, 1983.

In analyzing the behavior of oscillating wings by application of small disturbance theory, one of the most difficult and challenging areas lies in the very high subsonic compressible range. Two general methods of analysis have been used. The first and earliest was proposed by Possio, who used collocation methods to treat the integral equation for the intensity distribution of acceleration potential doublets. Subsequently, numerous authors have extended Possio's work to a high degree of sophistication. Detailed references and a survey of results may be found in the monograph by Tijdeman and Destuynder.

The second method consists of transforming the nonlinear differential equation for the velocity potential into elliptical coordinates and expanding the solution as an infinite series of Mathieu functions. Investigators following this method were first Reissner and Sherman, followed by Haskind, Reissner, Timman, van de Vooren and Greidanus, and Williams.

In formulating the present unsteady compressible flow problem for oscillating wings with thickness, consideration has to be given to the method of calculation , be it finite-differencing, semi-empirical, integro-differential, or mixed. For example, a number of investigators, such as Traci et al. and Weatherill et al, experienced concergence difficulties at moderate reduced frequencies using specific finite differencing schemes; possibly a natural consequence of their equations being the homogeneous Helmoholtz equation. Their equations resulted from the use of a linearized transonic flow equation. Hoping to avoid this problem, the researcher commenced the analysis with the nonlinear transonic flow equation. An explicit solution of the boundary value problem for the velocity potential was obtained by the use of a suitable curvilinear coordinate transformation, and an explicit solution was obtained in terms of Mathieu functions. In developing the subject of this paper, the analysis was confined for sake of brevity to the two-dimensional case of a nearly planar body in transonic flow, even it has been developed and applied to three-dimensional oscillating wings.

GRANGER, Robert A., Professor, "**On a Geophysical Inviscid Vortex,**" *Quarterly of Applied Mathematics* (October 1982), 339-346.

An inviscid vortex rotating in a stratified environment is investigated. The equations of linear momentum in combination with the conservation of energy are developed, when the centerline vorticity and the temperature are assumed functions of altitude. Experimental results of Granger were used for the centerline vorticity distribution. The type of geophysical inviscid vortex treated in this note is dictated by the type of distribution one uses to describe the potential temperatures, and this is largely governed by the range in altitude one wishes to consider. For certain weak strength dust devils, one might be interested in elevation less than 10 km such that the lapse rate is greater than adiabatic. Furthermore, Lilly's expression for the normalized temperature is used for the temperature distribution with elevation.

HASSON, Dennis F., Associate Professor, "**Advanced Processing Methods for Titanium**," co-editor *Proceedings* of a symposium sponsored by the Titanium and Physical Metallurgy Committees of the Metallurgical Society of AIME, Louisville, Kentucky, 13-15 October 1981.

Titanium and its alloys have attractive design properties, such as, (1) high strength-to-weight ratio over a wide range of temperature, and (2) corrosion resistance, especially in seawater environments. Initial high cost and sometimes availability, however, have limited its use. Associated with cost and availability is fabricability. Improved fabrication methods could result in reduced scrap losses and fabrication time, and thus reduced cost and increased availability.

This symposium *Proceedings* addresses the goal of improved fabricability with topics on forming, casting, welding, and machining. The authors represent a cross section of industry and academia. The information in their papers provides the reader with process details and consequent properties for design in the aerospace, chemical, and hydrospace industries for assessing the practicality of selecting titanium and its alloys for their applications. The *Proceedings* should be useful to researchers to determine the state-of-the-art, and where new research and development efforts are required to improve the cost and availability of titanium, especially through improved fabrication methods.

Specifically, the *Proceedings* show the opportunities to fabricate near-net-shape by isothermal forging, powder metallurgy, and superplastic forming. Diffusion bonding is also discussed. Also in terms of near-net-shape is centrifugal casting and hot isostatic pressing. Laser welding is shown to be a definite possibility for improvement in welding processes, and results on gas metal are presented. The papers on machining, a topic not given enough emphasis by The Metallurgical Society of AIME, show the difficulties in machining titanium and its alloys, especially with regards to slow cutting rates and cutting tool problems. The papers, nevertheless, provide an excellent insight to solutions to these problems, and represent a major contribution to the intent of improved fabricability, the goal of this volume.

HASSON, Dennis F., Associate Professor, co-author, "**Stress Corrosion Cracking in Depleted Uranium-Z w/o Molybdenum Alloy Penetrators**", *Proceedings of the 1980 Tri-Service Conference on Corrosion*. Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio, Report AFWAL-TR81-4019, Volume II (November 1980), pp. 123-162.

High kinetic energy rounds are required for a variety of defense systems, and dense uranium alloys are well suited for this application. A problem area involves storage of the rounds for extended periods in marine environments. Uranium is highly susceptible to general atmospheric corrosion and, more critically, to stress corrosion cracking (SCC). To date, coating schemes have achieved limited success in alleviating these problems. In general, alloying of uranium with elements such as molybdenum tends to improve resistance to uniform corrosion but results in a multi-phased structure and high SCC susceptibility.

Stress corrosion cracking in alloys in salt-laden, moist air environments has been studied by cantilever beam testing. Crack growth kinetics were continuously monitored during the test. Threshold stress intensity values for SCC, $K_{I_{SCC}}$, range from, 24.4 MPa.m$^{1/2}$ to 15.6 MPa.m$^{1/2}$ for DU-3/4 Ti and DU-Quint, respectively. Values for U-2Mo in two heat treated conditions were slightly less than the DU-3/4 Ti threshold. Data are presented in a "safe zone" plot of flaw size vs. stress. Fractographic investigations by SEM revealed mixed fracture modes with both transgranular and intergranular fracture occurring.

The SCC failure mechanism is caused by the conjoint action of localized stress and a corrosive medium. Earlier work has shown that crack propagation is rapid in U-2Mo. Presently, rounds are produced by hot rolling and grinding of U-2Mo bar or rod stock. Stress corrosion cracking in penetrators fabricated in this way has been reported during long-term exposures to humid air. Cracking was linked to the presence of residual stresses and oxycarbon-nitride inclusions in the material. These inclusions provide regions of stress concentration and localized corrosive attack which serve as sites for crack initiation. Tensile stresses are necessary for crack propagation and these may result from corrosion product wedging and/or residual tensile stress produced during fabrication of the round. Since α-uranium is very anisotropic mechanically, some internal stress always remains locked into any polycrystalline part even after "stress relief" heat treatments.

HASSON, Dennis F., Associate Professor, co-author, "**Flat, Horizontal, Vertical, and Overhead Position Welding of Thick Ti-6AL-2Cb-1Ta-0.8Mo Alloy**," David W. Taylor Naval Ship Research and Development Center Report C-SME-80/31, May 1982.

Ti-6A1-2Cb-1Ta-0.8 Mo weldments were fabricated in each of the flat, horizontal, vertical, and overhead positions. The gas-metal-arc spray welding process was used in the flat, horizontal, and overhead positions, while the gas-metal-arc spray welding pulsed-current process was used in the vertical position. Chemical analyses, compressive strength tests, Charpy V-notch impact toughness tests, 5/8-inch dynamic tear tests, hardness tests, and metallographic examination were used to determine the effects of welding position, welding process, and stress relief on the weldment properties. Weld position and the stress-relief heat treatment had no effect on weld metal chemistry, weldability as measured by the 6T-180° bend test, hardness, and 0.2% offset compressive and tensile yield strength, and ultimate tensile strength. Stress-relief results in a coarsening of the alpha platelets and disappearance of the macroscopically visible thermally-affected zone in the weld metal from all welding positions.

Some of the specimens from the vertical position weldment in both the as-welded and stress-relieved condition did not meet tensile ductility and toughness requirements. SEM fractography indicated that the low values for the Charpy V-notch and dynamic tear tests in these weldments seem to be associated with fracture along step-like features about the size of the columnar grains.

Specimens fabricated in all welding positions exhibited good fracture toughness, as indicated by results of ETT evaluation.

HASSON, Dennis F., Associate Professor, co-author, "**Stress-Relief Embrittlement of HY-100 Steel Cast and Rolled Plate Materials**," David W. Taylor Naval Ship Research and Development Center Report SME-82/97, February 1983.

An investigation was conducted to determine the stress-relief embrittlement characteristics of HY-100 heat treatments. Charpy V-notch impact energy testing and metallography on three cast materials and one rolled plate are presented. It was found that the HY-100 cast materials are highly susceptible to embrittlement during stress-relief heat treatment in the temperature range of 950 F to 1100 F. There was no single temperature at which stress-relief embrittlement was most rapid. Susceptibility to stress-relief embrittlement of the cast material appeared to increase with nickel content. There was no correlation between austenite grain size or tramp and impurity element content of the cast materials and susceptibility to embrittlement. HY-100 rolled plate material is more resistant to stress-relief embrittlement than the cast material. Although the impact energy transition temperature of the rolled plate was increased slightly, there was no evidence of intergranular fracture, and the material met specification impact energy requirements even after prolonged stress relief treatment. The superior resistance of the rolled place material was not attributable to differences in austenite grain size or tramp and impurity element content. Rather, the improved embrittlement resistance appeared to be due to differences in manganese and silicon content, thermo-mechanical working, and microstructure compared to cast material.

HASSON, Dennis F., Associate Professor, co-author, "**Corrosion Fatigue of SiC/AL Metal Matrix Composites in Salt Ladened Moist Air**," in *Strength of Metals and Alloys*, Edited by R.C. Gitkins, Sixth International Conference on the Strength of Metals and Alloys, Melbourne, Australia, Volume 2, August 1982, pp. 859-865.

Corrosion fatigue behavior of whisker reinforced and particulate reinforced forced SiC/6061-T-6 composites has been measured in lab air and in moist salt-ladened air. The results are compared with the corrosion fatigue behavior of wrought 6061-T6 in the same environment. In all cases, the salt-ladened moist air environment degrades the fatigue properties of the materials. Fatigue properties of the composites are, however, competitive with, or better than, those of the 6061-T6 while at the same time achieving improved Young's modulus.

JOYCE, James A., Associate Professor, "**Static and Dynamic J-R Curve Testing of A533B Steel Using the Key Curve Analysis Technique**," *Fracture Mechanics*: Fourteenth Symposium ASTM STP 791. J.C. Lewis and G. Sines, Eds., American Society for Testing and Materials, Vol. I, pp. 543-560, 1983.

Elastic-plastic J-R curves were obtained for compact specimens of A533B-02 plate tested at average load point velocities of 2.5×10^{-4} m/min and 0.25 m/s directly from the load displacement record using a key curve analysis technique. The slow velocity results compare well with J-R curves obtained on the identical specimens using an unloading compliance technique. The key curve method is shown to accurately predict the extent of crack extension. The J-R curves obtained from the high speed loading are shown to be elevated with respect to the slow test results in both the initial J_i and the tearing modulus T by from 50 to 100 percent.

JOYCE, James A., Associate Professor, "**Instability Testing of Compact and Pipe Specimen's Utilizing a Test System Made Compliant by Computer Control**," Division of Engineering and Technology, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C., Technical Report NUREG CR-2257, March 1982.

The aim of this report is to demonstrate that a computer controlled test machine can replace a test machine made compliant by a mechanical spring for tearing instability testing of simple compact and cracked pipe geometries. The results show that though the computerized system utilized here is slower than the spring machine, this is not a serious drawback for structural materials with low to moderate rate dependence. The "inertia free" response of the computerized system is in fact a positive feature for studying tearing instability arrest and promises to be very usetul in further studies in that area.

JOYCE, James A., Associate Professor, co-author, "**Experimental Investigation of Tearing Instability Phenomena for Structural Materials**," Division of Engineering Technology, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C., Technical Report NUREG CR-2570, Revised 1 August 1982.

The objective of this investigation was to extend the range of tearing instability validation experiments utilizing the compact specimen to include high toughness alloys. J-Integral of ASTM A106; ASTM A516; Grade 70; ASTM A533; HY-80; and HY-130 steels were performed in a variable compliant screwdriven test machine. Results were analyzed with respect to the materials J_I-R curves and various models of $T_{applied}$ for the compact specimen. Tearing instability theory was validated for these high toughness materials. For these cases of highly curved J_{I-R} curves, it was shown that the actual value of $T_{material}$ at the point of instability should be employed rather than the average $T_{material}$ value. The $T_{applied}$ analysis of Paris coworkers applied to the compact specimen appears to be nonconservative in predicting the point of instability, whereas, the $T_{applied}$ analysis of Ernst and coworkers appears to be accurate, requiring precision beyond that displayed in this program. The generalized Paris analysis applied to the compact specimen and evaluated at maximum load was most consistent in predicting instability.

LOPARDO, Vincent J., Professor, and Eugene L. KEATING, Associate Professor, "**Computer Simulation of Regenerative Cycles for Energy Conservation**," *Proceedings of the AMSE Conference*, Bermuda, 28 February - 3 March 1983.

This paper demonstrates the use of an interactive computer simulation program in teaching the intricacies of power plant design and analysis. The program allows rapid analysis of regenerative steam power plant for maximum performance. The concepts of first law thermal efficiency and second law exergetic effectiveness are used to determine if, when, and where to place feed water heaters.

LU, Yeh P., Visiting Research Professor, co-author, "**Noise Transmission in Submarine Structures. Phase I Mechanical Impedance Survey of a One-Third Scale Model SSN 637 Engine Room Compartment**," David W. Taylor Naval Ship Research and Development Center Report C-PAS-82-13 September 1982 (Confidential).

This is the first in a series of reports dealing with the experimental data measuring the dynamic responses of a one-third scale model of a SSN 637 engine-room compartment, including the main seawater system. This report presents the results of Phase I of the experimental program. The model configuration for this phase includes the hull, the main seawater pump foundation, condenser mock-ups, condenser foundation, main seawater suction and discharge valves but not the pumps or piping system. The excitation is applied at selected locations by an electromagnetic shaker driven by a random noise generator. The driving point components, hull, and frames are presented.

LU, Yeh P., Visiting Research Professor, co-author, "**Mechanical Impedances of the One-Third Scale Model of SSN 637 Engine Room Compartment without Piping System**," David W. Taylor Naval Ship Research and Development Center Report 82 103 (C2196 82) November 1982 (Confidential).

Analytical and experimental results of the driving point mechanical impedances and transfer impedances of the one-third scale model of the in-air SSN 637 engine-room compartment are presented and discussed. The model structural configuration includes the hull, main seawater pump foundation, condenser mock-ups, condenser foundation, and main seawater suction and discharge valves, but not the pump mock-ups or piping system. The excitation is applied at selected locations by an electromagnetic shaker driven by a random noise generator. A finite element mathematical model for this structural configuration is developed, and analytical solutions are determined and compared with the corresponding experimental data. The predictions follow the general trends of the experimental data except for the condenser and its foundation. Because structural damping is ignored in the analysis, the predictions are more oscillatory than the experimental data.

LU, Yeh P., Visiting Research Professor, co-author, "**Noise Transmission in Submarine Structures. Phases II and III. Mechanical Impedance Survey of a One-Third Scale Model SSN 637 Engine Room Compartment with Main Seawater Piping System**," David W. Taylor Naval Ship Research and Development Center Report C-PAS-82-44 (Confidential).

This is the second in a series of reports dealing with the experimental data measuring the dynamic responses of a one-third scale model of a SSN 637 class engine room compartment including the main seawater system. This report presents the results of phases 2 and 3 of the experimental program. The model configuration for these phases includes the hull, the main seawater piping system with and without water, the main seawater pump foundation, condenser mockups, pump mockups, condenser foundation, main seawater suction and discharge valves. The excitation is applied at selected locations by an electromagnetic starter driven by a random noise generator. The driving point and transfer mechanical impedances on major components, hull, frames, as well as piping are presented. In addition, sound pressure ratios are presented for several response points on the water-filled piping system.

LU, Yeh P., Visiting Research Professor, co-author, "**Mechanical Impedances of One-Third Scale Model of SSN 637 Engine Room Compartment with Unwetted Main Sea Water Piping System**," David W. Taylor Naval Ship Research and Development Center Report (Confidential).

Analytical and experimental results of the driving point mechanical impedances and transfer impedances of the one-third scale model of the in-air SSN 637 engine-room compartment are presented and discussed. The model structural configuration includes the hull, main seawater pump foundation, condenser mock-ups, condenser foundation, main seawater suction and discharge valves, pump mock-ups, and unwetted main sea water piping system. The excitation is applied at selected locations by an electromagnetic shaker driven by a random noise generator. A finite element mathematical model for this structural configuration is developed, and analytical solutions are determined and compared with the corresponding experimental data. The predictions follow the general generator. A finite element mathematical model for this structural configuration is developed, and analytical solutions are determined and compared with the corresponding experimental data. The predictions follow the general trends of the experimental data except for the condenser and its foundation. Because structural damping is ignored in the analysis, the predictions are more oscillatory than the experimental data.

MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy, "**Numerical and Experimental Stress Analysis Studies of Thin-Walled Oblate and Prolate Hemispheroidal Domes and Panel Structures for Sonar Systems**," *Proceedings of the International Conference on Computational Methods and Experimental Measurements*, Washington, D.C., July 1982, pp. 487-500.

As part of a total study and design of new sonar systems a major program of numerical and experimental work was undertaken.

Because the work required both fundamental research and extensive experimentation the program was divided into major areas. This paper reflects two of those areas, that of the structural analysis of domes under hydrodynamic conditions and the behavior of domes under simulated hydrodynamic loading. A full-scale study of domes and panels under service conditions has yet to be implemented.

The initial study concerned simplified configurations at approximately one-fiftieth scale. This program simplified the problems and allowed effort to be concentrated on the specific structural behavior of a series of oblate and prolate hemispheroidal domes. The effects of shapes and thickness on the static strength and deformation were established both from experimental and numerical studies. A new simple axisymmetric ring finite element was formulated and used to compute deformation, stress levels, instability pressure and some natural frequencies and the results obtained under hydrostatic loading conditions were compared with those obtained from a series of instrumented oblate and prolate hemispheroidal domes tested in a small pressure chamber. The behaviors of such domes were described in terms of a newly defined shape factor, which allowed all domes to be characterized within the range -1 to +1.

In the numerical program of work, hydrodynamic loadings were applied to the thin-walled shells and significant differences in shell behavior were noted between hydrostatic and hydrodynamic cases. A major cause of the difference in behavior, particularly the amount of axial deformation at the center of the dome is attributed to the relatively unloaded flank regions of the domes under hydrodynamic loading.

Although the hydrodynamic loads were numerically generated, a smaller experimental program was undertaken, and the pressures obtained from models fitted with surface pressure sensing compared well with the numerical results.

The second area of the work examined "likely configurations," that is particular domes and panels which contain less simplification and more of the complexities present in the "Final Configurations." Such major differences as the material characteristics and the hydrodynamic loading, other than axisymmetric, were considered.

The experimental requirements of this phase of the work required design, development, and commissioning of major experimental facilities Computer-based data acquisition systems, linked directly to the computer-controlled loading system, were used to simulate hydrodynamic loads.

Sophisticated software was also written to establish an advanced structural testing facility which had ease of use and setting up, as well as fast generation of report form data as its important advantages.

A flat panel facility, initially required in the evaluation of the simulation technique, which modelled distributed pressures as discrete step increments, provided the required lead in to a cylindrically curved panel facility necessary to evaluate the performance of thin glass reinforced plastic panels.

When stability performance is being evaluated, the importance of the correct boundary conditions, both experimentally and numerically, is not to be overlooked.

READ, Kenneth F., Assistant Professor, co-author, "**Surprising Energy Efficiency of the OTEC Power Plant**" *Proceedings of International Power Electronics Conference*, JIEE, Tokyo, Japan, 27-31 March 1983.

Ocean Thermal Energy Conversion (OTEC) into electrical utility power is a highly attractive energy management concept which can supplement nuclear and fossil fuel power. Utility grade power is generated in a three-stage process in which stored heat is converted into thermal energy, and this into mechanical energy and finally into electricity. The subtleties of this three-stage conversion process have lent themselves to many misunderstandings in regard to the effectiveness of an OTEC power plant which this paper attempts to resolve.

WU, Chih, Professor, "**Teaching Mixed-Refrigerants Cycles by Computer Simulation**," *Proceedings of the 1982 International Modelling and Simulation Conference*, Paris, France, 1-3 July 1982, pp. 130-132.

This paper provides a pilot interactive computer simulation program for teaching midshipmen to analyze and optimize a mixed-refrigerants cycle without experimenting on the real refrigeration system. The program allows fast and convenient modelling of a refrigeration system with several parameters. Typical usages include parametric evaluation, identification, and performance analysis.

WU, Chih, Professor, "**A Stochastic Finite Element Formulation for Thin Lubrication and Gap Heat Conduction**," *Proceedings of at the International Conference on Finite Elements Methods*, Shanghai, China, 2-6 August 1982.

As two rough surfaces approach each other, the in surface asperities begin to contact at a discrete number of points. The real contact area increases as the applied load increases. The degree of contact, which is a strong function of the number and nature of surface asperities, has a significant influence on the heat conduction behavior across the contacting gap and on the carrying capacity of a lubricated bearing.

This paper presents a stochastic finite element formulation in which effects due to the interference of asperities are included in the form of a truncated probability density function. The conventional heat conduction equation and Reynold's equation are modified. The work introduces the finite element method into the realm of stochastic processes, and may help to resolve such problems as gap heat conduction and film lubrication, where discrete microscopic effects cannot be ignored and where using each finite element as a continuum fails.

WU, Chih, Professor, "**Modelling of a Calcium Chloride Hexahydrate Thermal Energy Storage for Home Heating**," *Proceedings of the AMSE* (Association for the Advancement of Modelling and Simulation Techniques in Enterprises) Conference, Bermuda, March 1983.

Thermal energy storage in chemical compounds is a concept under development for home heating. Dow Chemical and Phillips Petroleum together have produced a calcium hexahydrate energy storage unit for commercial production. A theoretical simulation system analysis and a model experiment of the energy storage system in a passive mode is developed and presented in this paper. The objective was to determine the practicality and feasibility of using this unit for passive home heating. A model $3^{1}/_{2}$ inches diameter and 12 1/8 inches long cylinder rod containing the calcium chloride hexahydrate compound is used. Five thermal couples are installed at various positions on the sample. The model is subjected to repeated cycling. Heat flux rates and temperatures are recorded. The desired characteristics of the model testing are obtained. The results show a low heat transfer rate, a low discharge life-time, poor volume to surface ratio, and poor unit applicability to passive residential heating requirements. The finding is that passive heating use of calcium chloride hexahydrate thermal energy storage system is expensive and not practical.

WU, Chih, Professor, "**An Innovative Undergraduate Wind Power Engineering Program**," *Journal of Wind Engineering*, 7 (March 1983), 20-25.

Wind power engineering is a part of an energy conversion course which has been developed as a senior elective in the Mechanical Engineering Department at the U.S. Naval Academy. The goal of this course is to provide midshipmen with a technical knowledge of wind power as well as other alternative energy conversion systems to meet modern energy engineering challenges.

WU, Chih, Professor, "**Mixed-Refrigerants Cycle Analysis,**" Division of Engineering and Weapons Report, EW-30-82, July 1982.

This report provides computer programs to simulate a mixed-refrigerants cycle. A previous Department of Energy report by Stoecker is reviewed and documented. The computer programs allow convenient modelling of a refrigeration system with various temperature reservoirs. Typical usages include parametric evaluation, identification and performance changes.

Wu, Chih, Professor, "**Evaluation of Thermodynamic Properties of A Non-Azeotropic Mixed-Refrigerants,**" Division of Engineering and Weapons, EW-31-82, August 1982.

Information about the relationships among thermodynamic properties for a non-azeotropic binary refrigerant in explicit mathematical equations, in graphs, and in tables has been developed. The procedures and methods in evaluating these thermodynamic values are given. The substances included in this work are (R-12, R-114) and (R-22, R-114).

WU, Chih, Professor, "**On the Coefficient of Performance of a Non-Azeotropic Mixed-Refrigerants Vapor Cycle,**" Division of Engineering and Weapons, EW-32-82, September 1982.

The coefficient of performance (c.o.p.) of a non-azeotropic mixture-refrigerants vapor cycle is analyzed in a general case. The results show that the c.o.p. of a mixture-refrigerant cycle is not always higher than the c.o.p. of either component-refrigerant cycle.

WU, Chih, Professor, "**Parametric Analysis of a R12-R114 Mixed-Refrigerants Refrigeration Cycle Analysis,**" Division of Engineering and Weapons, EW-33-82, November 1982.

A parametric study of a R-12 and R-114 mixed-refrigerants cycle is made. Tables are generated from the print-out of the computer programs, WU 400 and WU 505. The program WU 400 is written for a mixed-refrigerants cycle analysis, and the program WU 505 is for a single refrigerant cycle analysis. Parameters used in this report includes x (concentration), U1 (overall evaporator heat transfer coefficient), U2 (overall condenser heat transfer coefficient), L1 (load), A(11)(evaporator inlet cooling water temperature), A(19)(condenser inlet cooling water temperature), and A(20)(condenser outlet cooling temperature). Parametric evaluation on the cycle performance changes such as C.O.P., condenser log mean temperature difference, condenser overall heat transfer coefficient, evaporator log mean temperature difference, and evaporator overall heat transfer coefficient, etc. are identified.

WU, Chih, Professor, "**Analysis of a R22-R114 Mixed-Refrigerants Air Conditioning System,**" Division of Engineering and Weapons Report, EW-34-82, December 1982.

A potential naval ship air conditioning system using a R-22 and R-114 mixed refrigerants is investigated. The outstanding thermodynamic properties of R-22 permit the use of smaller equipment (including condenser and evaporator) is possible with similar refrigerants. R-114 is added to R-22 forming a mixed-refrigerants which may have a better COP than a single R-22 refrigerant air conditioning system. The mixed-refrigerants air conditioning system is especially attractive for naval ships where both size and high performance are problems.

WU, Chih, Professor, "**Feasibility of Using a Vapor Lorentz Cycle to Naval Ship Applications,**" Division of Engineering and Weapons Report, EW-6-83, January, 1983.

The coefficient of performance (COP) of an air conditioning system (chiller) can be increased by using a zeotropic fluid mixture in a Lorentz Vapor Cycle. The zeotropic mixed-refrigerants has a temperature variation parallel to that of the surroundings fluid with which the heat exchangers heat transfer takes place during the evaporation and condensation processes. The zeotropic mixed-refrigerants Lorentz cycle is investigated theoretically in this paper and energy savings of such an air conditioning system is predicted. Potential application of a zeotropic Binary Fluid mixture for naval ship air conditioning is also examined.

WU, Chih, Professor, "**Choice of Working Fluids for Mixed-Refrigerants Energy Conversion Systems,**" Division of Engineering and Weapons Report, EW-7-83, January 1983.

Mixed-Refrigerants air conditioning is a potential energy saving process of removing heat from space. Desirable mixed-refrigerants should possess physical, thermodynamic, and chemical properties which permit their efficient operation in air conditioning systems. In addition to economical considerations, there should be no danger to health in case of their escape due to leaks or other causes in an air conditioning system. These physical, thermodynamic, chemical, economical, safety and specific properties are listed and discussed in this report.

WU, Chih, Professor, "**Zeotrope Energy Conversion**," Division of Engineering and Weapons Report, EW-8-83, February, 1983.

Fundamental subject matter of the zeotropic mixture energy conversion systems are covered in this paper. Basic concepts and theories are presented to explain why the zeotrope heat engines, heat pumps, and refrigerators have potentially better performance in either thermal efficiency or coefficient of performance for energy savings than conventional single working fluid energy conversion systems. An ideal zeotrope is defined. Properties and equations of zeotropic mixture systems are described and developed from basic multicomponent multiphase equilibrium thermodynamics. Discussion of the use of zeotropes in heat engines, heat pumps, and refrigerators are also included.

WU, Chih, Professor, "**Teaching, Demonstration, and Research in Power Engineering Wind Energy at the U.S. Naval Academy**," *Proceeding of the 1983 ASEE Conference*, Troy, New York, 19-23 June 1983, Vol 1, pp. 202-206.

This paper describes the program of teaching, demonstration, and midshipman research on wind power engineering in the Department of Mechanical Engineering at the U.S. Naval Academy. The program was started at the time of the Arab oil embargo in 1973. A need for alternative sources of energy for the Navy was recognized, and a program has been developed to help satisfy that need. Student research on wind power engineering concepts, including analytical and computer simulation types; demonstration; measurement; construction; and potential naval applications are briefly reviewed. Specific research projects included in this paper, in order of their review, are as follows: 1. Winco Model 1222 Demonstration and Measurement; 2. Thermax Helius Rotor Demonstration and Measurement; 3. Solor Breeze - An Electric Sailboat; 4. Vertical Axis Wind Turbine; 5. Simulation and estimation of the power production of a wind turbine; 6. Wind-Powered Naval Cargo Ships; 7. Offshore Naval Base Wind Energy Conversion Assessment; and 8. Helicopter, airplane propeller and wind mill models testing.

WU, Chih, Professor, "**A Novel Dry Geothermal Zeotropic Power Plant**," *Proceeding of the International Energy Symposium*, San Francisco, California, 16-18 May 1983.

A novel dry geothermal zeotropic power plant is proposed and analyzed in this paper. Dry geothermal fields, in which no water is present, are important potential sources of geothermal energy. A heat transfer fluid, water, is injected into the dry geothermal fields to tap the thermal energy with a secondary closed vapor power plant. The pressurized injected water in the evaporator and cooling water in the condenser are the non-constant temperature heat source and head sink for the secondary vapor cycle. A zeotrope, a mixture of two or more fluids which have different boiling points, is proposed to be used as the working fluid for the vapor cycle. Due to the special feature of the zeotrope, the working fluid may have a temperature variation well matched and parallel to that of the surrounding fluid with which the heat transfer takes place during the evaporation and condensation processes. Improvement on the efficiency of the zeotropic vapor cycle is potentially possible. The zeotropic vapor cycle is investigated theoretically and a greater power production by the geothermal plant is predicted.

WU, Chih, Professor, "**Modelling and Simulation of a Slider Bearing with an Arbitrary Curved Surface**," *Proceedings of the Second International Symposium on Applied Simulation and Modelling*, San Francisco, California, 16-19 May 1983.

A stochastic model for thin lubrication, assuming that the total normal load applied to the plane of the lubrication surfaces is carried partly by the hydrodynamic action of the lubrication film and partly by solid asperity contacts, is used to simulate the pressure distribution in a bearing experiencing thin lubrication. The stochastic model proposes a truncated normal distribution for the surface roughness in the form of ridges and valleys in the direction of flow. The side flow effect is neglected. The advantage of the proposed model is allowing application of the theoretical model to actual contacting surfaces with measurable roughness in a simple and convenient way. A simulation method is developed for computer calculating the lubricant pressures. Although the geometry treated and the pressure distribution obtained are for a slider bearing with a convex pad surface, the simulation method could easily be extended to other curved surface shapes to study the effect of the surface curvature on load capacity, center of pressure, fluid friction, and drag which are related directly to bearing pressure distribution.

WU, Chih, Professor, "**The Prediction of the Viscosity of Mixed-Refrigerants**," Division of Engineering and Weapons Report EW-17-83, May, 1983.

Based on a microscopic kinetic theory of gases and liquids model, the viscosity of a mixed-refrigerants in vapor and liquid states is predicted and expressed in terms of the mixture temperature, pressure, components masses, components molecular sizes, reduced temperatures, intermolecular potential function characteristics, mixture diffusivity, and components viscosities.

Presentations

JOYCE, James A., Associate Professor, "**Drop Weight J-R Curve Testing Using the Key Curve Method**," Commission on the Safety of Nuclear Installations (OEPD) Specialist Workshop, Paris, France, 3 December 1982.

MACKNEY, Michael D.A., Lieutenant Commander, Royal Navy, "**Numerical and Experimental Stress Analysis Studies of Thin-Walled Oblate and Prolate Hemishperoidal Domes and Panels Structures for Sonar Systems**," International Conference on Computational Methods and Experimental Measurements, Washington, D.C., July 1982.

WU, Chih, Professor, "**Some New Development in Modern Refrigeration**," 1982 Annual Meeting of Chinese Society of Refrigeration, Hunan, China, 10-13 August 1982.

WU, Chih, Professor, "**Improving the Energy Effectiveness of Building Air Conditioning by the Application of Zeotropic Refrigerants**," 1983 Energy and Engineering Education Conference, Columbus, Ohio, 5-8 April 1983.

WU, Chih, Professor, "**Thermodynamic Analysis of Fluid Mixture Energy Conversion System**," Conference on Advanced Technology, Bellevue, Washington, 21-22 May 1983.

DEPARTMENT OF

Naval Systems Engineering

PROFESSOR RAMESWAR BHATTACHARYYA
CHAIRMAN

Research in the Naval Systems Engineering Department continues to play a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1982-1983, faculty members and midshipmen participated in numerous and varied projects in the fields of marine engineering, ocean engineering, and naval architecture.

A variety of projects were undertaken, both funded and unfunded. These include faculty research in the areas of testing the USNA YP replacement model, heat transfer characteristics of the heat balanced internal combustion engines, seafloor dynamics, extreme wave generation, effects of bow bulb and stern wedge on the FFG-7 performance, electrolytic drag reduction, wave powered desalination, bottom gradient analysis for world-wide landing beaches, deck wetness, and faculty sponsored midshipmen projects in the areas of underwater navigation systems, wave forces on a vertical pile, underwater diver communication systems, submarine propulsion, wave energy converters, crevice corrosion of nickel-copper alloys in seawater, neutron spectrometers, dynamic responses of offshore structures, and the development of theoretical damaged ship stability calculations. Finally, a SWATH unmanned surveillance platform will soon be available for future experiments within the Department and the Division at-sea research.

Support for research was found in many sources, from departmental operating funds to contracts and grants from such diverse organizations as the Naval Academy Research Council, the Naval Sea Systems Command, the Naval Civil Engineering Laboratory, the U. S. Coast Guard, the Naval Underwater Systems Center, the Office of Naval Research, and the Naval Surface Weapons Center, Dahlgren.

Sponsored Research

Evaluation of the Heat Transfer Characteristics of the Heat Balanced Internal Combustion Engine

RESEARCHER: LIEUTENANT COMMANDER DAVID A. BLANK, USN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The primary objective of this analysis is to numerically determine the temperature distribution and heat transfer rate throughout the piston cap of the heat balanced engine by bringing to bear on the problem the most recent developments in the areas of computational fluid flow and combustion modeling. The ultimate intent of the study is two-fold: (1) provide an analytic basis for cap piston design which minimizes heat stress in the piston, and (2) increase overall engine efficiency through a study of the mechanisms causing regeneration within the thermodynamic cycle of the engine.

Evaluation of Proposed Oceanographic Configurations for the 108-FT YP

RESEARCHER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON
SPONSOR: OCEANOGRAPHY DEPARTMENT

Arrangements and stability studies were conducted for the existing and new procurement Yard Patrol Craft to determine the suitability of each craft for oceanographic research use. Results indicate that the existing YP is preferable from the standpoint of arrangement flexibility, but that its stability characteristics are unsatisfactory. The use of the new procurement YP's is the subject of discussions between the Oceanography and Professional Development Departments.

The Resistance of a Systematic Series of Semiplaning Transom Stern Hulls

RESEARCHER: PROFESSOR ROGER H. COMPTON
SPONSOR: NAVAL SEA SYSTEMS COMMAND

The results of a model test program involving a family of six systematically varied patrol craft hullforms are presented as a contribution to the early stage design data base for low to medium speed, transom-sterned, coastal patrol vessels. Hullform parameters that were varied were section shape (hard chine versus round bilge), length-to-beam ratio, displacement-length ratio, and longitudinal position of the center of gravity. Speeds from zero to that corresponding to a Froude Number (based on waterline length) of 0.65 were investigated in calm water conditions. Measured experimental variables included model speed, model resistance, and vertical attitudinal changes. The results are presented in both graphical and numerical form.

Wave-Induced Seafloor Movement

RESEARCHER: ASSOCIATE PROFESSOR THOMAS H. DAWSON
SPONSOR: OFFICE OF NAVAL RESEARCH

This project is a continuation of seafloor response to surface waves begun in 1979. Recent work has involved the correlation of field measurements taken in a soft deformational feature in the Gulf of Mexico with predictions from a simple analytical model. Results were presented at a research conference on seafloor stability held in Bay Saint Louis in October 1982. Indications are that the soft feature sloshes back and forth in a standing-wave manner in response to the overhead waves.

Extreme Wave Generation

RESEARCHER: PROFESSOR BRUCE JOHNSON
SPONSOR: NAVAL SEA SYSTEMS COMMAND

A micro computer-based transient wave generation technique has been developed for the Naval Academy towing tanks. It utilizes a Tektronix 4051 terminal and a digital-to-analogue converter to sequence a controlled frequency and amplitude sweep of the drive signal to the wavemaker. Extreme waves, including plunging breakers in deep water, have been used in capsize tests in both tanks. Current research involves attempts to characterize the important time domain parameters in the resulting wave record. These parameters are needed in order to relate the synthesized extreme wave in a towing tank to the situations which might produce extreme waves in the open ocean.

Effect of Bow Bulb and Stern Wedge on FFG-7 Performance

RESEARCHER: PROFESSOR BRUCE JOHNSON
SPONSOR: NAVAL SEA SYSTEMS COMMAND

This study is the start of a 5-year research program concerning the effect of appendage shape on powering and sonar performance. The initial study concerns the addition of a bow bulb of the "Maestrale type" and a stern wedge to the FFG class frigates. The stern wedge study was completed by Ensign Jim Righter and showed an optimum wedge angle. The bow bulb study began in May.

Future plans include the search for a below-baseline bow bulb which could also enclose a bow mounted sonar. If a resistance improvement resulting from sonar dome shape changes is possible, fuel economy and or speed improvements should be possible.

Analysis of Bottom Gradient Data for World Wide Landing Beaches

RESEARCHER: LIEUTENANT COMMANDER ALAN W. KATZ, USN
SPONSOR: NAVAL CIVIL ENGINEERING LABORATORY

The purpose of this project is to analyze readily available bottom gradient data on landing beaches world wide. The accumulative probability of encountering the 20-foot and 50-foot depth contours within a range of distances from the shore will be graphically presented. If information is available on bottom sediment, similar graphs will be generated.

Computer Simulation of Wave Excited Ship Hull Deformations

RESEARCHER: ASSOCIATE PROFESSOR THOMAS J. LANGAN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Naval architects are beginning to design ship structures with dynamic loading rather than with the static methods of the past, and future design rules will incorporate dynamic loading in their specifications. Because of existing computer-aided design programs that have been developed and are presently being used by members of the Division of Engineering and Weapons, this division is in a unique position to make a substantial contribution in this area of naval architecture. The ship lines developed with the existing programs can be used as a basis for a computer simulation of the hull dynamics in waves. These lines provide a hull shape that can be used to derive the structural properties of the hull treated as a girder and to compute the fluid and weight forces on this hull. Indeed scientists at the David W. Taylor Naval Ship Research and Development Center have a program for predicting a ship's weight from a ship's lines and its proposed mission. This program is available and would be a major component of the structural dynamic ship model developed in the proposed research. A similar program for predicting the elastic stiffness of the hull from its lines and mission would have to be developed.

Deck Wetness Experiments

RESEARCHER: VISITING RESEARCH PROFESSOR ADRIAN R.J.M. LLOYD
SPONSOR: NAVAL SEA SYSTEMS COMMAND

Study is underway on the effect of bow shape on deck wetness characteristics in head seas. A model of the FFG7 will be tested with a family of seven alternative bow forms in irregular head seas appropriate to the North Atlantic. The mechanism of wetness will be studied with the aid of video recording, detailed measurements of relative bow motion, and monitoring of impact pressures experienced by an array of pressure-sensitive cells on the forecastle.

Electrolytic Drag Reduction

RESEARCHER: PROFESSOR MICHAEL E. McCORMICK
SPONSOR: NAVAL UNDERWATER SYSTEMS CENTER

Over the past decade, experiments conducted at the U. S. Naval Academy have shown that gas bubbles created on the submerged hull skin of a ship effectively reduce the frictional resistance of the model. The models studied in the towing tank experiments include a 1-meter hull of revolution, a 2-meter destroyer hull, and a 6-meter destroyer hull — the latter studied at the David Taylor Naval Ship Research and Development Center.

Results of theoretical analyses indicate that the method of drag reduction is similar to that of Bogdevich, *et al*, in that the mass of produced gases concentrates at the position of maximum turbulent shear stress. Furthermore, since the gas bubbles are of microscale, there may also be a particle-in-flow effect, as studied by Buevich. The analyses applied to full-scale ships predict significant drag reduction with a modicum of parasitic power (to produce the gases). For example, a 10% reduction in the local friction is predicted for a 100m ship traveling at 7.7 m/s (15 knots) with a parasitic power of 18 kW.

A full-scale test program is presently underway at the Naval Academy on the "Solar Breeze," a 13-meter fixed-keel sailboat. The hull has a large beam-to-length ratio, making it ideal for the drag reduction study. The anodecathode pairs are mounted athwartships on the hull from the bow to the midship section. Bubbles are to be produced by a series of d.c. batteries. The tests will be conducted in December in the Chesapeake Bay.

Powering Comparison Experiments in Deep and Shallow Water for a U. S. Coast Guard 160'WLIC (Aids to Navigation Vessel)

RESEARCHER: ASSOCIATE PROFESSOR BRUCE C. NEHRLING
SPONSOR: UNITED STATES COAST GUARD

A series of shallow water resistance experiments were conducted in the Hydromechanics Laboratory of the United States Naval Academy on two scale models of a United States Coast Guard 160' WLIC (Aids to Navigation Vessel). These geometrically similar models were towed in several water depths over both a fixed and a false bottom. Plotted results clearly show the notable influence that both ship speed and water depth have on a vessel's powering requirements. In addition, the ratio of beam to basin width, as well as the type of bottom, was shown to have a marked effect on shallow water resistance predictions. A comparison with an earlier set of shallow water tests conducted on the same hull form was made.

Development and Application of a Neutron Spectrometer

RESEARCHERS: ASSOCIATE PROFESSOR MARTIN E. NELSON AND PROFESSOR PETER F. WIGGINS
SPONSOR: NAVAL SURFACE WEAPONS CENTER

The USNA Neutron Spectrometer system consists of a NE-213 scintillation detector, various amplifier and delay circuits, a multichannel analyzer, and several computer programs which convert the neutron data into usable neutron energy spectrums. A dual parameter system was used. This system enabled the researcher to separate gamma rays from neutrons by their different rise times. The system was used to determine the neutron energy spectrum from the following sources: a 14 MeV neutron generator, a Californium-252 neutron source, and a Plutonium-Beryllium neutron source. The results to date compare favorably with the experimental results of others in the field.

Improving Boiling and Condensing Heat Transfer in Refrigeration Systems

RESEARCHER: PROFESSOR BRUCE H. RANKIN
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS

This task involved doing the background research needed for improving the performance of refrigeration and air conditioning systems on naval ships. Over 2000 titles and 150 papers on the subject of heat transfer were examined. From this a bibliography of 250 applicable papers was assembled. Short papers were prepared on these subjects: "Plate-Fin Heat Exchangers," "Improving Condensation," and "Improving Evaporation."

Results of Oil Separation Analysis Program

RESEARCHER: ASSOCIATE PROFESSOR CLYDE C. RICHARD
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS

One method for removing oil from an oil water mixture is to use a gravity, parallel-plate separator, whose operation depends on the differences in the specific gravity of the fluids to be separated. To enhance the operation of this separator, banks of vertical and or horizontal plates are used to coalesce the oil and allow it to rise in large bubbles to an upper chamber, where it is removed.

To date, only limited analysis of the physical phenomena that describes the operation of gravity, parallel-plate, separators has been performed. One research effort has led to the development of a computer program for predicting the concentration of oil in the output stream for variations in the inlet conditions, separator geometry, separator size, mean oil droplet size, etc.

Turning Diameter Tests of the Swath T-Agus Models

RESEARCHERS: ENSIGN JAMES R. RIGHTER, USN, AND ASSOCIATE PROFESSOR HOWARD CHATTERTON
SPONSOR: NAVAL SEA SYSTEMS COMMAND

Two small waterplane area twin-hull (SWATH) ship configurations were tested in the McDonough Hall training pool to determine their turning diameter. A technique using overhead photography was developed, and the models were outfitted with self-propulsion. Resulting data were presented to Naval Sea Systems Command personnel to provide a quick check on computer predictions of tactical diameter.

Closed Cycle Propulsion System Gas Management

RESEARCHER: LIEUTENANT COMMANDER ACE J. SARICH, USN
SPONSOR: NAVAL COASTAL SYSTEMS COMMAND

Underwater propulsion is, at present, limited primarily to nuclear power and battery systems. The standard Otto or diesel cycle can be made to operate in a closed loop with proper gas management. CO_2 must be removed if the system is to be operated for any extended period. Two methods are under investigation: (a) the direct absorption of CO_2 by sea water by using a scrubbing tower with sea water as the absorbent, and (b) the use of membrane technology for the separation of CO_2 from the exhaust gas. The second method mentioned will be investigated in the fall of 1983 as a midshipman research project.

Wave Powered Desalination

RESEARCHER: LIEUTENANT COMMANDER ACE J. SARICH, USN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL AND THE UNIVERSITY OF DELAWARE

Wave powered desalination systems have the potential to produce fresh water from seawater at 10% to 50% of the costs of the most economical present day desalination process. The basic system consists of a wave driven buoy which drives a pump which supplies pressurized water to a reverse osmosis desalination element. Two specific areas are currently under investigation: (1) the design of a salt water hydraulic spool valve for use with a saltwater booster pump, and (2) the analysis of fluid flow over notches in a very narrow channel. The results are to be applied in the design of a ringless piston for salt water pumping.

Swim Fin Analysis

RESEARCHER: LIEUTENANT COMMANDER ACE J. SARICH, USN
SPONSOR: NAVAL SURFACE WEAPONS CENTER, DAHLGREN

This is an on-going midshipman research project. A wide selection of commercially available swim fins are being analyzed. Fins are categorized and tested in the 120-ft tow tank and performance measured. Materials are also analyzed. Midshipmen have tested the fins for comfort, power, and durability. A body of data is being developed from which optimum hydrodynamic characteristics will be obtained.

Permeable Membrane Helium Reclamation

RESEARCHER: LIEUTENANT COMMANDER ACE J. SARICH, USN
SPONSOR: NAVAL SURFACE WEAPONS CENTER, DAHLGREN

To date, four permeators have been tested and evaluated for use in the reclamation of helium from divers breathing gas. The permeators currently being evaluated have excellent characteristics. The next step is to incorporate the new permeators into an existing hyperbaric chamber for further testing and modification.

Unmanned Surveillance Platform

RESEARCHER: LIEUTENANT MICHAEL C. TRACY, USN
SPONSOR: NAVAL SEA SYSTEMS COMMAND

The Navy continues to be affected by a decrease in available manpower, a limited number of ships, and rising construction, fuel, and manning costs for the foreseeable future. This project explores the technology applicable to the design of a remotely operated, unmanned platform for open ocean surveillance.

The concept is that of a Small Waterplane Area Twin Hull (SWATH) platform which can be placed at sea by a larger vessel, and left to conduct surveillance operations for an indefinite time. The vehicle would monitor its own position and, upon command, proceed under its own power to another position and maintain station. The platform would monitor ocean areas by means of passive sensors. The platform support systems would be capable of quiet operation to avoid interference with the surveillance system. Wind, solar, and possible ocean wave energy recovery techniques will be utilized as prime sources of power.

The design objectives for the project are: (a) build and operate a SWATH model capable of a minimum of one week operation using energy recovery devices to provide power; (b) install an instrumentation system for recording of environmental data, with either storage or transmission capability; (c) incorporate the ability for wind and solar energy recovery, and explore the use of wave energy recovery techniques; and (d) size the vehicle to allow a 200-pound technician to board and service equipment with the model in the water.

Construction of the base platform is completed. Electrical control system design is in progress with installation of equipment on the platform scheduled for early summer. Testing of the vehicle on the Severn River is scheduled for late summer.

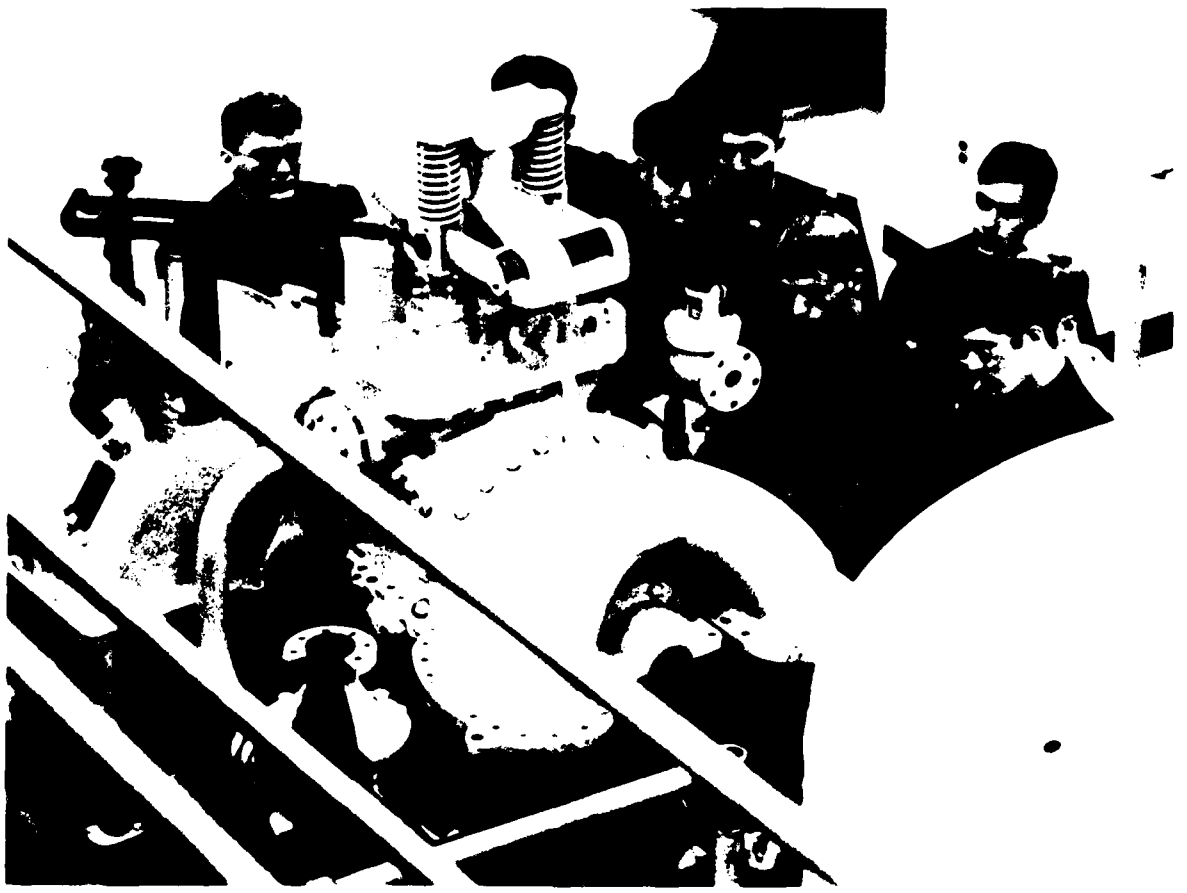
Independent Research

Computer-Aided Design and Manufacture of Marine Propellers

RESEARCHERS: PROFESSOR RAMESWAR BHATTACHARYYA, ASSOCIATE PROFESSOR THOMAS J. LANGAN, ET AL.

This study presents a computer-aided design and manufacturing method for marine propellers that can be executed on a microcomputer based system and can be adapted to an individual designer's particular requirements. Conceptually, the researchers approached the development of the method from the point of view of the designer and not that of a researcher or a computer enthusiast. The computer is used for calculations, data retrieval, plotting routines, and controlling machine tools. It does not replace the designer but provides him with the information necessary for design decisions. Rather than use the most eloquent mathematical treatment of the propeller, models have been chosen which are adequate for design purposes and which should be familiar to designers in some form. Although the individual programs depend on details of the methods, the computer techniques are independent of the design method and computer hardware. A designer can utilize them with any method or computer hardware available to him.

During the design phase the various sources of data from which to develop the initial propeller are discussed. In addition, methods for modifying the sections and the hydrodynamic basis for the modifications are given. A brief overview of structural considerations is also presented and a discussion in some depth is presented on several mathematical surface representation techniques. Following a brief discussion of the computational hardware utilized for the work described herein is a description of the numerically controlled process used to create the example propeller.



Research Course Projects

Cleaning Stack Gases on Coal Burning Ships

RESEARCHER: MIDSHIPMAN 1/C DARREN ANDERSON
ADVISER: PROFESSOR BRUCE H. RANKIN

All uses of coal on large ships were researched. An excellent paper on coal burning problems and possible methods of alleviation was written.

Measurement of Shielding Coefficients with A Neutron Spectrometer

RESEARCHER: MIDSHIPMAN 1/C SCOTT W. BELL
ADVISER: ASSOCIATE PROFESSOR MARTIN E. NELSON

The objective of this project is to measure the attenuation coefficients of various shield materials with different neutron sources by the use of a neutron spectrometer. This semester the emphasis will be on the design of the neutron spectrometer. The spectrometer consists of a NE-213 scintillation detector, various amplifiers and delay circuits, a multi-channel analyzer, and several data reducing computer programs. This system is unique in that it is a dual parameter system, simultaneously measuring both the rise time and the energy of each event. A Pu-Be (Plutonium-Beryllium) source will be examined for its neutron spectrum and compared with data from the USNA 14MeV neutron generator and the USNA Cf^{252} (Californium) source. The project has been completed and the results were presented at the American Nuclear Society Student Conference at the University of Virginia in Charlottesville, Virginia, 22 April 1983.

Feher Cycle for Submarine Propulsion

RESEARCHER: MIDSHIPMAN 1/C JOSEPH M. BERGEN
ADVISER: PROFESSOR BRUCE H. RANKIN

Feher Cycle uses CO_2 in the super critical range. By selecting proper temperature and pressure, the cycle can be made so that pump work is similar to the Rankine cycle values and regeneration is similar to Brayton Cycle values. Net result is a cycle more efficient than either. However, the cycle must be closed. The researcher consulted the inventor and developer of the cycle for information and then ran the calculations for sizing such a plant for a small submersible.

Resistance Tests of the U. S. Coast Guard 210-Ft Medium Endurance Cutter

RESEARCHERS: MIDSHIPMEN 1/C DENNIS BEVINGTON AND KURT J. KAMMERER
ADVISER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

The U. S. Coast Guard's 210-foot Medium Endurance Cutter is approaching mid-life renovation. Model tests were conducted to evaluate modifications which might improve its performance. Model tests for resistance were conducted at three displacements with the ship in its existing, and a lengthened, configuration. Both configurations were also tested with a stern wedge in an attempt to improve speed.

Results of these tests were presented to the Chesapeake Section of the Society of Naval Architects and Marine Engineers.

Underwater Navigation System

RESEARCHER: MIDSHIPMEN 1 C WHITMORE S. BUTTS AND MARK R. KALMBACH
ADVISER: LIEUTENANT COMMANDER ACE J. SARICH, USN

An underwater navigation system consisting of two master/slave transmitters and a hand-held receiver are under development. The system will enable the diver to accurately navigate/search an underwater area in conditions of poor visibility. The system, being developed in conjunction with the Electrical Engineering Department, will use LORAN technology.

Wave Forces on a Vertical Pile

RESEARCHER: MIDSHIPMAN 1/C BRUCE F. DAMMEIER
ADVISER: ASSOCIATE PROFESSOR THOMAS H. DAWSON

The objective of this work is to measure the forces exerted on a vertical 2-inch diameter pile by waves of varying heights and periods and determine appropriate drag and inertia coefficients for use in engineering wave-force formulas. The results will be compared with published coefficients derived from oscillatory (non-wave) experiments at the Naval Postgraduate School and with results at the Naval Academy in a previous Trident Scholar project concerned with wave forces on an off-shore test structure.

Underwater Diver Communication System

RESEARCHERS: MIDSHIPMEN 1/C GEORGE M. FERRIS AND GARY R. REEVES
ADVISER: LIEUTENANT COMMANDER ACE J. SARICH, USN

A diver to diver communication system for use by SCUBA divers is being refined from a previous midshipman project in conjunction with the Electrical Engineering Department. The system, as envisioned, will be an inexpensive, simple communication device consisting of a bone conductor earphone/microphone, battery power amplifier, and magnetically coupled hard wire communications line. The device would allow SCUBA divers to communicate underwater without putting acoustic energy into the water.

Evaluation of A Wave Energy Converter

RESEARCHERS: MIDSHIPMEN 1/C EDWARD D. HALPIN, TIMOTHY F. HEALEY, AND MICHAEL E. SMITH
ADVISER: PROFESSOR MICHAEL E. MCCORMICK

This project dealt with the performance evaluation of a wave energy converter. The converter used was an exact scaled-down replica of the original system. Two identical 1/25th scale pontoons were joined end to end by a bearing and hinge system designed for reducing frictional energy losses to a minimum. The pontoon system underwent a series of tests in the large towing tank. A Pierson-Moskowitz wave spectrum with an average wave height of three inches was generated. The vertical displacement of each pontoon bow was recorded. A random sea was created by the wave generator and vertical motion of the pontoon system was again observed. The purpose for testing vertical pontoon motion due to wave action is to prove that the motion of the leeward pontoon remarkably decreases with increased wave frequency. The original project consisted of testing the McCabe wave energy pumps. Through the motion of the pontoons the piston-type pumps would be driven, resulting in the development of water pressure head and volumetric flow. The pump efficiency is then based upon the amount of head and volumetric flow developed. Due to complications, the McCabe pumps arrived too late and could not be installed in the pontoon system.

Evaluation of Crevice Corrosion in Nickel-Copper Alloys in Seawater

RESEARCHER: MIDSHIPMAN 1/C GARY HOBSON
ADVISER: ASSOCIATE PROFESSOR EUGENE H. KINELSKI

The objective of this project is to study the effects of crevice corrosion upon various nickel-copper alloys including Monel (70:30 Ni-Cu). Early in this semester, while the necessary platforms are being constructed, research will be conducted at the David W. Taylor Naval Ship Research and Development Center as to their work on crevice corrosion and the suitability of Monel for naval use. The experiment will consist of various flat panel specimens with numerous crevices created by grooved washers. This experiment will be conducted in the Severn River and will cover a period of at least eight weeks, so that the effects of time can be observed. The final report will contain the results and analysis of the experiment, a summary of the information found at DTNSRDC, and conclusions on the susceptibility of nickel-copper alloys to crevice corrosion, and whether the corrosion is being driven by metal-ion or oxygen concentration cell corrosion.

Development of Neutron Spectrometer

RESEARCHER: MIDSHIPMAN 1/C THOMAS H. HODGSON
ADVISER: ASSOCIATE PROFESSOR MARTIN E. NELSON

The object of this project is to continue research from the Fall 1982-1983 semester in the development of a neutron spectrometer to measure neutron energy distribution. The spectrometer will then be used to determine attenuation coefficients for various shielding materials. This will be done through the reduction of experimental data collected using the neutron spectrometer. Neutrons involved will be of various energies, including those from a 14 MeV neutron generator, 4 MeV neutrons from Beryllium and Plutonium sources, and fission energy neutrons from a Californium source.

This project has been completed and the results were presented at the American Nuclear Society Student Conference at the University of Virginia in Charlottesville, Virginia, 22-23 April 1983.

Resistance Tests of a Diver

RESEARCHERS: MIDSHIPMEN 1/C STEPHEN G. MARR, DONALD L. HEIKEN, MICHAEL E. SMITH, AND STEVEN YOUNG
ADVISER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

This project was conducted to evaluate the resistance of free swimming divers with varying equipment configurations. A similar midshipman project, conducted the previous year, did not have adequate control of the diver's attitude in the water. A towing device was modified for use in the 120-foot towing tank in the USNA Hydromechanics Laboratory. A diver was towed and resistance measured in the following configurations: (a) swim trunks, (b) wet suit, (c) single air tank, and (d) double air tank.

Zero Speed Motions Comparison of Two and Four Strut Swath Ships

RESEARCHERS: MIDSHIPMEN 1/C JOHN MCPHERSON AND BRADLEY VOIGHT
ADVISER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

The Coast Guard is investigating the utility of a small waterplane area twin hull ship for buoy tending. Two possible ship configurations were dynamically modelled and tested in waves in the Hydromechanics Laboratory's 380-foot towing tank. Deck edge motions at the bow and beam were measured, and accelerations at the beam were also recorded. These data were used to evaluate a computer program by which motion records are differentiated twice to obtain acceleration. The results were presented at a meeting of the Chesapeake Section of the Society of Naval Architects and Marine Engineers.

Freeing Forces for Stranded Ships

RESEARCHER: MIDSHIPMAN 1/C MICHAEL R. MUNDT
ADVISER: ASSOCIATE PROFESSOR THOMAS H. DAWSON

This research involves measurements of the forces needed to free small-scale ship models grounded on clay bottoms. The objective is to determine the relationship existing between freeing force, weight agrôund, contact area and soil cohesion and, ultimately, improve the Navy's ability to predict the freeing forces needed for ships grounded on clay (muddy) bottoms.

Development of Theoretical Damaged Ship Stability Calculations — Part II: Satisfaction of Intact and Damaged Stability Criteria

RESEARCHER: MIDSHIPMAN 1/C DON W. NOBLES
ADVISER: PROFESSOR RAMESWAR BHATTACHARYYA

This semester's research was a continuation of last semester's theoretical calculations for damaged stability. The work for the second semester began with the use of a second method for the calculation of the damaged ship's stability in waves. Using this $\partial P / \partial Z$ method, which involves partial differentiation of the wave pressure equation to yield the pressure distribution on the hull, the trim and heel conditions were determined for equilibrium in a wave. The wave had its crest at the amidship section of the box-shaped lighter, which was employed for simplicity in all of the semester's calculations. (The box-shaped lighter is of the same dimensions and damage as the lighter used for last semester's calculations.) This method yielded results which were exactly equal to last semester's more conventional but more tedious method.

Dynamic Responses of Offshore Structures

RESEARCHER: MIDSHIPMAN 1/C DONALD P. REIS
ADVISER: ASSOCIATE PROFESSOR THOMAS H. DAWSON

This research involves measurements of the dynamic deflection of a small-scale test structure in waves of varying heights and periods. The objectives are (1) to determine the adequacy of existing engineering methods for predicting dynamic response, and (2) to determine drag and inertia coefficients for comparison with existing published data.

Pneumatic Wave Energy Conversion

RESEARCHER: MIDSHIPMAN 1/C DAVID W. SABA
ADVISER: PROFESSOR MICHAEL E. MCCORMICK

This project dealt with the pneumatic wave energy conversion capture chamber. An eight-foot cylinder fixed in the 380 foot wave tank at the U. S. Naval Academy was used. A series of waves were run against the cylinder with data being collected on pressures and wave heights in the cylinder, wave heights outside the cylinder, and air velocity exiting the cylinder. The final test used a Bretcschnieder wave spectrum. All data were analyzed to determine the performance of this particular wave energy conversion device.

Publications

BOCK, Arthur E., Professor Emeritus, "**U. S. Naval Academy Dairy Farm Energy System Maintenance Program Development**," Division of Engineering and Weapons Report EW-29-82, November 1982.

The report gives historical background supporting the need at the U. S. Naval Academy Dairy Farm for an energy system maintenance program and includes the initial increments of an energy system maintenance program.

CHATTERTON, Howard A., Associate Professor, "**U.S. Coast Guard Wind-Class Replacement Icebreaker**," *Marine Technology*, 19 (October 1982), 387-399.

The general requirements for a wind-class replacement icebreaker are presented. The design of the vessel with these requirements are also presented together with a discussion of the icebreaker synthesis model which was used to identify the design problem solution. The chief characteristics and some of the features of the design are included.

DAWSON, Thomas H., Associate Professor, *Offshore Structural Engineering*, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1983.

This book is intended primarily as an introduction to the structural engineering of fixed offshore platforms and deals with basic structural theory as well as those aspects, such as wave loading, pile support, and dynamic response, that are of special importance to the subject.

The presentation is developed entirely from fundamentals acquired from basic undergraduate courses in engineering mechanics. The mathematical level is similarly limited to that obtained in conventional calculus and differential equations courses. Throughout the book, discussions of theory are followed by numerical examples designed to clarify details and illustrate proper applications.

A general introduction is followed by chapters on the structural theory of trusses and frames, the environmental loadings that can exist on offshore platforms, the static analysis of offshore structures, and analysis of foundations of such structures. A final chapter includes more detailed topics, such as time-dependent joint loadings from wave forces, multiple-degree-of-freedom dynamic analysis, dynamic response to irregular random seas, and response of offshore structures to earthquake loadings.

DAWSON, Thomas H., Associate Professor, co-author, "**Preliminary Studies of Line Pull Needed to Free Stranded Ships**," Division of Engineering and Weapons Report EW-23-82, September 1982.

Preliminary results of small-scale model studies on stranded ships are presented. Tentative freeing-force relations for ships stranded on sand and clay bottoms are proposed, based on these studies. For sand bottoms, the relation is the usual friction equation, with a coefficient of friction of 0.38. For clay bottoms, a similar friction relation is found to hold when the weight aground divided by contact area is less than about 64 percent of the soil cohesion. The friction coefficient in this case is about 1.6. For values of weight aground divided by contact area greater than 64 percent of the cohesion, the freeing force does not obey a friction relation, but rather is proportional to the contact area, the proportionality factor being the soil cohesion.

JOHNSON, Bruce, Professor, and Thomas C. GILLMER, Professor (retired), *Introduction to Naval Architecture*, Annapolis: U. S. Naval Institute Press, 1982.

The engineering fundamentals of naval architecture are emphasized in this basic textbook. The book develops such topics as ship geometry, strength, and stability, submarine-hydrostatics, ship hazards and vulnerability, and ship hydrodynamics. This generously illustrated volume includes numerous example problems and suggestions for additional study. A concise overview of the technical aspects of ship design, it is useful both as an undergraduate text and as a convenient reference for professionals concerned with the design of naval vessels.

MAYER, Robert H. Assistant Professor, co-author, "**Coping with Uncertainty in Unit Price Contracting**," *Journal of the Construction Division, ASCE*, 108 (September 1983), 379-389.

Unbalancing of unit price proposals is widely used to improve cash flows and the competitiveness of a tender. Such practices can alter a contractor's risk favorably or otherwise. This paper is concerned with selecting unit prices which achieve a balance between maximizing the present worth of profit and minimizing potential contractor loss due to quantity mis-estimates. A quadratic programming model is devised to determine optimal unit prices and an example illustrates features of implementation.

McCORMICK, Michael E., Professor, co-author, "**Pneumatic Wave Energy Conversion**," *Proceedings of the United States China Energy Resource and Environment Symposium*, November 1982.

Wave energy conversion using the pneumatic system is discussed. The performance of the system is shown to be optimized by both tuning to a desired wave period and impedance-matching. The desired wave period may be either that of the local swell or the period corresponding to the peak of the wave energy spectrum. Air compressibility is shown to be an important factor in the tuning process. By reducing the air volume above the oscillating water column, the natural period of the system is reduced.

The turbine system found to be most suitable to the pneumatic system is the McCormick counter-rotating turbine. Since the turbine operation is unaffected by changes in flow direction, it requires no rectifying flaps or valves which are subject to fouling.

McCORMICK, Michael E., Professor, "**Analysis of Optimal Ocean Wave Energy Conversion**," *Journal of Waterway, Port, Coastal and Ocean Engineering*, 109 (May 1983), 180-198.

The performance of two single degree-of-freedom systems — the heaving vertical circular cylinder and the vertical oscillating water column — are theoretically studied. The systems are optimized by using impedance-matching at the design frequency. This frequency is that of the peak of the wave energy spectrum in a wind generated sea. The results show that the optimized system acts as a strong antenna, attracting significantly more wave power than is incident in its body dimension. As the diameter of the system is increased, the draft of the device is decreased. Thus, there is a size limit for each design sea. Furthermore, there is also a lower limit of the diameter of the device operating in restricted waters. Because of the strong antenna effect, relatively small systems can be effectively used, making the optimized wave energy conversion system cost effective.

McCORMICK, Michael E., Professor, "**The Determination of the Directional Spectrum from Cross-Correlation Wave Measurements**," Division of Engineering and Weapons EW-14-83, April 1983.

The method of determination of the directional spectrum of a wind-generated sea using the results of cross-correlation measurements is described. From sparse correlating data, a mathematical form of the cross-correlation function is assumed. The convolutions of the function result in an expression for the directional spectrum in which the spreading function is a function of both direction and frequency.

McCORMICK, Michael E., Professor, "**Evolution of an Ocean Engineering Mechanics Course**," *Proceedings of the ASEE Annual Conference, 1983*, Vol. 2, 655-657.

The evolution of the Ocean Engineering Mechanics (OEM) course at the United States Naval Academy is discussed. In fourteen years the course has expanded from a concentration on monochromatic wave mechanics to a coverage of mechanics in both regular and random seas. The course as it is now taught is described along with the background and specialized ancillary courses which support the OEM course.

McCORMICK, Michael E., Professor, co-author, "**Air Driven Counter Rotating Wave Turbine: Modeling and Test Development**," *Proceedings of the 5th Miami International Conference on Alternative Energy Sources*, 1983.

A prototype Pneumatic Wave Energy Conversion (PWEC) device that utilizes a wave-compressed air supply coupled to a pair of counter-rotating turbines has been built. Each turbine shaft has a fixed rotation direction, and a gearing system is used to combine the output and drive an electric generator. The Johns Hopkins University's Applied Physics Laboratory (APL) has performed systems engineering analyses of the prototype PWEC device in order to prepare for a proposed at-sea test. As a result of these analyses, required modifications and additions to the existing PWEC prototype unit, equipment and control systems have been specified and necessary characterization and preinstallation testing requirements determined. A numerical model of the combined hydro- and thermodynamics of the PWEC capture chamber has been developed and predictions of resonance frequency and amplification factor of the oscillating water column in the capture chamber have been compared with a limited amount of experimental data. The model demonstrates resonance with predictions that are in qualitative agreement with the data. The numerical model has been used to study the generated power as a function of the capture chamber geometry and wave resource parameters, and to make performance predictions for a potential ocean platform test at Point Mugu, California. System operational requirements and performance estimates are presented and discussed.

NEHRLING, Bruce C., Associate Professor, co-editor, "**Computer Applications in the Automation of Shipyard Operation and Ship Design, IV**," *Proceedings of the IFIP IFAC Fourth International Conference*, North Holland Publishing Company, Amsterdam, The Netherlands, 1982.

ICCAS '82 is the fourth in a series of tri-annual conferences on the interrelated subjects of computer-aided ship design and computer assisted ship production. The three previous conferences were held

in Japan (Tokyo, ICCAS '73), Sweden (Gothenburg, ICCAS '76), and Scotland (Glasgow, ICCAS '79). The purposes and eventual results of these three conferences were to provide the international maritime community with a forum for the exchange of ideas, experiences, and future expectations for the application of computers to ship design and construction. The goal of ICCAS '82 has been to continue this important service.

NELSON, Martin E., and Clyde C. RICHARD, Associate Professors, "**The Availability Improvement Methodology - An Overview,**" 10th FDM/RAM Conference, Montreal, Quebec, Canada, 24-27 May 1983.

In recent years, the subject of utility power plant productivity and reliability has received significant attention from the federal and state agencies and from within the utilities. As part of its program to help improve electrical power plant productivity, the U. S. Department of Energy (DOE) has developed a methodology for evaluating productivity improvement projects. This paper presents a simplified overview of this methodology called the *Availability Improvement Methodology* (AIM), which provides a systematic approach for prioritizing plant improvement projects. Combining the results obtained from AIM with a cost/benefit analysis, a utility engineer can evaluate the merits of perspective plant improvement projects.

NELSON, Martin E., and Clyde C. RICHARD, Associate Professors, co-authors, "**The Availability Improvement Methodology (AIM) for Evaluating Power Plant Improvement Projects,**" 1982 Joint Power Conference, Denver, Colorado, October 1982.

The Availability Improvement Methodology (AIM) presented in this paper describes a method for calculating the increase in the power plant equivalent availability factor resulting from a proposed improvement project. AIM uses the recently developed IEEE definitions, along with other reliability parameters for establishing unit availability and performance. Additionally, AIM calculations are based primarily on data being collected for the Generating Availability Data System (GADS) of the National Electric Reliability Council. Many utilities are presently collecting equipment outage data on the GADS Performance and Event Report Forms. This data, if properly developed, is sufficient for performing AIM calculations.

Once collected and sorted, this data is used to develop reliability parameters describing past plant operation. Based on assumptions concerning the effect of a specific improvement project to increase plant production, hypothetical reliability parameters are developed and compared to the historical parameters. A hypothetical reliability parameter is an estimate of the future value of reliability the parameter will have if a given improvement project is implemented. The differences in the historical and hypothetical reliability parameters show the resultant increase in plant equivalent availability factor that results from the improvement project under study.

Included in this paper are a description of the data requirements of AIM, the most pertinent AIM equations, and a discussion of the seven steps needed to perform an AIM analysis. Using GADS-type data and the AIM equations, an example is presented that shows the increase in plant equivalent availability factor resulting from an improvement project. Combining this calculation with a cost/benefit analysis, a utility engineer can evaluate the merits of this improvement project.

RICHARD, Clyde C., Associate Professor, et. al., "**Seawater Biofouling Countermeasures for Spirally Enhanced Condenser Tubes,**" I.CHEM.E Symposium Series No. 75, 22-23 March 1983, England, 200-211.

The effect of condenser tube surface enhancement on biofilm accumulation and heat transfer was evaluated for stainless steel (AL-6X) and pure titanium (CP-2) tube material in natural seawater. Both smooth and spirally grooved enhanced tubes were installed in electrical heat transfer monitoring devices which provided real time digital measurements of biofilm resistance under simulated condenser conditions. Biofouling rates were determined for equal pressure drop and equal velocity conditions between the smooth and enhanced tubes. A series of tests for three seawater cooling velocities demonstrated the effectiveness of fresh-water lay-up, high-velocity flushing, and chlorination cleaning.

RICHARD, Clyde C., Associate Professor, "**Results of Oil Separation Analysis Program,**" Division of Engineering and Weapons Report EW-5-83, January 1983.

One method for removing oil from an oil/water mixture is to use a gravity, parallel plate separator whose operation depends on the differences in the specific gravity of the fluids to be separated. To enhance the operation of this separator, banks of vertical and/or horizontal plates are used to coalesce the oil and allow it to rise in large bubbles to an upper chamber where it is removed.

To date, only limited analysis of the physical phenomena that describes the operation of gravity, parallel-plate, separators has been performed. One research effort has led to the development of a computer program for predicting the concentration of oil in the output stream for variations in the inlet conditions, separator geometry, separator size, mean oil droplet size, etc.

SARICH, Ace J., Lieutenant Commander, USN, "**Applications of Permeable Membranes as Carbon Dioxide Scrubbers**," in *The Characterization of CO_2 Absorbing Agents for Life Support Equipment*. New York: American Society of Naval Engineers, 1982, pp. 197-208.

The problem of carbon dioxide in breathing gas is described and the potential for permeable membrane separators, or permeators, for carbon dioxide removal (scrubbing) is presented. Basic membrane theory, permeator design, and the use of permeators in cascade systems is discussed. Gas selectivities and permeabilities for candidate membranes are presented in tabular form. Potential permeable membrane application is looked at in the areas of collective protection shelter (citadel systems), submarine atmosphere control, air recompression and treatment chambers, saturation diving systems, self-contained breathing systems, and underwater habitats.

SARICH, Ace J., Lieutenant Commander, and Edward H. KIDERA, Instructor, "**Permeable Membrane Recovery of Helium from Diving Gas**," *Proceedings from International Diving Symposium*. New Orleans, Louisiana, 7 February 1983, 89-100.

Helium can be reclaimed from waste-diving gas by using a small reliable device called a gas permeator. Helium is enriched by means of a thin membrane through which helium permeates substantially faster than oxygen, nitrogen, and a number of other contaminants. High quality helium is retained and other gases are exhausted.

Basic permeator theory and design criteria area presented. Spiral wound cellulose acetate permeators were analyzed for helium enrichment. Helium selectivities, flux rates, pressure ratios, and efficiencies were determined. The permeators were incorporated into a proposed reclaim system and approximate system costs determined. Results indicate that permeators offer a simple, economical means of helium recovery.

Presentations

DAWSON, Thomas H., Associate Professor, "**Elastic and Visco-Elastic Solutions to Wave-Induced Sub-bottom Movements**," Research Conference on Seafloor Stability of Continential Margins, Bay St. Louis, Missouri, 12-15 October 1982.

LLOYD, Adrian R.J.M., Visiting Research Professor, "**Progress Towards a Rational Method of Predicting Submarine Manoeuvres**," RINA International Symposium on Naval Submarines, London, May 1983.

LLOYD, Adrian R.J.M., Visiting Research Professor, "**Deck Wetness Experiments**," 20th ATTC, Stevens Institute of Technology, Hoboken, August 1983.

LLOYD, Adrian R.J.M., Visiting Research Professor, "**Deck Wetness Research**," USNA Hydromechanics Laboratory Seakeeping Seminar, Annapolis, 13 October 1982.

LLOYD, Adrian R.J.M., Visiting Research Professor, "**Ship Motions, Wind, and the Helicopter**," USNA Sigma Xi Club, Annapolis, 16 February 1983.

METCALF, John T., Associate Professor, "**Recent Advances in Underwater Surveys for Extension of Time Between Drydocking**," Spring Meeting Star Symposium, Society of Naval Architects and Marine Engineers, Washington, D.C., 7 April 1983.

SARICH, Ace J., Lieutenant Commander, et. al., "**An Overview into Submarine CO_2 Scrubber Development**," ASME Winter Meeting, Phoenix, Arizona, November 1982.

DEPARTMENT OF

Weapons and Systems Engineering

PROFESSOR CHARLES F. OLSEN
CHAIRMAN

The Weapons and Systems Engineering Department provides and maintains an environment in which research activities contributing to the professional growth of the faculty and outstanding midshipmen flourish. Such research, in addition to keeping both faculty and midshipmen abreast of today's rapidly advancing technology, ultimately improves the academic environment by providing examples of, and solutions to, existing problems. Where research is based on problems posed by the U. S. Navy, the association causes the academic environment to be more relevant to the professional development of midshipmen.

Faculty research is regularly undertaken by nearly all civilian members of the Weapons and Systems Engineering Department and on occasion by some military members as well. Funding for research activities is available from several sources, including grants or contracts from various federal agencies as well as funding support from within the Naval Academy. Current contracts have been made by faculty members with the Naval Surface Weapons Center at White Oak and Dahlgren. Excellent faculty and midshipmen research relations have additionally been established with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

Sponsored Research

AEGIS Doctrine Study

RESEARCHER: ASSOCIATE PROFESSOR C. GEORGE BROCKUS
SPONSOR: NAVAL SURFACE WEAPONS CENTER, DAHLGREN

In the AEGIS combat system, the decision-making procedures have become very rapid and parallel in nature. In many cases human intervention takes the form of forbidding actions recommended automatically by the computers in the various components of the system. Each of the three main components, the Radar system, the Command and Display system, and the Weapons Control system, has its own computer control system, and each processes a set of IF (Conditions are met) THEN (Take the appropriate Action) doctrine statements. Since that facility is new, and because it is quite complex and interdependent, it is very difficult to fabricate and judge for completeness a set of doctrine statements.

As a result of an intensive study of the systems and their doctrine capability, it has been decided to build a functional simulation of the AEGIS Combat System, and to evaluate the performance of sets of doctrine statements utilizing a new technique from the field of Artificial Intelligence known as Genetic Algorithms. This effort will continue into Fiscal Year 1984, with the Simulation to be programmed in the new DOD HOL Ada.

Magnetoelastic Strain Gauge

RESEARCHERS: ASSOCIATE PROFESSORS ROBERT DEMOYER, JR. AND E. EUGENE MITCHELL
SPONSOR: NAVAL SURFACE WEAPONS CENTER, WHITE OAK

Magnetoelastic ribbon is a metallic substance with no crystalline structure. When annealed in a magnetic field, it attains a strong coupling between mechanical and magnetic properties. Stress applied to the ribbon produces a change in magnetic permeability, measurable as a change in inductance in a coil wound around the ribbon. Experimental results have shown the ribbon to act as a strain gauge with a gauge factor three orders of magnitude greater than that of a typical resistive strain gauge. On-going research is being conducted to eliminate undesirable drift apparently due to the ribbon bonding agent.

Application of Stochastic Optimal Control to Networks

RESEARCHER: ASSISTANT PROFESSOR RICHARD V. HOUSKA
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A statistical approach to solving network routing problems is investigated. By relating distances between nodes in a network to transition probabilities in a discrete state, discrete time Markov Process, the problem of finding a shortest path can be transformed into one of finding an optimal control. This method of finding an approximate solution to the shortest path problem can be programmed easily on a digital computer and is numerically efficient.

Power Line Carrier Systems

RESEARCHER: ASSOCIATE PROFESSOR OLAF N. RASK
SPONSOR: NAVAL SURFACE WEAPONS CENTER, DAHLGREN

Power line carrier systems are intended to be used to replace dedicated signal lines in transmitting control signals around a ship. This concept has been in use for many years in commercial power generation and is now being considered for shipboard use. The work last summer included the study of four presently available systems and the measurement of their performance. Also, it includes a study of the power cables as transmission channels. The three phase power lines support two modes of propagation. One is termed the symmetric mode and the other is termed the difference mode. Each mode has a different phase velocity and a different impedance. Expressions for the reflection coefficients associated with the 60 Hz generators and the 60 Hz loads were formulated. Coupling between the modes was studied.

Dynamic Models of Regenerative Cycle Gas Turbine Engines

RESEARCHER: ASSISTANT PROFESSOR JERRY W. WATTS
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The addition of a heat exchanger to a gas turbine engine to reduce fuel consumption by using exhaust heat can result in transient problems for the engine. For example, in a drop load, overspeed condition, a heat exchanger would aggravate the situation.

A dynamic model is being developed which will investigate this problem. The model will effectively simulate any gas turbine engine including intercooled regenerative engines and variable geometry engines. It is likely that special controls will need to be developed to protect regenerated gas turbine engines from some of the transients which may occur. Work achieved so far includes a simple (i.e. short computational time) dynamic model of a heat exchanger and incorporation of a 20-page computer model of Detroit-Diesel-Allison's fuel control into an in-house gas turbine model, which was made to function properly.

Stability Enhancement of a Flexible Robot Manipulator

RESEARCHER: MIDSHIPMAN 1/C THOMAS D. LOOKE
ADVISER: ASSOCIATE PROFESSOR KENNETH A. KNOWLES
SPONSOR: TRIDENT SCHOLAR PROGRAM

A computer software programming technique was developed to compensate a highly oscillatory robot system controlled by a bang-bang input. The assumptions that the system was linear and had lumped parameter characteristics allowed a fifth order, simplified dynamic model to be derived. Analysis using frequency response methods led to further simplification of the model to a third order system. Based on the third order model, a technique was developed which would compensate the system with a form of a deadbeat control. Simulation of the model driven by the compensated bang-bang input verified the deadbeat response. The technique was implemented on an 8080-based microcomputer system, which controlled the input. Actual system response to the compensated input was observed to be essentially free of the undesirable oscillatory motions, thus yielding an apparently rigid system.

Independent Research

Genetic Algorithms and the Traveling Salesman

RESEARCHER: ASSOCIATE PROFESSOR C. GEORGE BROCKUS

Genetic Algorithms, a new search technique from the field of Artificial Intelligence, were combined with an Optimal Control method recently developed for Stochastic Control Systems in order to search for optimum paths in the context of the Traveling Salesman Tours.

The combination of these disparate techniques, working together to satisfy a common goal, provided a new and very time-efficient technique for providing approximate (sub-optimal) solutions for an historically very difficult (in terms of time of computation) problem.

Research Course Projects

Robot Control Designs and Algorithms

RESEARCHERS: MIDSHIPMEN 1/C BARBARA A. BELL, CHERYL A. DOLYNIUK, RANDALL L. FUCHS, WILLIAM B. RAMSEY, AND DALE T. WALTER
ADVISERS: ASSOCIATE PROFESSORS ROBERT DEMOYER, KENNETH A. KNOWLES, E. EUGENE MITCHELL, AND ASSISTANT PROFESSOR JERRY W. WATTS

The goal of this project was to develop fundamental control accessories and control algorithm software packages to provide a foundation upon which future robotics research can build. The test vehicle was a small commercial six-axis, single speed, electric drive, rotary-joint table-top robot arm (RHINO XR-1). The control computer was an 8080-based, 64K byte memory, disk drive microcomputer operating under CP/M. Compiled Microsoft BASIC was used as the computer language, because of the ease of development utilizing interpretive BASIC, and the fact that the final programs, when compiled, executed with approximately 90% or more of the speed of similarly compiled microsoft FORTRAN programs. After developing a set of fundamental robot control, coordinate transformation, and safety programs as a group, each participant undertook one of the following specific projects:

1. A software package was developed to enable the RHINO to type out arbitrary messages on the controlling computer's terminal keyboard. A special orientation initialization routine was developed to permit the subsequent use of pre-stored key location coordinate data. Lack of tactile sensors and the tendency of the RHINO to destroy itself when physically restrained required the development and use of a spring-loaded typing wand.

2. Two physically different joystick-based pendants were developed for use in manually controlling the RHINO for use as a teleoperator, or for "teaching" a specific sequence of motions and coordinates. Software, including the track and display programs, was developed for use with the pendants. The single joystick pendant utilizing a trigger switch for end-effector control and a thumb switch for shifting joystick control between three groups of two axes each appeared to be more effective in controlling the RHINO than the two-joystick-two-hand control pendant.

3. A PDP-15/EAI-681 hybrid computer-based graphics and simulation package of software was developed for real-time computer study of the RHINO. An interface to the robot was also implemented, thus providing the basis for future hybrid computer-based compensated control of the RHINO, or similar robots.

4. Several collision avoidance algorithms were investigated by computer simulation to lay the groundwork for future multi-robot control research. A computer-controlled vertically moving obstacle, termed a "vertiveyor," was developed to provide a standard robot task impediment for comparing the performance of various collision avoidance algorithms. No algorithms were actually implemented on the microcomputer.

Voice Activated Telephone Dialing System

RESEARCHER: MIDSHIPMAN 1/C CRAIG HUSA
ADVISER: ASSOCIATE PROFESSOR OLAF N. RASK

The project up until this time has consisted of a study of the properties of the human voice in time and frequency, of telephone circuits, and of the various telephone chips which are available to replace discrete components. Ten band-pass filters distributed in a logarithmic manner between 200 Hz and 3000 Hz have been designed. Circuit boards have been built and the filters are now being assembled and tested. A dialing chip, the Mostek MK5173, has been selected and ordered.

Artificial Intelligence in Self-Learning Problem Solving Methods

RESEARCHER: MIDSHIPMAN 1/C JOEY MILLER
ADVISER: ASSISTANT PROFESSOR RICHARD V. HOUSKA

This research investigates the problem of developing an "intelligent" problem solving procedure which can both be programmed easily on a digital computer and applied to a variety of problems of potential interest to the U.S. Navy. To a certain extent the approach taken is similar to one known as the Graph Transverser, a method for finding paths through networks efficiently, introduced first in 1965. This is combined with a so-called "backtrack" analysis component to give the overall procedure memory and the ability to discriminate between good and bad moves in the course of solving any problem to which the procedure is applied. To date the results of this research include the development of a general algorithm in the form of a detailed process flow chart; the development of a digital computer program in BASIC, which implements the algorithms and applies it to playing a game of Tic-Tac-Toe; and some preliminary results of how the algorithm can be combined with good methods for obtaining approximate solutions to exponential time problems such as finding the shortest path connecting N points.

Publications

HOUSKA, Richard V., Assistant Professor, and C. George BROCKUS, Associate Professor, "**Stochastic Optimal Control Applied to Deterministic Network Problems.**" *Modeling and Simulation*, 13 (November 1982), 429-435.

A stochastic optimal control model is used to solve certain minimum path and minimum transit time problems in networks, including a version of the famous traveling salesman problem. The correspondence between a stochastic control model and deterministic problems is established by considering the minimum expected time optimal control as a permutation of system states which is equivalent to the shortest path through the network. In addition, a computationally efficient algorithm for finding the optimal control is developed and used to provide numerical results for several example problems. The algorithm itself can easily be programmed on a digital computer.

MITCHELL, E. Eugene and Robert DEMOYER, Jr., Associate Professors, et al., "**Force Feedback Sensors for Robot Adaptive Control,**" *Proceedings of the Fourth Meeting of the Coordinating Group on Modern Control Theory*, Part II, Oakland University, Rochester, Michigan, October 1982, pp. 1-22.

This paper describes the Naval Surface Weapons Center (NSWC) Program for developing high performance, simple, rugged, cost effective magnetoelastic force feedback sensors for robots and machine tools. Also, NSWC has designed magnetic circuits which are easily adapted to force feedback sensors. In this paper, magnetoelastic materials are described along with the properties that make them potentially such outstanding force feedback sensors. Following this, the NSWC Program is detailed, including advances in materials research, in simple, low cost electronic and magnetic circuits, and designs for force feedback sensor modules. The results are in the public domain.

MITCHELL, E. Eugene and Robert DEMOYER, Jr., Associate Professors, et al., "**Outstanding Potential Shown by Magnetoelastic Force Feedback Sensors for Robots,**" *Sensor Review*, (October 1982), 200-205.

This paper describes the Naval Surface Weapons Center (NSWC) program for developing high performance, simple, rugged, cost effective magnetoelastic force feedback sensors for robots and machine tools. The paper includes a description of the magnetoelastic materials and the properties that make them outstanding candidates for force feedback sensors. Also, included are some details on some of the low cost electronic and magnetic circuits.

Presentations

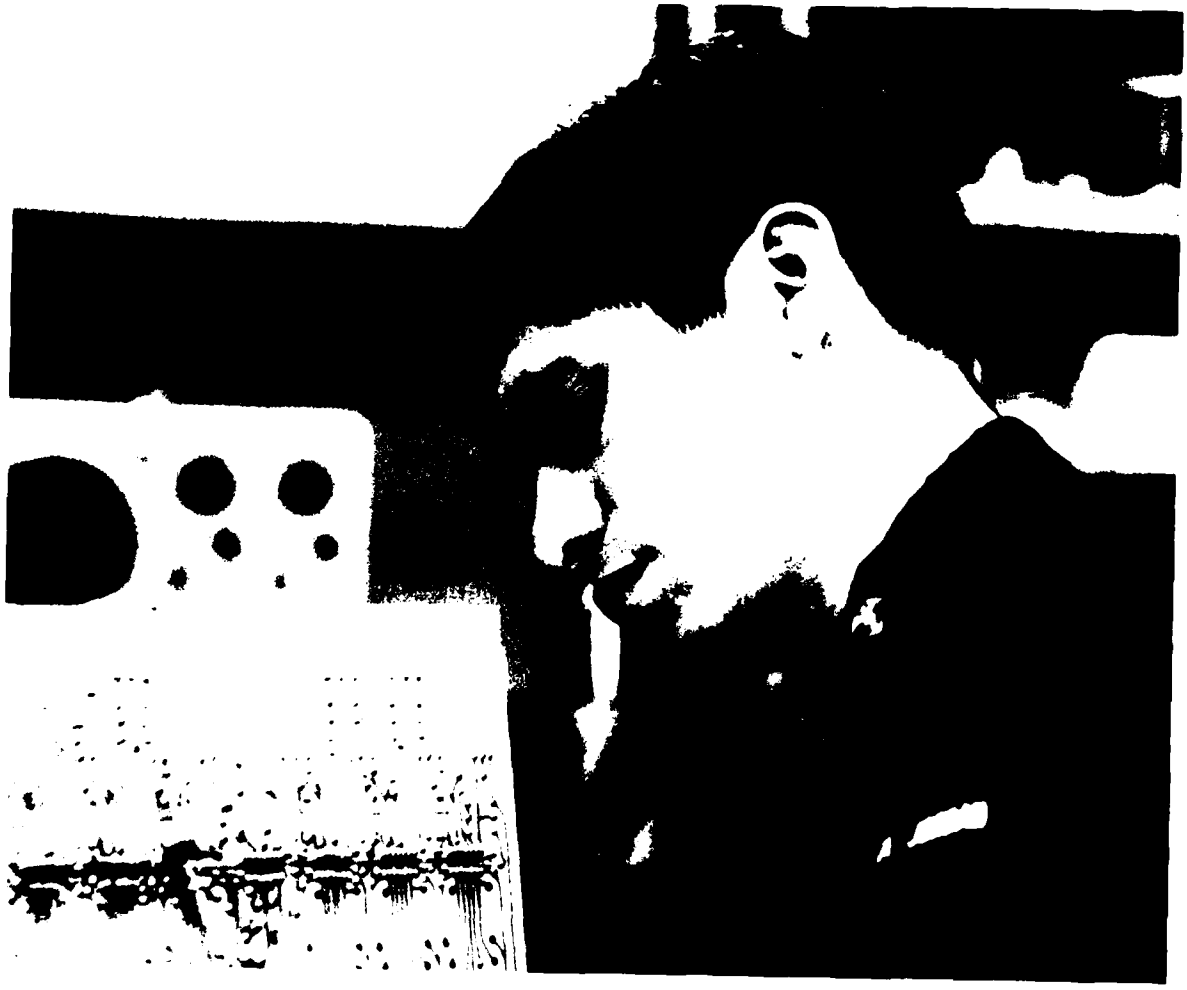
BROCKUS, C. George, Associate Professor, "**Shortest Path Optimization Using a Genetic Search Technique**," Fourteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 21-22 April 1983.

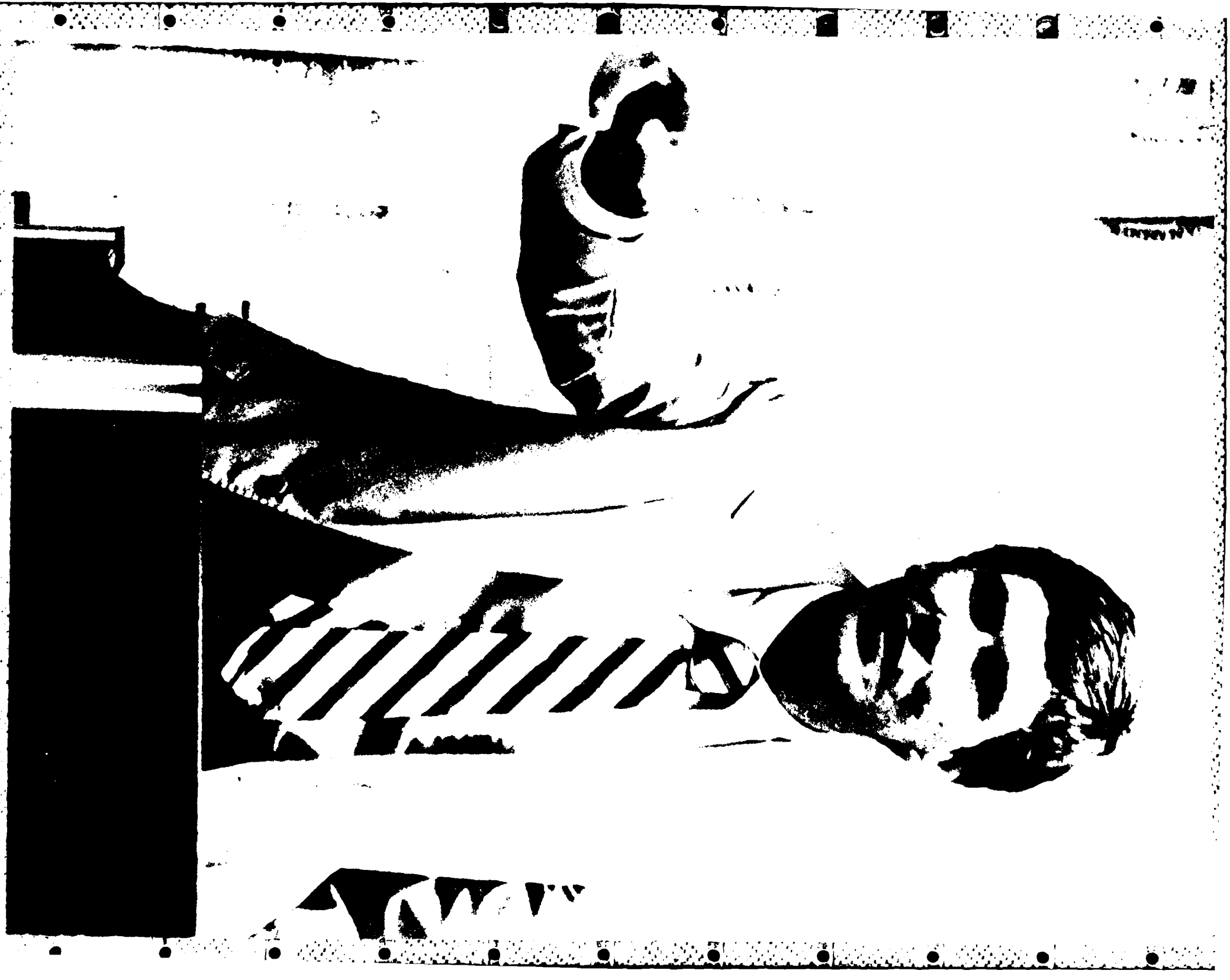
DEMOYER, Robert Jr., Associate Professor, and E. Eugene MITCHELL, Associate Professor, "**Force Feedback Sensors for Robot Adaptive Control**," Fourth Meeting of the Coordinating Group on Modern Control Theory, Oakland University, Rochester, Michigan, October 1982.

HOUSKA, Richard V., Assistant Professor, and E. Eugene MITCHELL, Associate Professor, "**Design and Analysis of Optimal Observers Using 3D Graphics**," Fourteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 21-22 April 1983.

MILLER, Joey, Midshipman 1/C and Richard V. HOUSKA, Assistant Professor, "A Self-Learning Method for Solving Shortest Path Network Problems," Fourteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 21-22 April 1983.

WATTS, Jerry W., Assistant Professor, "**Simulation of a Linear Time-Varying Deterministic Control Problem**," Fourteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 21-22 April 1983.





DEPARTMENT OF

English

PROFESSOR DAVID O. TOMLINSON
CHAIRMAN

For faculty members and midshipmen majors of the English Department, Academic Year 1982-1983 was a vintage year for literary research and scholarly publication. Two sponsored projects, with support from the Naval Academy Research Council, were underway: work toward an illustrated scholarly edition of the autobiography of a seventeenth-century Spanish soldier-of-fortune, and completion of a computer-generated concordance of Tennyson's poetry. Sponsored by the Trident Scholar Program and directed by an English faculty member, Midshipman Mark *Gorenflo completed* a study of John Milton and the "New Philosophy."

Independent (non-funded) research, with 27 projects in progress, included such varied topics as enchantment in nineteenth-century English literature, seafood and strategy in Elizabethan England, rhetoric, improving writing, and Renaissance women. English writers studied included James Bryce, Thomas Carew, Joseph Conrad, Robert Graves, John Milton, and Alfred, Lord Tennyson. The works of American authors Robert Hayden, John Pendleton Kennedy, Herman Melville, William Stryon, and James Wright were among topics investigated. One faculty member was at work on a novel and completed several short stories.

Twenty-eight articles were published in professional journals, and two bibliographies and contributions to an international bibliography were completed. Eighteen presentations were made by Department members at sessions of literary organizations. Ten research course projects were completed by English majors, under the direction of English faculty members.

Research, critical investigation, and creative writing by members of the English faculty enhance the quality and vitality of instruction in the classroom as well as the scholarly reputations of those involved and the Naval Academy they represent.

Sponsored Research

The Life of Captain Alonso de Contreras

RESEARCHER: LIEUTENANT COMMANDER C. HERBERT GILLILAND, USNR
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The researcher is preparing a fully annotated and illustrated edition of the book-length autobiography of a Spanish professional soldier who served as a galley captain for the Knights of Malta and as an infantry officer in the Spanish Army, during the period 1595-1630. His voyages took him throughout the Mediterranean and to the Caribbean. His picaresque narrative compares interestingly with the fiction of the time and, with proper annotation, will provide a valuable picture of everyday military life and small-unit operations during the period covered.

A Computer-Generated Concordance of Tennyson's Poetry

RESEARCHER: MAJOR LAURENCE W. MAZZENO, USA
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This ongoing project, begun in 1980 with support from the Naval Academy Research Council, will culminate in the production of a new concordance to the works of Alfred Tennyson. The new edition of Tennyson's poetry, forthcoming from Longman's Press and edited by Christopher Ricks, is being used as the base text for the project. The text is entered into memory and then the WATCON (Waterloo Concordance) program is used to arrange data into the desired format and to produce statistical summaries of word frequency, omitted words, line lengths, etc. During the year representatives from Western Ontario University in London, Ontario, Canada, asked to include this work with their work on the poet Robert Browning in a major project to complete concordances to the major Victorian poets; the final work will be published as part of the Cornell University Concordance series.

Milton and the "New Philosophy": A Literary-Historical Examination of the Sciences and the Humanities in Seventeenth-Century England

RESEARCHER: MIDSHIPMAN 1/C MARK GORENFLO
ADVISER: ASSOCIATE PROFESSOR JOHN C. WOOTEN
SPONSOR: TRIDENT SCHOLAR PROGRAM

Empirical thinkers and scientists, known to the world as the "New Philosophers," challenged the foundations of social, political, and religious ideology in seventeenth-century England. The researcher conducted a historical-literary exploration of the relationship between science and humanity in the seventeenth-century through research into both primary and secondary sources. Using the writings of Michel de Montaigne, Sir Thomas Browne, Thomas Hobbes, Abraham Cowley and Sir Francis Bacon as a backdrop, this Trident Scholar then focused his research on the figure of John Milton, a man deeply involved in the political, religious, and literary issues of his day.

In John Milton, he found a poet who was concerned with and sympathetic to the new scientific inquiries and methods. He incorporated empirical concerns with space and dynamics into his epic poetic works. Above all, Milton was dedicated to changing society as he found it into a new, righteous Christian commonwealth in which empirical science, guided by the precepts of his faith and concern for the dignity of man, would play an important, though not paramount, role.

Independent Research

The Significance of the Young Russian's Book in Conrad's "Heart of Darkness"

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. ARNOLD

This is a sequel to an article entitled "The Young Russian's Book in Conrad's 'Heart of Darkness.' " The first article identified the book as Nicholas Tinmouth's *An Inquiry Relative to Various Points of Seamanship, Considered as a Branch of Practical Science*. The sequel will attempt to explain the strong appeal of the book to the young Russian and Marlow, the narrator and protagonist of the story. Such an explanation will require a careful examination of their characters with a view to determining what Conrad really wanted his readers to think of their feelings and attitudes, not only about the book but also about other characters in the story. It will also require a study of contemporary newspaper and magazine articles to define British public opinion about European operations in the Congo.

Conrad's Seamanship in "Typhoon"

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. ARNOLD

Conrad's statement in his Author's Note to "Typhoon" that "the particular typhoon of the tale was not a typhoon of my actual experience" is equivocal: it leaves open the possibility that there was no typhoon in his experience. However, he has been quoted as saying later that "I experienced another one in the Indian Ocean, and used my impression of that . . ." Indeed, the weather and sea conditions as described in the story give an accurate *impression* of such storms as now known and as described in late nineteenth-century books on weather and cyclonic storms available to Conrad. (It may be possible to find a book on seamanship of Conrad's seagoing period with a chapter on cyclonic storms such as the one Captain MacWhirr consulted). On the other hand, some of Conrad's data on ship course, direction of swell, and wind direction are inaccurate and contradictory. For example, it is impossible to determine whether the *Nan-Shan*'s course is north or northeast, though the latter is more likely. However, in that case, the "cross swell from the direction of Formosa Channel" that the ship encounters should be coming from dead ahead rather than broad on the bow and would not cause the severe roll that the first mate wants to moderate by heading "to the eastward." In fact, Captain MacWhirr, a keen observer of detail, says to his first mate that the swell comes from northeast. Apparently Conrad cared little about accuracy of technical detail in his description so long as its general impression was correct and effective.

The Geography of Conrad's Eastern Tales

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. ARNOLD

This research project is a complete survey of the setting of Conrad's eastern tales with particular emphasis on *Lord Jim*. It will be partly based on the published work of Conrad scholars. However, the location of Patusan in *Lord Jim* has not yet been correctly identified, nor has Samburan in *Victory*. On the basis of data in the novels themselves and a study of detailed maps in atlases of the general areas concerned, it should be possible to locate these places.

Conrad's Use of Names

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. ARNOLD

This study is an attempt to discern a pattern in Conrad's use of real and fictitious names and changes of names of persons, places, and ships in Conrad's fiction. Much data have been collected, but the study is still in an amorphous state. When data are complete it might lend itself to computer analysis.

Styron's Use of Melville In *Sophie's Choice*

RESEARCHER: ASSOCIATE PROFESSOR NEIL BERMAN

An outgrowth of the investigator's teaching contemporary American literature, this project will explore the various ways in which William Styron consciously uses Melville's *Moby Dick* as source parallel in *Sophie's Choice*. Styron's narrator invites this comparison by invoking Melville's Ishmael at the outset of the novel. In various complex ways Styron's novel is an exploration of the nature of evil – at times allegorical, at times realistic – and thus recalls Melville's exploration of the same abstraction through the conflict between Ahab and the white whale. The project is still in an early stage, but the comparison seems clearly fruitful.

Portraits and Personae: Characterization in The Poetry of Robert Hayden

RESEARCHER: ASSOCIATE PROFESSOR FRED M. FETROW

The study was begun as part of a larger plan involved in the preparation of a monograph-length biographical/critical examination of the life, career, and works of Robert Hayden. The specific concentration on characters, both real and fictional, comes out of Hayden's own recurrent and emphatic interest in character portrayal. Ultimately, a thorough knowledge of whom and how he characterizes should reveal more about the poet's priorities and techniques. The methodology involves a categorization of character types, devolving into three major genres: historical/racial "heroes," biographical sketches of ancestry and kin, and allegorical personae in partial revelation of the poet's own psyche. The results are presently being written up and will appear as an article/chapter in a book on the neglected black poet of the era from 1940-1960, to be published by the University of Tennessee Press.

The Seventeenth-Century English Animadversion: A Lost Genre

RESEARCHER: LIEUTENANT COMMANDER C. HERBERT GILLIAND, JR., USNR

The animadversion was a literary form of considerable importance during the sixteenth and seventeenth centuries. Flourishing especially in the religious and political pamphlet controversies of the period, it attracted the talents of many of the finest writers, including John Milton, John Dryden, and Andrew Marvell. The genre is now largely unrecognized, and apparently no extended definition of the term "animadversion" or analysis of the genre has ever been undertaken. The investigator's analysis results in the definition of "animadversion" as "a work of some length, attacking a previously published work, which follows the argument of the previous work point by point." Additionally, certain features frequently occur. These include: (1) the liberal use of the opponent's own words; (2) the suggestion that the opponent's statements are deranged and/or meaningless; (3) an occasional preoccupation with seemingly trivial points, especially points of philology or grammar; (4) an attack on the opponent's prose style; and (5) an attack on the opponent's person, often involving a biography or "character" of the opponent.

Seafood and Strategy in Elizabethan England

RESEARCHER: LIEUTENANT COMMANDER C. HERBERT GILLIAND, JR., USNR

The project is a study of an effort by the Elizabethan government to enhance England's seapower by [illegible] the diet of the population. Over a period of [illegible] running into the Stuart period, a series of [illegible] royal decrees required every person in [illegible] to consume fish one day a week and on certain [illegible] days. The purpose of this policy was avowedly *not* religious, but rather to increase the size of the English commercial fishing fleet and hence the pool of experienced seagoing manpower that would be available to man the navy in time of war. The researcher is documenting this policy and exploring its effectiveness and ramifications.

The Real "Selvagee" and Others of the Frigate *Neversink*

RESEARCHER: PROFESSOR WILSON L. HEFLIN

The best way to identify the officers of the frigate *United States* when Herman Melville was aboard as an ordinary seaman (18 August 1843-14 October 1844) is to examine the signed entries in the official Log Book of the voyage. This information, coupled with the Muster Roll of the ship and identifications made in a first edition of *White-Jacket* (at the Mystic Seaport Library), makes it possible to name with more precision than formerly both officers and men who sat as originals of many of the characters in *White-Jacket*.

Previous identifications, based on the Harrison Robertson notes in a copy of *White-Jacket*, have long been well-known: Thomas ap Catesby Jones as the Commodore; James Armstrong as the Captain; James Gardner as the First Lieutenant, "Lt. Bridewell"; Latham Avery as "Mad Jack"; and so on. Robertson's connection with the *United States*, however, was only for the homeward-bound cruise, and his identifications are accordingly limited.

Using the method outlined above, it is now possible to identify Acting Lieutenant Francis Winslow as "Selvagee"; Latham Avery as the Commodore's Flag-Lieutenant; Lt. George W. Robbins as both Corporal Colbrook and the officer-in-charge of the Marine detachment; George Folger of Nantucket, captain of the forecastle, as possibly "Ushant"; and Midshipman George Jones as "Boatplug." The suicide later of Lt. Robbins has a possibly important connection with one of the final chapters of *White-Jacket*.

Elegies on James Wright: Criticism and Confession

RESEARCHER: ASSOCIATE PROFESSOR PHILIP K. JASON

The late James Wright was a "poet's poet," beloved and respected by many, and a significant influence on many more. Upon his death, several prominent and emerging poets felt the need to express their sense of loss and *their* estimate of Wright's accomplishment. Their elegies can be viewed, then, as a body of informal literary criticism that helps to fix Wright's place in literary history. Traditionally, elegiac poetry has revealed as much about the writer as about the subject. The death of an exemplary figure is an occasion for the mourner to measure himself. Through an examination of the elegies on James Wright, the *researcher* hopes to clarify these two perspectives.

The Designs of Tennyson's Poetry

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

This book-length study considers Tennyson's career in terms of the four characteristic designs of his major long poems, examining how each is the product of a gradual transformation of Romantic voices, interests, and forms. The relationships between and among these four designs are addressed in the course of the study, as are their characteristic rhetorical strategies and central themes. The study aims to clarify these matters as well as Tennyson's place in the history of English poetry. It demonstrates the fundamentally ethical goal of Tennyson's poetry, and its means of accomplishment—briefly, through salvaging the forms of Romantic poetry and changing their rhetorical direction. Tennyson works to help the reader accommodate himself to life within a fallen world—an imperative which proves to be as strenuous as the Romantic quest for a new Jerusalem.

This *were* a Medley: Tennyson's *The Princess*

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

The Princess is the least appreciated of Tennyson's major works and also the one most deserving of revaluation. The poem's genre, style, imagery, characterization, plot, and narration can all best be understood in relation to medley. Medley is the formal realization of the poem's central vision of human potentiality, both the individual's and society's, and lends itself to the celebration of those qualities Tennyson wished to affirm: variety, inclusiveness, energy, receptivity, and harmonious order. Ultimately, *The Princess* projects towards human beings in society an attitude that is itself a medley—a mixture of hopefulness and skepticism.

Studies in the Uses of Enchantment in Nineteenth-Century English Literature

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

Fairy tales figure importantly in the major works of a number of nineteenth-century English writers, especially Tennyson, Dickens, and George Eliot. The researcher has begun to investigate these authors' uses of fairy tale plots, characters, imagery, and values, and to familiarize herself as well with the theory and history of the fairy tale as they are presented in numerous articles and books. Ultimately she hopes to write her own book or articles on the subject. It has been part of the focus of her course, "The Victorian Frame of Mind," this year; the results of this research are also evident in an article, currently in circulation, on Tennyson's *The Princess*.

James Bryce and His American Friends: A Study of the Anglo-American Intellectual Community in the Late Nineteenth Century

RESEARCHERS: MAJOR LAURENCE W. MAZZENO, USA, AND PROFESSOR ALLAN B. LEKOWITZ

James Bryce, British Ambassador to America in 1907-1913 and author of *The American Commonwealth*, was a frequent traveler to America in the 1870-1900 period, and his acquaintances with various figures in this country provide a real insight into the intellectual community of America during this period. Some of his correspondents and friends were men and women who are now recognized as intellectual giants of the period; others have been neglected, but their contributions to American society were most valuable at the time, and the researchers hope to "resurrect" some of these figures and present a portrait of the American intellectual community of the period that does justice to all of the figures who had a hand in shaping the American mind and character during this period.

Improving Writing Programs

RESEARCHER: ASSOCIATE PROFESSOR CHARLES J. NOLAN, JR.

Because of his position as chair of the Ad Hoc Committee on Communication Skills, the researcher did rather extensive reading about various aspects of improving writing programs. Especially important was the research on Writing Across the Curriculum, on the relationship of literature and composition, and on various other aspects of the writing process. He expects this research to result in publication.

Diamond's Dust: Carew, King, and the Legacy of Donne

RESEARCHER: ASSISTANT PROFESSOR MICHAEL P. PARKER

The two best known elegies on John Donne, those by Henry King and Thomas Carew, are related in a way that has remained unnoticed heretofore. King's poem responds to Carew's and attempts to refute it. Carew's fascination with Donne's achievement leads him to explore the ways in which his poetry, both sacred and profane, has transformed English verse. King, Donne's literary and spiritual executor, attempted to suppress Donne's early amatory poems lest their publication undermine the editying legend of the saintly Donne that he and Izaac Walton had disseminated. Thus, King lashes out at Carew's "unauthorized" elegy in his own piece, insisting that Donne is inimitable in order to prevent the indiscriminate exploration of his poetic legacy. Happily, Donne's poems were published despite King's efforts. Carew's elegy remains as the most incisive and suggestive critical comment on Donne by a contemporary.

Annapolis: A Walk Through History

CO—RESEARCHER: ASSISTANT PROFESSOR MICHAEL P. PARKER

This project is the first book-length guide to Annapolis written in almost one hundred years. The book will contain a historical introduction and will be organized by street; it will provide information on many nineteenth- and twentieth-century structures as well as the better known eighteenth-century sites. The guide will prove an important contribution to state and local history.

Comely Gestures, Sweeter Manners: Carew, Kit Villiers, And The Character of Caroline Courtliness

RESEARCHER: ASSISTANT PROFESSOR MICHAEL P. PARKER

Thomas Carew's "To the Countesse of Anglesie" revises Jacobean history in terms of Caroline preoccupations. The poem ostensibly eulogizes Kit Villiers, the Earl of Anglesey; the embarrassing details of the historical Anglesey's life are glossed over, however, and Carew presents instead an Anglesey who is the pattern of Caroline courtliness. Banishment from the court is reinterpreted as a voluntary embrace of the retired country life; drunkenness and lack of self-control become a capacity for measured enjoyment. The elegy itself derives from Jonsonian models, but the virtues Carew chooses to stress reflect a new Caroline concern with exteriors rather than interiors, with manners rather than morals. The poet adduces the example of this idealized Anglesey in persuading the countess to moderate her grief and conform her behavior to the courtly standard of elegent restraint. Carew consigns the historical Anglesey to a merited oblivion, but the idealized portrait he sketches survives as an example of the courtly values of the early 1630's.

The Facts of War: An Anthology of Poetry About War

RESEARCHERS: ASSISTANT PROFESSOR NANCY PROTHRO AND MAJOR LAURENCE W. MAZZENO, USA

The researchers have compiled an anthology of poetry of war from all periods and a variety of cultures. Among the works are selections from Homer's *Iliad*, Virgil's *Aeneid*, the old English "Battle of Brunaburgh," classic Chinese poems, Renaissance and neoclassic lyrics celebrating war, such nineteenth-century classics as Emerson's "Concord Hymn" and Tennyson's "The Charge of the Light Brigade," modern anti-war poetry, and others. The editors have divided the poems into eight categories—"The Glory, Spectacle and Romance of War," "Songs of Battle," "The Sweep of Battle," "Victors and Vanquished," "Leaders and Followers," "The Pity and Horror of War," "War and the Populace," and "War and Nature."

Theory of Narrative Voice

RESEARCHER: ASSOCIATE PROFESSOR STEPHEN M. ROSS

The term "voice" as applied to works of literature has become an important concept in recent American and English criticism. "Voice" seems to offer a conceptual bridge between contemporary critical concerns, with their increased emphasis on abstract analysis, and more traditional concerns with biography and literary history. The project is leading toward a book on voice in the novels of William Faulkner.

Novel-In-Progress; Short Fiction

RESEARCHER: ASSOCIATE PROFESSOR MOLLY B. TINSLEY

The author is writing the following pieces of short fiction: "Villa Nueva"; "Shower"; "Takes"; and "Somewhere Horses." She is almost halfway through the first draft of a novel about two young women graduates of an Ivy-League women's college.

The Journals of John Pendleton Kennedy

RESEARCHER: PROFESSOR DAVID O. TOMLINSON

Between 1829 and his death in 1870, John Pendleton Kennedy kept extensive journals, noting, among other things, his relationship with major writers—Edgar Allan Poe, Charles Dickens, Anthony Trollope, Washington Irving, William M. Thackeray, James Fenimore Cooper and others; his consultations with Presidents of the U.S. from Jackson to Lincoln; his friendships with politicians including lights like John Quincy Adams and Henry Clay; and visits to the Naval Academy while he was Secretary of the Navy.

The project consists of preparing an edited and annotated text from the manuscript journals suitable for publication.

Occasions for Writing

RESEARCHER: ASSISTANT PROFESSOR NANCY WICKER

The researcher is co-authoring a rhetoric-reader for composition instruction. The text contains introductory explanations, model essays, analyses, assignments, and a handbook of grammar, mechanics, and usage. *Occasions for Writing* has practical writing assignments for the real professional worlds. Notions of audience, purpose, and voice are thoroughly examined.

The Poetry of Robert Graves

RESEARCHER: INSTRUCTOR HARDY CULVER WILCOXON, JR.

The researcher is trying this summer to complete his doctoral dissertation about the poetry of Robert Graves. His main purpose in this work is to examine relations between Graves' poetic style and a radically contradictory state of mind that goes by the name "ambivalence." The thesis, in a word, is that he has developed a very archaic "emblematic" style because this style is singularly well suited to accommodating conflicting aims and impulses. In pursuing this theme, the researcher has been able to define the nature of his poetic style better than anyone else has so far. The main method of inquiry has been to examine particular poems in a very detailed manner. Of two chapters yet to be finished, one will concern Graves' characteristic images and poetic plots, and another will briefly detail some important changes in Graves' poetry over the course of his career and attempt to explain why Graves' poetry has been for the most part rather flat and dull since the 1960's.

"By Violent Stroke": Milton, Violence, and Renaissance Culture

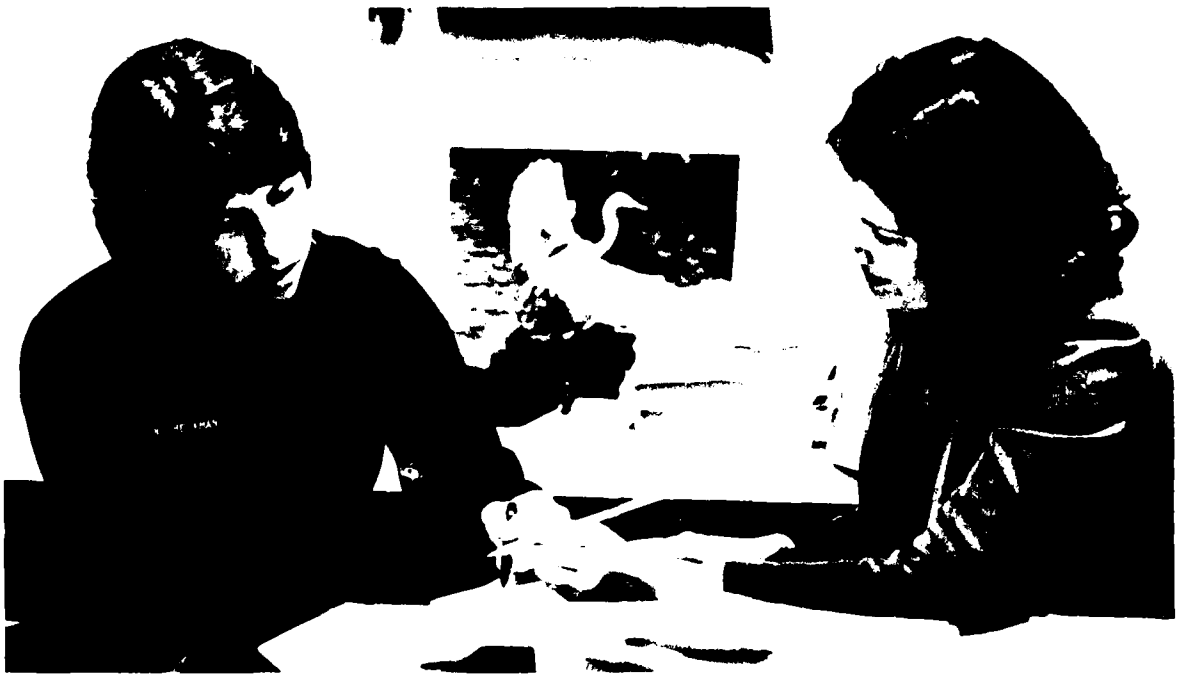
RESEARCHER: ASSISTANT PROFESSOR JOHN WOOTEN

This research project is the result of dissatisfaction with various scholarly and critical efforts to account for and to characterize John Milton's political and personal development before, during, and after the English Civil War. Milton, major seventeenth-century poet and revolutionary, moved in the course of his adult life from a passionately active political idealism to a seemingly pacifistic state of world-weary resignation. Milton, in the 1640's and 1650's, ardently defended the beheading of King Charles I and forcefully celebrated the martial victories of Oliver Cromwell. By 1667, however, Milton had modified his views. In his last work, *Paradise Regained*, there is a severely restrained and passionless dismissal of all the Satanic temptations to martial glory political power, and even humanistic learning. This research is intended to widen the area of discussion about this development in Milton's attitudes. A fuller examination of violence in Renaissance culture will shed new light on Milton's growing disenchantment with physical force as an acceptable weapon for social order.

Renaissance Women's Work and Works by Women

RESEARCHER: ASSISTANT PROFESSOR MALLORY YOUNG

The writer is doing research for a presentation which will involve the work of three women of the Renaissance: Isabella d'Este, a stateswoman and patron of the arts; Caterina Sforza, a military leader; and Marie de France, a poet. All three of these women were extremely well-known and influential in their own time, though none now has the fame of, say, Elizabeth I or Joan of Arc. The researcher will be considering their attainment of high-ranking positions, their contributions to Renaissance life and culture, and their own views of the roles and work of women.



Research Course Projects

Old English, the Language and its Literature

RESEARCHER: MIDSHIPMAN 1/C MARION C. BROWN
ADVISER: ASSOCIATE PROFESSOR JOHN C. HILL

The researcher concentrated on the fundamentals of Old English grammar and applied them to the interpretation of the literature of the period in his paper "Old English, the Language and its Literature." After reviewing components of speech such as pronouns, nouns, adjective declensions, and verb conjugations, he studied the etymology of the Old English language. He combined his work in both areas to translate four Old English lyric poems: *The Wanderer, The Seafarer, The Dream of the Rood,* and *The Battle of Maldon.* With special concentration on *The Wanderer,* he analyzed the cluster of verbs and nouns that defines the poet's exploration of frozen feelings, hopes, thoughts, and, finally, life itself for the poem's central speaker.

The Use of Color in Wallace Stevens' Poetry

RESEARCHER: MIDSHIPMAN 1/C DONALD DREHOFF
ADVISER: ASSISTANT PROFESSOR NANCY PROTHRO

The researcher compiled a manuscript of 20 poems as a result of his study of poetry and its composition. During the course of the semester he concentrated on contemporary poets: Dylan Thomas, Wallace Stevens, and Lucille Clifton. He examined Wallace Stevens' color imagery and the technical composition of his poems in his paper, "The Use of Color In Wallace Stevens' Poetry."

The study of these poets aided the researcher in writing and evaluating his own poetry. In order to become more proficient, he experimented with techniques of accomplished poets. He broadened his technical appreciation of poetry through close reading and discussion of many different poets.

John Steinbeck: A Study of the Fiction

RESEARCHER: MIDSHIPMAN 1/C M. CATHERINE GAUT
ADVISER: ASSOCIATE PROFESSOR CHARLES J. NOLAN

The researcher focused her semester study of John Steinbeck on two major objectives: to read his 14 fictions and to explore his style through criticism.

In "Development of a Theme: The Group Man Theory" she traced the origin and progression of Steinbeck's thematic technique with particular attention to its use in his most noted work, *The Grapes of Wrath.*

The group-man theory states that certain men tend to group together in units. These groups, with individual personality and character, work together toward common goals. Although personal sacrifice is sometimes required, the group-man is stronger and more productive than the self-oriented individual.

Through her research, she discovered the complexity of this theme and she examined its multiplicity in the context of other novels by the same author.

Mark the Music: A Novel

RESEARCHER: MIDSHIPMAN 1 C JEREMY GILLESPIE
ADVISER: ASSOCIATE PROFESSOR PHILIP K. JASON

The novel opens in New York City where Jessica Collins, an aspiring actress, attempts to find employment. The novel develops the conflict between Jessica's desire to become an actress and her lack of determination in realizing this goal.

The novel deals with the metaphysical and the psychological as it explores the sources and nature of creativity as well as the drives and personalities of several artists with whom Jessica comes into contact. She develops a better understanding of herself and her art through this interaction with the secondary characters who serve as models and sounding boards for her. The three most important of these characters are Don Durban, Jessica's fiance, who is a successful young film director whose compassionless, impersonal, and unswerving dedication to success eventually alienates Jessica; Cheryl Davis, a close friend and confidante who serves as a voice of reason throughout the novel; and Ward Summers, a lonely and miserable jazz sax player who has been driven deep into himself and his music by cruel circumstances, yet in whose passionate dedication to his art Jessica finds some part of the answer to her own dilemma.

The value of the project, aside from its intrinsic merits, is that it has enabled the student to develop a sophisticated understanding of the components of fiction by solving real problems in plotting, creating the illusion of time, setting scenes, characterization, dialogue, and thematic focus. Certain materials have had to be researched to provide verisimilitude, and all materials have had to be fashioned towards an entertaining, unified, cohesive, and evocative rendering of universal values without ever losing concreteness and the illusion of a life being lived.

The Character of the Literature of Medieval England

RESEARCHER: MIDSHIPMAN 1/C FRANCIS B JONES
ADVISER: ASSOCIATE PROFESSOR JOHN M. HILL

The researcher studied the style and tone of Old English literature in his project. He examined the basic components of Old English grammar and etymology, including verb conjugations and adjective declensions. He emphasized the characteristics of Old English prose concerning biblical and Germanic heroic subjects in addition to translating the best Old English lyric poems: *The Wanderer*, *The Seafarer*, *The Dream of the Rood*, and *The Battle of Maldon*. Paying special attention to *The Dream of the Rood*, he concentrated his research on the heroic imagery found in this poem. Finally, he traced the inversions of response by which the poet redefines heroism, translating the idea of courage from a Germanic to a Christian context.

One Short Sleep Past: Donne and Death

RESEARCHER: MIDSHIPMAN 1/C ALISON S. MCCRARY
ADVISER: ASSISTANT PROFESSOR MICHAEL P. PARKER

The poetry of John Donne (1572-1631) reveals a lifelong obsession with death and dying. The reasons are in part historical and social. Donne lived in a period of high mortality; he experienced the plague first-hand during his residence in London and, as a priest, was in frequent attendance at deathbed scenes. Yet, Donne's peculiar preoccupation with death surpasses that of any of his contemporaries and pervades even his earliest amatory works.

In his lyric poetry, death represents the gateway to the perfect union with the lover never attainable on earth. Sexual consummation is described as a death followed by resurrection; lovers in the poems frequently leave bodies behind to seek spiritual oneness; even the grave becomes a fine place to embrace. Attracted to women yet distrustful of them, delighting in the body but anguished by its decay, Donne looks to the afterlife to harmonize his own hateful contraries.

An important shift occurs in the later meditative poetry. Donne courts God in much the same way he courted the ladies and his lyrics; he longs for a perfect union with God but finds such security impossible on earth. Heaven becomes the ultimate ecstasy and all earthly mistresses prove to be "but a dream of Thee." Donne's elaborate funeral preparations assume the character of a bridal. In an ultimate declaration of where his allegiances lay, Donne chose to be buried separately from his wife, interred less than a mile away; his final resting place in St. Paul's suggests his total surrender to sacred love.

MacLeish's J.B. and the Book of Job

RESEARCHER: MIDSHIPMAN 1/C JAMES A. NAII
ADVISER: MAJOR LAURENCE W. MAZZENO, USA

The researcher conducted a study of Job through Archibald MacLeish's contemporary play of *JB*, asserting that the modern interpretation of the biblical figure represented by MacLeish's title character contrasts sharply with the actual religious personage of Job. The play, written in verse form represents the conflict between God and Satan within the characters of Zuss (God) and Nickels (Satan). In describing heaven and hell they define the major conflict in the play: is God just or unjust?

JB showed unwavering faith despite the utter despair that he experienced. Although the play concludes that he is faithful to God, he has decided that instead of loving man, God merely exists.

The researcher used this point to compare the Biblical Job to this fictional character. Unlike JB, Job becomes enraged at God and, later, repents. Through these major differences in character JB proves a reworking, not an interpretation, of a biblical character. He provides a more fitting character of Job for contemporary society as he fulfills the need for a model of patience and long-suffering in a world of pain.

The Evolution of Camelot

RESEARCHER: MIDSHIPMAN 1/C LINDA A. PETRONE
ADVISER: MAJOR LAURENCE W. MAZZENO, USA

This researcher studied the development of the Arthurian Legend from its earliest inception to the musical presentation *Camelot* by Alan Jay Lerner and Frederick Lowe in 1960. The major works considered in this project were *The History of Britain* by Geoffry of Monmouth, *Le Morte D'Arthur* by Sir Thomas Malory, and *Idylls of the King* by Alfred, Lord Tennyson. After analyzing the expanded characterization and the shift in literary tone from objective to subjective, the study focused on the actual creation of *Camelot* and the major surrounding criticisms. The paper treated such inherent problems as: the classification of the musical as history or fiction, the problem of too much humor, and the possibility of a trivial analysis of the majesty of Camelot. The research concluded that regardless of the historical validity, *Camelot* preserves the spirit of the Arthurian Legend in a context accessible to the modern audience.

The Rhetoric of Religious Writing

RESEARCHER: MIDSHIPMAN 1/C KEVIN SMITH
ADVISER: MAJOR LAURENCE W. MAZZENO, USA

The author explores the reaction to J.C. as Messiah by modern man. In creating a hypothetical short story, the researcher considers a valid religious question.

As a freshman at Texas University, J.C. meets with two opposing views: acceptance and rejection. These represent the conclusion the two main characters reach after hearing the words of Christ and listening to his message. As an example, the author creates a twentieth-century version of Christ's miracle at Cana when he changed water into wine. By developing the conflicting views of each main character, the author fully considers each side of his theme: the acceptance of Christ within the context of the twentieth-century.

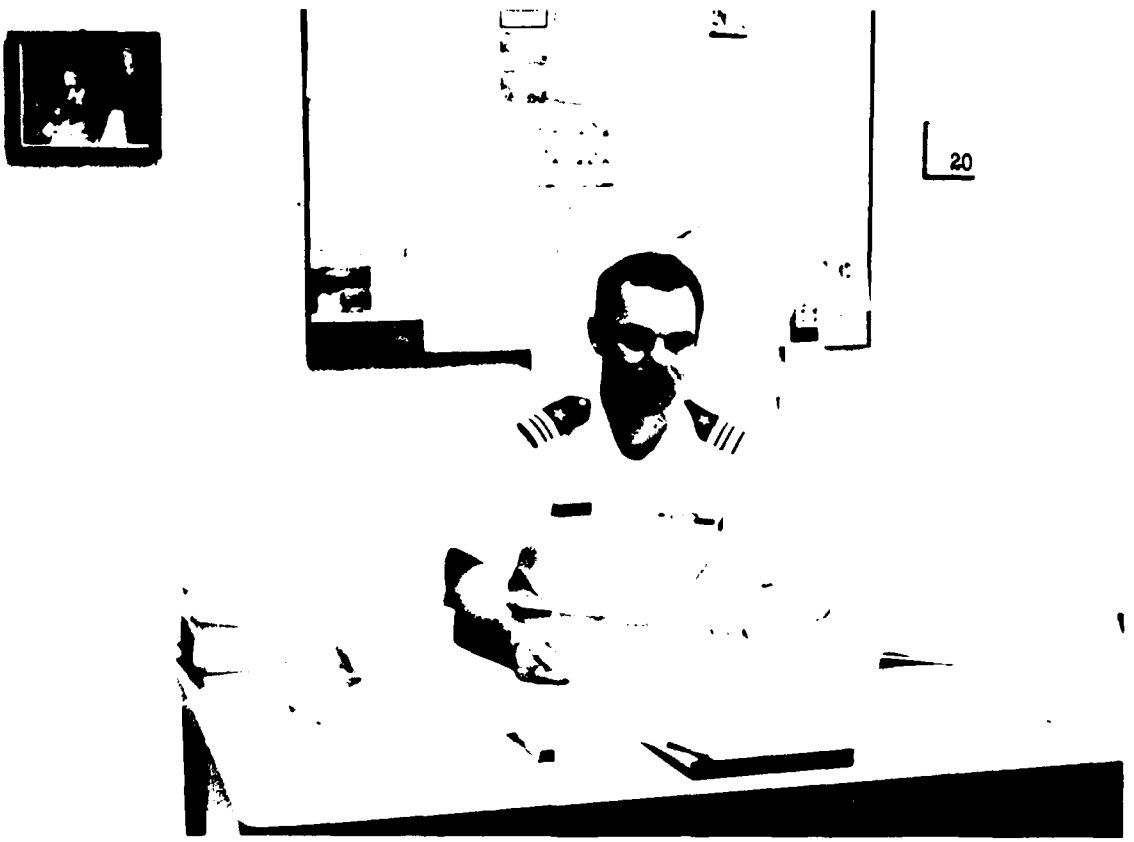
Rhetorical Patterns in Christian Apologetics

RESEARCHER: MIDSHIPMAN 1/C DOUGLAS J. WADSWORTH
ADVISER: MAJOR LAURENCE W. MAZZENO, USA

The author concentrated his research on the scripture, traditions, and interpretation of Catholic and Protestant theology. By focusing on three major areas—ministry, assurance of salvation, and transubstantiation—he found both rhetorical and substantive disagreement in Christian doctrine.

He demonstrates the difficulty caused by oversimplification and stereotypes of both Catholic and Protestant doctrines. He points to the mystical-priest-who-takes-the-place-of-Christ view of many Protestants toward the Catholic ministry, and the I'm-saved-so-nothing-else-is-required-of-me view thought by many Catholics to be held by Protestants, as examples leading to Christian diversity.

In conclusion the author recalls the commonality between these major sections of Christian faith: both believe in Christ as Redeemer.



Publications

FETROW, Fred M., Associate Professor, "**American Poet**," *Poet Lore*, 77 (Spring, 1982), 36-41.

Robert Hayden's final volume of poetry, his posthumous *American Journal*, in many ways encapsulates the poet's life, career, and artistic canon. The slim volume of twenty-three poems reveals Hayden's complete mastery of technique while it also shows his inexhaustible experimentation with modal variation. Perhaps the most notable feature of this collection is the emergence of Hayden's personal voice as he more and more toward the end of his life turned to that life as poetic subject matter. Still "guarded" by objective distancing in the allegorical frameworks of such poems as "**American Journal**" and "**The Tattooed Man**," Hayden nevertheless returns to his youth in the Detroit ghetto to provide psychic revelation in such poems as "**Elegies for Paradise Valley**" and "**Names**." Finally, this group of poems, like their creator, transcends origins: Hayden's importance of American letters lays in his ability to chronicle cultural diversity in human and humane terms. His unique voice, both poetic and personal, continues to help us better understand ourselves as uniquely American, but transcendently human.

GILLILAND, C. Herbert, Jr., Lieutenant Commander, USNR, "**Andrew Marvell**," in *Critical Survey of Poetry* ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983, V, pp. 1908-1918.

This reference article includes a brief biography of Andrew Marvell, the seventeenth-century English poet, pamphleteer, and parliamentarian. In addition there is an evaluation of his literary achievements and of the development of his reputation as a writer. Finally, and most importantly, the article provides close readings, incorporating previous scholarship, of three of Marvell's poems. "**To His Coy Mistress**" is his most widely-known work; "**The Garden**" epitomizes Marvell as "the garden poet"; "**Upon Appleton House**" adumbrates Marvell's involvement in politics. The article is intended as a graduate-level introduction to the man and his work.

HILL, John M., Associate Professor, "**Beowulf and the Danish Succession**," *Mediaevalia et Humanistica* 11 (1982), 177-197.

The *Beowulf* poem contains a largely unnoticed dramatic line concerning Beowulf, the hero, and an arguably implicit offer of succession to the Danish Kingship. That offer creates a subtle social tension in the scenes of gift-giving, which scenes in turn give us a first-hand sense of social life—especially economic life-within the warrior aristocracy of an Anglo-Saxon kingdom; such insight is simply not available in any other document surviving from the period.

JASON, Philip K., Associate Professor, "**Brendan Galvin**," *Critical Survey of Poetry*, ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983, III, pp. 1050-1057.

Brendan Galvin (b. 1938) is a poet whose hard-won accuracy of statement is remarkable in an age that prefers "poetic" ambiguities. Fresh diction and imagery, imaginative yet highly appropriate figures of speech, and a finely tuned sense of rhythm and sound combine to prove Galvin a master of free verse. His ability to offer the reader a close look at a particular object, especially a natural object (or process), is unparalled in his generation. The coastal northeast, particularly Cape Cod, is made almost mythically real by Galvin's re-creations of the animals of shore and sea, the birds above, the climate and landscape, and the cultural temperature of the small New England town. In helping us to see these things clearly, Galvin helps us to see ourselves.

JASON, Philip K., Associate Professor, "**Dave Smith**," *Critical Survey of Poetry*, ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983, V, pp. 2641-2648.

Dave Smith (b. 1942) is a poet of inclusion. His work is unashamedly passionate—exuberantly so. Smith never merely outlines a theme; he elaborates it with loving care. A moralist and story-teller, he has helped to bring back the long poem, both meditative and narrative. For such poems, Smith has created a rhetoric based on long lines and longer sentences—a rolling terrain of accumulating phrases and clauses. This style is close to that of Faulkner's prose; it is in the tradition of Southern Baroque. Smith writes of memory and yearning on the personal, familial, and communal levels. By continuing the traditions of Whitman and Frost in his own unique voice, Smith has become a contemporary American classic. He is a poet of the greatest ambition who takes the kind of risks that lead to greatness.

MAZZENO, Laurence W., Major, USA, *Liberal Learning in a Technical Curriculum*, Annapolis: U.S. Naval Academy Press, 1982.

This softbound book contains the proceedings of the Conference on Liberal Learning in a Technical Curriculum, sponsored by the U.S. Naval Academy on 18 March 1982. Included are major essays by Arnold Arons, University of Washington (Physics), and Lew Soens, Notre Dame University (English), as well as a philosophical introduction by J. M. Hill, U.S. Naval Academy, and essays by panel chairmen from the various sessions held during the conference.

MAZZENO, Laurence W., Major, USA, "**Index**" to William Strunk and E. B. White, *Elements of Style*, 3d ed., rev., New York: Macmillan, 1982, pp. 87-92.

Strunk and White's booklet on style has been a standard text for over half a century, but has been criticized by teachers for some time because it lacked an index for quick reference in locating specific discussions of points of grammar, style, and diction. To rectify that omission, a new index was prepared to identify all major points of grammar, spelling, diction, and style, as well as to identify all authors and works cited in the text.

MAZZENO, Laurence W., Major, USA, "**Idylls of the King in 1981**," *The Arnoldian: A Review of Mid-Victorian Culture*, 9 (Spring, 1982), 48-62.

This essay presents a review of J. M. Gray's *Thro' the Vision of the Night* (Edinburgh and Toronto: Edinburgh University Press, 1981). In a lengthy preliminary discussion, the history of criticism of Tennyson's long Arthurian poem is reviewed, and the two sides of the controversy over the poet's characterization of his hero are discussed. The second half of the review discusses Gray's work as an attempt to settle critical difficulties and present a sensible interpretation of Tennyson's Arthurian poem.

MAZZENO, Laurence W., Major, USA, and Allan B. LEFCOWITZ, Professor, "**Matthew Arnold and James Bryce**," *The Arnoldian: A Review of Mid-Victorian Culture*, 9 (Fall, 1982), 28-41.

In a lengthy essay, the friendship of Arnold and Bryce is reviewed, using several original, never-before-published letters of Arnold and Bryce. The friendship of these two important figures in Victorian England spanned three decades, and led to some significant interchanges of information between the two. As result, each may have influenced the other in his perceptions on a number of matters, among them the notion of America as a new land of opportunity (for Bryce) or as a cultural wasteland (for Arnold).

MAZZENO, Laurence W., Major, USA, "**Alan Lerner's *Camelot*: Arthurian Tradition and Some Individual Talent**," *Odyssey: A Journal of the Humanities*, 5 (1982), 1-11.

The Arthurian legend, retold for over a thousand years, lives on in contemporary works that often rearrange details of the story or recreate the tale using the original characters as familiar touchstones. Often contemporary versions of the story are made light of by traditional literary critics who find them perversions or dilutions of the original stories. Lerner's *Camelot* has received such criticism, and that harsh treatment is in part justified by the great liberties the author takes with his subject. But there is great merit in some of Lerner's portrayals of the Arthurian characters, and his timing in presenting the play can tell the cultural critic something about the value of the legend as an expression of its inherent appeal to all times, and also reveal something of the specific era in which the play became so popular.

MAZZENO, Laurence, W., Major, USA, "**Alfred, Lord Tennyson**," *Critical Survey of Poetry*, ed. Frank N. Magill, Englewood Cliffs, New Jersey: Salem Press, 1982, VII, pp. 2859-2870.

As part of Salem Press' new *Critical Survey* series, this essay on Tennyson provides a short review of the poet's life and accomplishments. Included is a list of major works, a short description of Tennyson's work in drama, a general discussion of his major aims as a poet, and extensive commentary on three poems to illustrate his methods of composition and his major themes. Discussion of Tennyson's concern for the past and his use of classical authors to illustrate modern themes is highlighted by a discussion of "**The Lotos Eaters**," and discussed in great detail through an explication of "**Ulysses**," in which the ambiguities of the poem are shown to be intentionally interjected by the author as a means of calling attention to the perplexities of modern existence. Tennyson's methods of composition for his long poems is illustrated by a discussion of *In Memoriam*.

MAZZENO, Laurence, W., Major, USA, "**The Beginning of Something**," *Journal of Contemporary Satire*, 9 (Spring, 1982), 32-34.

This short story relies upon the reader's familiarity with the works and life of Ernest Hemingway to illustrate the fine line between the high seriousness of the Hemingway style and the simplistic parodies that can be made of it.

MURPHY, Mary C., Lieutenant (junior grade), USNR, "**Samuel Foote**," *Critical Survey of the Drama*, ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983.

This article is a general overview of Foote's life and critical thought. It includes critical evaluations of two of Foote's plays, *Taste* and *The Orators*. The article also lists Foote's major works, both fictional and critical.

MURPHY, Mary C., Lieutenant (junior grade), USN, "**A Selected Bibliography**," in *Liberal Learning in a Technical Curriculum*, ed. Laurence W. Mazzeno. Annapolis: U.S. Naval Academy Press, 1982, pp. 70-72.

This bibliography is composed of the most recent, best books about the marriage of technology with the liberal arts.

NOLAN, Charles J., Jr., Associate Professor, Contributions to the *Annual Bibliography of English Language and Literature*, Vol. 54, ed. Michael Smith, James B. Misenheimer, Jr., and Mary Jean DeMarr. Leeds: Modern Humanities Research Association, 1982.

Contributions to the *Annual Bibliography* come from a careful review of the many issues of fourteen journals ranging from *Anthropological Linguistics* to the *International Philosophical Quarterly*. The contributor examines and notes any article, edition, book, or thesis, published in any language, that has an important link to English or American language or literature and any ancillary work that bears significantly on those fields. Using a specialized format, he then prepares bibliography cards for such items and forwards them to the American editor, who in turn sends the American contribution to Leeds, England, where the *Annual Bibliography* is published. The result each year is one of the two major bibliographies in English studies.

PARKER, Michael P., Assistant Professor, "'**To my friend G. N. from Wrest**': **Carew's Secular Masque**," in Claude J. Summers and Ted-Larry Pebworth, eds., *Classic and Cavalier: Essays on Jonson and the Sons of Ben*. Pittsburgh: University of Pittsburgh Press, 1982, pp. 171-191.

Despite current interest in the English country-house poem, Thomas Carew's major contribution to the genre, "**To G. N. from Wrest**," has largely been ignored. This neglect is unfortunate because Carew's poem represents the crucial middle term between Jonson's initial essays in the English country-house poem and Marvell's transformation of the genre in the 1640's and 1650's. Due to a scholarly blunder in the early twentieth-century, critics have been unaware of the lively cultural and literary activities that focused on Wrest Park, seat of Henry de Grey, the eighth earl of Kent, in the 1620's and 1630's: John Selden, Samuel Butler, Samuel Cooper, Sir John Suckling, and Thomas Carew were all intimates of the family. The identification of Henry de Grey as proprietor of the estate illumines many of the iconographic and historical details of the poem whose significance has eluded earlier researchers. Carew celebrates the de Grey family through the use of a structure and techniques borrowed from the court masque; oblique criticisms of the king's Scottish Campaign of 1639 suggest that the poet has abandoned the court to pursue his aesthetic ideals in a narrower, more practicable sphere. "**To G. N. from Wrest**" culminates Carew's poetic career, tying together the themes that govern his hundred-odd lyrics. More importantly, the piece marks the end of the Caroline period in poetry and anticipates the concerns of Interregnum writers.

PARKER, Michael P., Assistant Professor, "'**All are not born (Sir) to the Bay**': '**Jack**' **Suckling, Tom Carew, and the Making of a Poet**," *English Literary Renaissance*, 12 (Autumn 1982), 341-368.

Sir John Suckling's brief career may be read as a struggle to free himself from the influence of Thomas Carew in order to stake out his own place in Caroline poetry. Suckling's frequent references to Carew are double-edged; his life and poems seem to be modeled in calculated contrapposto to those of the older poet. Suckling's affected libertinage represents an attack upon the "platonic love" fashionable at court but also an attempt to conceal his inability to write poems in the proper courtly style. Similarly, his vaunted amateur status in poetry is both a rejection of poetic fathers and a hedge against the possibility of failure. Suckling eventually finds a solution to the contrary impulses that stymie him in lyric by abandoning that genre in favor of the familiar letter, the epithalamion, and drama; the question of his vocation as a poet, however, was still unresolved at the time of his death.

PARKER, Michael P., Assistant Professor, "**Carew's Politic Pastoral: Virgilian Pretexts in the "Answer to Aurelian Townshend**," *John Donne Journal*, 1 (Winter 1982), 101-116.

Received critical opinion notwithstanding, Thomas Carew's "**Answer to Aurelian Townshend**" is a poem both politic and political. In his answer, Carew subtly informs Townshend that his effusive praise of the martial exploits of the Swedish monarch Gustavus Adolphus may jeopardize his position at the English court. Reminding his addressee of the success of the pastoral masques he had written the previous year, Carew redefines pastoral as a genre encompassing both the heroic and the lyric modes; as such, pastoral is the fitting vehicle to express the aspirations of the court of Charles I. A sustained series of allusions to Virgil's First and Ninth Eclogues legitimates Carew's argument: England becomes the successor to the Virgilian Mantua and Charles, who combines good government with artistic patronage, a new Augustus. The oft-quoted final lines of the poem express a brave confidence in the *pax carolina*, but also suggest a recognition of how frail that peace may actually prove.

PARKER, Michael P., Assistant Professor, "**Sir John Suckling**" in *Critical Survey of Poetry*, ed. Frank N. Magill, Englewood Cliffs, New Jersey: Salem Press, 1983, VII, pp. 2775-2783.

Sir John Suckling played an essential role in transforming English poetic diction during the seventeenth century. His ability to capture the rhythms of colloquial speech in rhymed verse represents a real innovation. Although his attitudes toward women and love are often cynical and occasionally grating, his earthy common sense usually comes across as a necessary antidote to the stylized neoplatonism of so much amatory verse of the 1630's. In similar fashion, Suckling's embrace of native literary forms such as the ballad and the riddle serves as a corrective to the classicizing tendencies of Renaissance poetry. Suckling's *oeuvre* is small, but the role he played in English poetry was a pivotal one; his experiments in diction and essays in satire furthered the shift from a Renaissance to a Restoration aesthetic.

PARKER, Michael P., Assistant Professor, "**Edmund Waller**" in *Critical Survey of Poetry*, ed. Frank N. Magill, Englewood Cliffs, New Jersey: Salem Press, 1983, VII, pp. 3008-3018.

Edmund Waller is one of the truly transitional figures in English literature, straddling the Renaissance and the Restoration. Although not the "inventor" of the heroic couplet, he played a critical part in gaining its acceptance as the preferred verse form for neoclassical poetry; his style of classical allusion, singular in the 1620's and 1630's, provided the model for English poets of the succeeding century. Although his individual poems rarely achieve greatness, Waller's work as a whole is consistently witty, perceptive, and stylistically distinguished. The homogeneity of Waller's *oeuvre* may in fact be his greatest achievement, inasmuch as it provided one of the few fixed standards of excellence in a period of radical political and literary change.

PROTHRO, Nancy W., Assistant Professor, "**The Wealth of Poverty, the Jewel of Need: Wallace Stevens' "The Sail of Ulysses**," *Concerning Poetry*, 15 (Spring, 1982), 1-10.

The key to Wallace Stevens' enigmatic late poems -- or certainly *a* key -- may be found in the poem "**The Sail of Ulysses**." The poem presents two aspects of the self, the seeker and the child, that dominate the last poems as Stevens searches for a final solution to the problem of the split between the self and the world that has concerned him throughout his life. It presents as its central metaphor a voyage toward knowledge, toward a definition of reality that discovers reality at the "central of the earth," the center of the self. The integrations of the self and the world that these poems achieve give them much of their power.

ROSS, Stephen M., Associate Professor, co-author, "**The Empty Locus and Desire: Woman as Familial Center in Modern American Fiction**," *Denver Quarterly*, 17 (Winter 1983), 109-120.

In modern novels by male authors, women in families are often portrayed as redemptive centers toward which male family members turn for emotional sustenance. But in family novels by women writers this role as redemptive center is more often depicted as a trap from which female protagonists yearn to escape.

SHENK, Robert, Commander, USNR, co-author, *Lyric Metaphysical Poetry: A Bibliography, 1961-1980*, San Antonio: Trinity University Press, 1983.

This bibliography, which lists scholarship on metaphysical poetry from 1961-1980, updates earlier checklists that covered the period 1912-1960. It differs from these works in that it omits three poets, John Donne, George Herbert, and Andrew Marvell. Bibliographies on these poets have been published quite recently; consequently, the compilers of this volume chose to focus on nine poets, Thomas Carew, John Cleveland, Abraham Cowley, Richard Crashaw, Edward Herbert, Henry King, Katherine Philips, Thomas Traherne, and Henry Vaughan.

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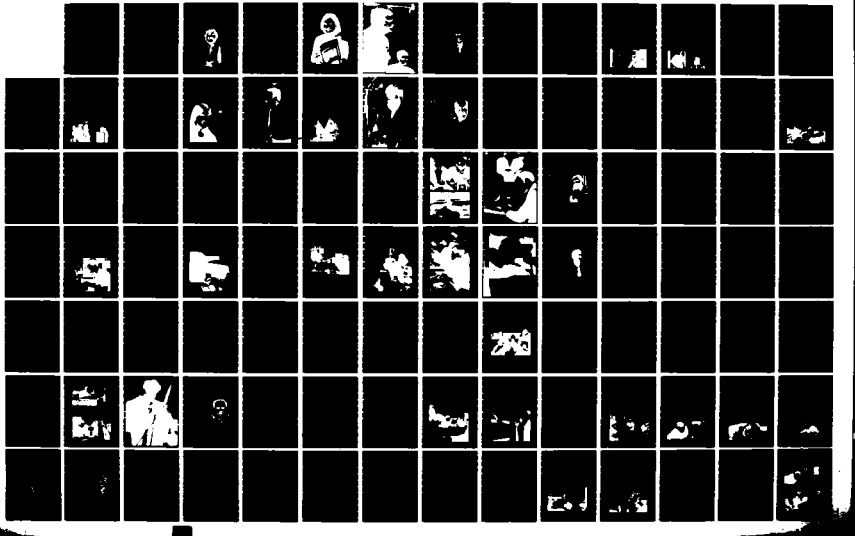
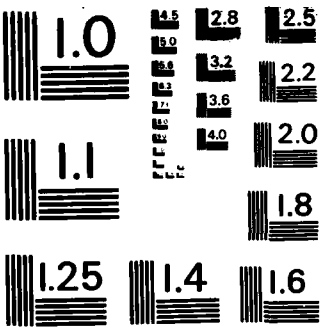




TOMLINSON, David O., Professor, "**A Poignant Christmas Past from** *Colonel Carter's Christmas*," *Chesapeake Country Life*, (Christmas 1982), 26-27.

F. Hopkinson Smith, popular turn-of-the-century novelist born in Baltimore, includes a picture of a Maryland dinner in *Colonel Carter's Christmas*, a dinner which, though it preserves the Free State rural traditions, is served in New York City.

The article introduces Smith and his work and includes the excerpt previously mentioned from *Colonel Carter's Christmas*.

WICKER, Nancy R., Assistant Professor, "**Galway Kinnell**," *Critical Survey of Poetry*, ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983, IV, pp. 1589-1601.

This essay for a larger bibliographical work discusses the life, writing, and achievements of Galway Kinnell. Kinnell has created one of the most eclectic yet distinct American voices in contemporary poetry. Born in Rhode Island, and educated at Princeton and Rochester, he has traveled extensively in the United States, Europe, and the Far East. Kinnell has received numerous grants and awards, including a Ford Grant and a Fulbright, two Guggenheim Fellowships, and a Rockefeller Foundation award. Kinnell's achievement lies in his perfecting both the lyric and the narrative poem. His love for particularity and his identification with nature allow him to depict varying locales in startling detail, and his philosophical speculations allow his vision to be at once real and surreal. The predominant themes of Kinnell's poetry have been identified variously as pain, alienation, death, mystery of time, the violence of twentieth-century America, and, most recently, domestic life. Yet all of these motifs are in truth leitmotifs for Kinnell's major theme of mortality, mortality in all its nuances—the world, humanity, death, love. Kinnell creates his poems from the real elements of the earth and renders his obsession with the physical world with vivid imagery, sinuous language, and metaphors of nature.

WOOTEN, John, Assistant Professor, "**The Comic Milton and Italian Burlesque Poets**," *Cithara*, 22 (November 1982), 3-12.

Milton, much more than has been acknowledged, was influenced by the vogue for burlesque poetry which reached its zenith of popularity in England in his litetime. Milton scholarship has rediscovered Milton's sense of humor, a facet of his personality lost for a while in overly sober assumptions about the Puritan poet and classicist. But there is still more work to be done in order to demonstrate that Milton's classicism allowed for a variety of manner that included burlesque debunking. Milton's admiration for and readiness to respond to things Italian help to explain his receptivity to burlesque, for the roots of Renaissance burlesque are Italian. In particular, Milton knew the comic burlesque poetry of Luigi Pulci (1431-1487), Teofilo Folengo (1496-1544), and Alessandro Tassoni (1565-1635). Passages from these poets' works shed light on certain passages in *Paradise Lost*.

WOOTEN, John, Assistant Professor, "**From Purgatory to the Paradise of Fools: Dante, Ariosto, and Milton**," *ELH: English Literary History*, 49 (December 1982), 741-750.

Most editors and commentators have assumed, and with good reason, that Milton's Limbo in Book III of *Paradise Lost* functions in some way as a literary allusion to Dante's first circle of Hell, which is Dante's Limbo. Dante *is* relevant, though not in so simple a way as critics have believed. In addition, critics and commentators have assumed, because of Milton's reference in the Limbo passage to the canto in Ariosto's *Orlando Furioso* where Astolfo, the English knight-errant, flies to the moon, that Milton has Ariosto very much in mind as a complementary source. Milton uses Ariosto, even "corrects" him, a strategy that also involves a correction of Dante, and of Dante's *Purgatorio* in particular. What we have in Milton's Paradise of Fools, his Limbo, is a very sophisticated piece of literary and theological criticism. Through the filter of Ariosto's moon fantasy, which in its turn is a literary and theological parody of Dante's *Commedia*, Milton achieves a masterly double aim: to borrow some of Ariosto's comic-satiric thunder while striking at the same large satiric target—Dante's great medieval poem, especially the middle part of it.

WOOTEN, John, Assistant Professor, "**Sir Henry Wotton**," in *Critical Survey of Poetry*, ed. Frank N. Magill. Englewood Cliffs, New Jersey: Salem Press, 1983, VII, pp. 3139-3145.

This essay on Sir Henry Wotton, seventeenth-century English poet and diplomat, gives pertinent information about editions, collections, and criticism of Wotton's poetry. In addition, a section analyzes Wotton's literary achievement; another briefly describes his life; while a more extended section analyzes particular poems in an effort to make very specific the nature of Wotton's modest but influential poetic talent.

YOUNG, Mallory, Assistant Professor, "**The Phaecians: Pleasure, Poetry, and Tragic Choice**," *Southern Humanities Review*, 16 (Spring 1982), 145-152.

The decision of the Phaeacians to convey Odysseus to his home in Ithaca is one of the most problematical events in the *Odyssey*. The Phaeacians are well aware of the conflict between Poseidon and Odysseus: their guest has revealed it in his own story. They also know the dangerous consequences of aiding and abetting this wanderer. Numerous explanations have been offered to justify their action—forgetfulness, hospitality, even cowardice. But a better answer may appear in a consideration of the Phaeacians' own position and culture.

The Phaeacians live in a world of unfailing abundance, free from effort and toil. Their play-oriented culture represents the height of civilization. They live the life of the gods, separated from all men. Their view of storytelling corresponds: the bard Demodocus provides them with pleasure. But the Phaeacians are not gods; they are mortal. Odysseus' story forces them to a recognition of their own humanity. No one can stand disinterested between gods and men; the Phaeacians enter the struggle on the side of man, choosing their own mortality—much as had Odysseus himself on the island of Calypso. The *Odyssey* reveals that men are not gods—and that poetry is not solely an instrument of pleasure.

Presentations

HILL, John M., Associate Professor, "**The Intrusive Narrator in *The Canterbury Tales*,**" International Medieval Conference, Kalamazoo, Michigan, 8 May 1983.

JASON, Philip K., Associate Professor, "**Poetry Reading,**" The Phillips Collection, Washington, D.C., 19 November 1982; Montpelier Arts Center, Laurel, Maryland, 3 June 1983.

LEFCOWITZ, Allan B., Professor, "**Poetry and the Second Law of Thermodynamics,**" Conference of the World Futurist Society, Washington, D.C., 15 July 1982.

LEFCOWITZ, Allan B., Professor, "**All That a Writer Has to Know About Everything,**" Writers Conference of the Northern Virginia PEN Woman, 1 November 1982.

MAZZENO, Laurence W., Major, USA, " '**Matthew the Chatterer' and 'that damn'd Scot': The Friendship of Matthew Arnold and James Bryce,**" Athenaeum, U.S. Naval Academy, 15 October 1982.

MAZZENO, Laurence W., Major, USA, "**Some Considerations for English Teachers in Using Computers,**" Spring Meeting of the Maryland Association of Departments of English, Charles County Community College, La Plata, Maryland, 15 April 1983.

NOLAN, Charles J., Jr., Associate Professor, "**Hemingway's Women's Movement,**" Annual Convention of the Popular Association in the South, Atlanta, Georgia, 7 October 1982.

PARKER, Michael P., Assistant Professor, "**Comely Gestures, Sweeter Manners: Carew, Kit Villiers, and the Character of Caroline Courtliness,**" Southeastern Renaissance Conference Annual Meeting, Charlottesville, Virginia, 26 March 1983.

PARKER, Michael P., Assistant Professor, "**Mutinous Members: Shakespeare, Parliament, and the Body Politic,**" Sixteenth-Century Studies Conference, St. Louis, Missouri, 29 October 1982.

PARKER, Michael P., Assistant Professor, "**Diamond's Dust: Carew, King, and the 1633 Elegies of Donne,**" Fifth Biennial Renaissance Conference, Dearborn, Michigan, 16 October 1982.

PROTHRO, Nancy W., Assistant Professor, " '**Sing, Heav'nly Muse': Techniques of Teaching Poetry,**" Maryland Council of Teachers of English Language Arts Spring Conference, Ocean City, Maryland, 19 March 1983.

ROSS, Stephen M., Associate Professor, "**Reading Voices in Part iv of Faulkner's 'The Bear,' **" Meeting of Northeast Modern Language Association, Erie, Pennsylvania, 14 April 1983.

SHENK, Robert E., Commander, USNR, "**Cultural Literacy, or Cultural Mastery: the Context of the Writing Craft,**" Conference on College Composition and Communication, Detroit, Michigan, March 1983.

TOMLINSON, David O., Professor, "**A National Man in Local History,**" The Catonsville (Maryland) Historical Society, 23 November 1982.

TOMLINSON, David O., Professor, "**Literary Figures of Maryland: Poe and Kennedy,**" Fairfield Senior Center, Annapolis, 19 October 1982.

WOOTEN, John, Assistant Professor, "**The Baroque Rhetoric of Space: Ariosto and Milton,**" Baroque Festival Symposium, Washington University, St. Louis, Missouri, 26 February 1983.

YOUNG, Mallory, Assistant Professor, Poetry Reading, Maryland Writers' Council, Maryland Institute College of Art, Baltimore, 23 September 1982.

DEPARTMENT OF

History

PROFESSOR PHILIP W. WARKEN
CHAIRMAN

For the History Department, 1982-1983 was an outstanding year in publication and research. The faculty published twelve articles, chapters in books, papers, and encyclopedia entries in the field of history.

The Department continued to participate actively in professional conferences across the country. At nine of these, faculty members presented papers. Also, presentations were made to fifteen military and civic audiences.

The results of the History Department's deep involvement in research are reflected in the ongoing enrichment of the classroom experience offered the midshipmen as well as in the production of scholarly publications and papers.

Sponsored Research

Taverns and Popular Sociability in Eighteenth-Century Paris

RESEARCHER: ASSISTANT PROFESSOR THOMAS BRENNAN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study covers popular culture in eighteenth-century Paris for publication as a book on working class communities and social behavior, which focuses on the role of taverns as a community forum and center for sociability. Judicial documents give a concrete and quantified foundation to our knowledge of the normal lives of the "nameless poor." Their use and perceptions of taverns, of drink, and of leisure are the subjects of this inquiry. The tavern was also the object of enormous fear and condemnation by the authorities and the church at the time. In the contrast of elite and popular perceptions, a fascinating clash of two cultures at the dawn of the Industrial Revolution appears.

The Via Flaminia

RESEARCHER: ASSOCIATE PROFESSOR PHYLLIS CULHAM
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The project focuses upon two topographical problems with the route of the ancient Via Flaminia in Italy. First is the entry of the Flaminia into the Mera Gorge. Secondly, there is the problem of the more recent, but longer alternate route through Foligno. The purpose of the investigation is to offer an explanation for these apparent anomolies. Explanations are sought in the ancient literature, examination of the topography and morphology of the region, archaeological characteristics of surviving substructures, and computer simulation of various engineering solutions. Preliminary findings were presented in a paper to the Field School in Archaeology of Florida State University in July 1982. Efforts are continuing to find outside support for more field work in Italy to lead to completion of a number of papers and possibly a scholarly monograph.

John L. Sullivan

RESEARCHER: COMMANDER MICHAEL T. ISENBERG, USNR
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A cultural biography of boxing champion John L. Sullivan (1858-1918) has been partially supported by the Naval Academy Research Council. Such a biography seeks to answer the question of how Sullivan, an ethnic outsider from a proletarian background, managed to become America's first truly national sports hero in boxing, an "outlaw" sport. The research involves investigation into little-used historical sources, such as sporting journals and newspapers, to document the life story of a man about whom no scholarly biography has ever been written.

The British Expedition to Egypt, 1801

RESEARCHER: CAPTAIN BRENDAN P. RYAN, USMC
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study continues work begun under a Naval Academy Research Council grant of 1982. It involves an in-depth study of the British amphibious expedition to Egypt in 1801, the object of which was to defeat the remnants of Napoleon Bonaparte's Army of Egypt and end a perceived threat to the British possessions in India. The expedition, commanded by Lieutenant General Sir Ralph Abercrombie, was one of the largest pre-20th Century amphibious campaigns. It included a fiercely contested landing at Aboukir Bay that is a model for amphibious assaults. Despite the death of the commanding general from wounds received in battle, the campaign was a success and represents one of Britain's first major victories in the Napoleonic Wars.

Medalists and Mutineers: A Test of Social-Order Theory

RESEARCHER: LIEUTENANT COMMANDER JAMES W. WILLIAMS, USNR
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project continues research begun under a Naval Academy Research Council grant in 1981-1982 by looking at a specific organization and time period—the U.S. Army in World War II. This project aims to develop a relative scale of risks associated with the types of combat situations in which people received the Medal of Honor and, if possible, to develop a subjective scale with which to compare objective risk and probable fear as a component in individual behavior in the situation. This project also tries to go further into questions about differences in distributions of awards according to rank in the U.S. armed forces.

Western Civilization Computer Assisted and Video Disc Program

RESEARCHERS: PROFESSOR LARRY V. THOMPSON; ASSOCIATE PROFESSORS P. ROBERT ARTIGIANI, PHILIP R. MARSHALL, CRAIG L. SYMONDS; ASSISTANT PROFESSORS DANIEL M. MASTERSON AND JACK SWEETMAN
SPONSOR: NAVAL ACADEMY INSTRUCTIONAL DEVELOPMENT ADVISORY COMMITTEE

The project entails the expansion and modification of the computer assisted self-study program inaugurated in 1982 with IDAC funding. Appropriate CAI for the new six-credit History Plebe core course will be developed. This involves creating a new question data base for the first semester course and revising and updating the question data base for the second semester to facilitate the new chronological and topical emphasis. Additionally, the computer program itself will be modified to improve user efficiency and eliminate program elements deemed unnecessary through previous use.

The second major component of the project involves interfacing the prototype video disc, developed last year, with the computer—both for the CAI program and the classroom. Further collation and collection of images for the permanent disc will continue, and the indexing of them for efficient use by instructors will be completed.

"Babushka" of the Russian Revolution: The Life of Ekaterina K. Breshko-Breshkovskaia, 1844-1934

RESEARCHER: ASSISTANT PROFESSOR JANE E. GOOD
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Ekaterina Konstantinovna Breshko-Breshkovskaia (1844-1934) was a prominent *narodnik* (populist) and leader of the Russian Socialist Revolutionary Party. Her devotion to the revolutionary cause, her generosity to her fellow Siberian exiles, and her solicitude for the poor earned her the nickname Babushka—"Little Grandmother" of the Russian Revolution. The project is to research and write a book-length biography of Breshkovskaia.

Breshkovskaia's life deserves study for several reasons: Breshkovskaia lived ninety years; she was born during the reign of Nicholas I and died as Stalin tightened the reins of his communist dictatorship. Therefore, her life spanned three distinct periods of Russian revolutionary activity: the revolutionary underground (1860-1917); the Revolutions of 1917; and the revolutionaries in European exile. Usually these periods are studied separately, largely because few of the *narodniki* survived tsarist persecution to witness the revolution when it finally occurred. A careful study of her activities is thus a chronicle of the fate of the entire revolutionary movement in Russia.

Breshkovskaia was a *narodnik*, a Socialist Revolutionary, and *not* a Marxist. She began debating Marxists in the 1890s, when the writings of Karl Marx first began to attract the attention of revolutionaries disillusioned by the failure of the populists to overthrown the autocratic regime. She remained an implacable foe of the Bolsheviks until her death.

The biography of Breshkovskaia will be based on the type of primary source material that historical research demands: archival and manuscript collections; letters; diaries; reminiscenses; interviews; and newspaper accounts. Indeed, Breshkovskaia is a good subject for study because all of this vital material is located outside the Soviet Union. (Since she is a "nonperson" in the Soviet Union today, it would be impossible to gain permission to go there to work on her biography). In particular, the biography will address such questions as why Breshkovskaia turned from reform to revolution; why she committed herself to the theories of Russian populism; why she was able to emerge from Siberian exile still eager to continue to fight autocracy when so many of her fellow exiles gave up the struggle; and why she was so hostile to Marxism in general and Lenin in particular.

Breshkovskaia's impressions will be analyzed within the framework of Russian populism, but the entire movement will not be reduced to her thinking. Also, it is difficult to answer motivational questions without resorting to some psychological analysis. Thus, although the study will not be a pure psychobiography, insights from the field of psychology will be used when appropriate. At present the first five chapters of this biography are completed. The sixth chapter, which covers Breshkovskaia's activities in 1917-18, is being written by David R. Jones of Dalhouisie University. The seventh and final chapter will be completed by December 1983.

Siegfried Sassoon and the Crisis of Modernity in the Great War

RESEARCHER: ASSISTANT PROFESSOR THEODORE W. BOGACZ
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study discusses the English soldier-poets of the First World War as representative figures of the generation of 1914. At the center of this study is the English war poet, Siegfried Sassoon (1886-1967). In his war-induced search for a new language to express his feelings about the modern world, in his joyous participation in battle and subsequent revolt against the slaughter at the front, in his growing politicization during the war, in his discovery of the new world of psychology during his treatment for "shell-shock," in short, in his intellectual and spiritual transformation during the war, Siegfried Sassoon exemplifies a radical shift in consciousness in the generation of Englishmen who came of age in the First World War.

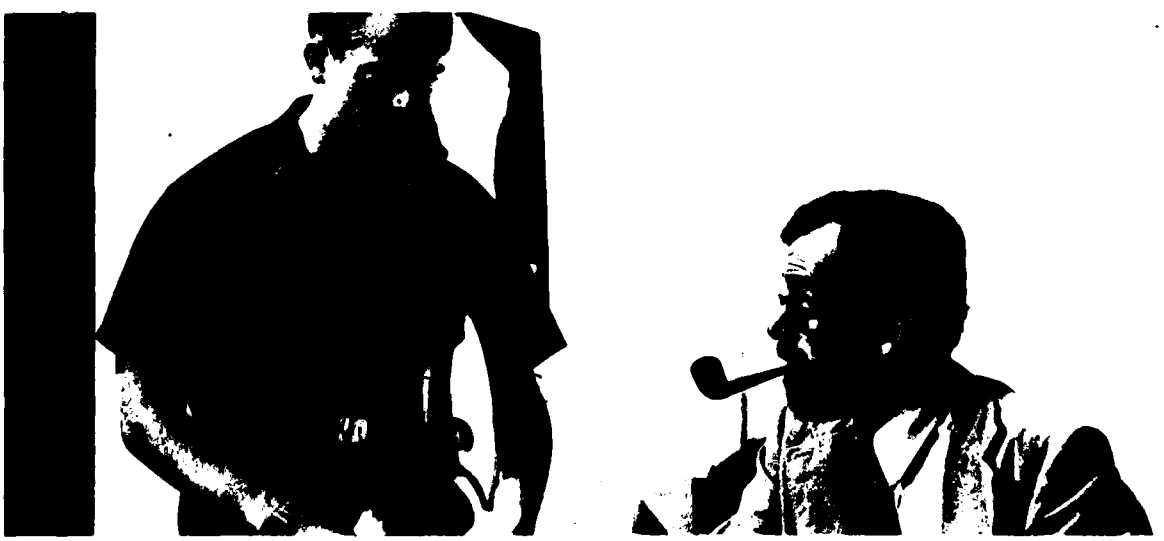
This study emphasizes three major crises which Sassoon and his comrades encountered during the war: those of language, politics, and psychology. Each of these crises merits a separate article. In addition to continuing research on the impact of the First World War on Sassoon and his fellow war poets as well as on English culture generally, during 1983 it was also possible to finish one article on the national crisis of language which arose from the war and a second article on the impact on British attitudes toward psychology resulting from the shell-shock crisis of 1914-1918.

Energy Awareness: Faculty Interdisciplinary Seminars

RESEARCHER: ASSOCIATE PROFESSOR ROBERT ARTIGIANI
SPONSOR: NAVAL SEA SYSTEMS COMMAND

During academic year, 1982-1983, the USNA Energy Awareness Committees sponsored five interdisciplinary faculty seminars. Speakers and their topics included: David Burns, Department of State, "Global Energy Security"; Sumner Benson, Department of Defense, "Siberian Pipeline and the NATO Alliance"; Commander Richard Katz, USN, "Navy Energy Policy: An Overview"; Rodney Jones, Georgetown Center for Strategic and International Studies, "Nuclear Energy and Nuclear Proliferation"; and Jack Holl, Department of Energy, "U.S. Energy Policy Since World War II."

The seminars met throughout the academic year and normally attracted about twenty faculty auditors. Attendees were divided equally between military and civilian faculty. Typically, the audience represented all three academic areas—science, engineering, and humanities. Several speakers were also kind enough to address midshipmen extra-curricular societies, where a lively give-and-take usually followed the speaker's presentation.



Independent Research

The History of Technology and the Philosophy of Technology: Steps Toward a Conceptual Model

RESEARCHER: ASSOCIATE PROFESSOR ROBERT ARTIGIANI

The philosophy of technology is developing a dynamic model of the human environment which will be applied to historical developments in an interpretive way.

William Howard Taft

RESEARCHER: PROFESSOR PAOLO E. COLETTA

This essay, not footnoted but with selected bibliography, on the presidency of Taft covers background that helps explain his conservatism; attitude toward the tariff, conservation, and progressive reforms; his role as commander-in-chief; his handling of foreign affairs; and his relations with Theodore Roosevelt before his election, during his tour, and in the campaign and election of 1912. It is to be published in 1983 in Henry Graf, ed., *The American Presidency*, 2 vols. N.Y.: Charles Scribner's Sons.

The Naval Air Station

RESEARCHER: PROFESSOR PAOLO E. COLETTA

A chapter in the forthcoming edition of the *Naval Aviation Guide*, this work includes choice of site, construction, mission, operations, short histories of selected stations, selected commanding officers, and services the stations provide ship's company and transients. The essay has been accepted for publication by Naval Aviation History Office.

Aviation at Annapolis

RESEARCHER: PROFESSOR PAOLO E. COLETTA

The first naval aviation camp was established at Greenbury Point. After 1926, all Academy graduates had to become pilots or observers. Training was provided by a squadron of float planes, later flying boats. Unable to find a suitable location near Annapolis, the aviation program was closed down in 1962.

The Chiefs of Staff of the Army

RESEARCHER: ASSOCIATE PROFESSOR ROBERT W. LOVE, JR.

This study is a continuation of the "military executives" series that includes the *Chiefs Of Naval Operations* and the *Commandants Of The Marine Corps*. As in those volumes, each author will deal with the career of one general, provide essential details of his entire career, but concentrate the bulk of the essay on the officer's service as chief-of-staff. The essays are due for editing in late 1984 and the book is projected for publication in 1986.

"Journey to Pearl Harbor," Vol I of *From Pearl Harbor to Tokyo Bay: U.S. Naval Policy and Strategy in World War II*

RESEARCHER: ASSOCIATE PROFESSOR ROBERT W. LOVE, JR.

This study traces the careers of a number of flag officers who were instrumental in the creation of prewar planning and shipbuilding and details their roles in the evolution of American naval policy from 1936 to 1941. The study concludes with the attack on Pearl Harbor and evaluates new evidence concerning the role of the American navy in the months prior to the Japanese stoke. The manuscript is nearly completed and will be submitted for publication in the fall of 1983.

The War of the Falkland Islands, 1983

RESEARCHER: ASSOCIATE PROFESSOR ROBERT W. LOVE, JR.

This study of the background and fighting during the Anglo-Argentine war over the Falklands Malvinas Islands in 1982 is the product of research conducted by a multi-national team of over fifteen scholars and written by the researcher. It is intended to present not only a detailed analysis of the causes and course of the war, but to provide the reader with a view of the conflict not only from the standpoint of the combatants, but also from the helpers over whose future the conflict was waged. Nearly complete, the book will be published in 1984.

A Battlefield Atlas of the Civil War

RESEARCHER: ASSOCIATE PROFESSOR CRAIG L. SYMONDS

This study is designed to fulfill the need for a general reference work that depicts all the major campaigns of the American Civil War on full page color maps, keyed to a detailed text that explains the tactical decisions of the battle. The final volume will contain 43 full page maps, 24 photographs, and 100 pages of text.

The Sykes-Picot Agreement of 1916

RESEARCHER: ASSOCIATE PROFESSOR JAMES P. THOMAS

The purpose of this project is to investigate the causative elements in the British and French decision to agree to partition the Arab portions of the Ottoman Empire and to provide for the creation of an independent Arab state during World War I. Emphasis is placed on elements of strategic interest. Investigation has already been carried out by research in the British Foreign Office, War Office, Admiralty, and Cabinet Office records in the Public Record Office in London. Also, many collections of private papers of British officials have been investigated. The material in the French Ministry of Foreign Affairs Archives in Paris has been investigated. The material produced by this research is in the process of digestion, collation, and incorporation into the study.

Major Geuerd William H. Witherspoon

RESEARCHER: PROFESSOR PHILIP W. WARKEN

An essay on the life and contributions of Geuerd Witherspoon, concentrating on his tenure as Chief of Staff of the Army, will be included in a book on the Chiefs of Staff.

Publications

ARTIGIANI, Robert, Associate Professor, "**The Tablet and the Tool: An Essay in Technology and Human Value**," *Journal For the Humanities and Technology*, 4 (December 1982), 1-14.

The theory of forms and a definition of technology as a public art are related to criticize humanistic opponents of technology and offer a positive argument relating technological progress to human values.

CALDERHEAD, William, Professor, "**Prelude to Yorktown: A Critical Week in a Major Campaign**," *Maryland Historical Magazine*, 77 (Summer 1982), 123-135.

Although General Washington was not aware of it at the time, he had seven days (from September 10 to September 17) to get a portion of his army, moving southward, to the vicinity of Yorktown to eliminate the possibility that the British enemy would attempt a last-minute breakout of their position before they became completely sealed in. Although the main body of Washington's army did not reach Yorktown in time for this, the van of the army did arrive before the "deadline." Evidence suggests that the van's appearance at Yorktown caused General Cornwallis to decide to not attempt an escape.

CULHAM, Phyllis, Associate Professor, "**The Lex Oppia**," *Latomus*. 41 (October-December 1982), 786-793.

The Lex Oppia was not one of the admittedly numerous confiscatory economic measures passed during the Second Punic War as is usually thought. Although it is early in the series, it is to be assigned to the series of sumptuary laws passed during the succeeding century. Its effects were not economic, nor were they intended to be. It was instead a measure aimed at increasing social control and cohesion in the crises of the Second Punic War.

GOOD, Jane E., Assistant Professor, "**America and the Russian Revolutionary Movement, 1888-1905**," *The Russian Review*, 41 (July 1982), 273-287.

This article described the activities of the four individuals who were most responsible for shaping American public opinion of Russian revolutionaries at the turn of the century: American journalist George Kennan; the nihilist Sergie Stephniak; the liberal Paul Miliukov; and the Socialist Revolutionary E. K. Breshkovskaia. The major question the article seeks to answer is how Americans got such a distorted view of revolutionary Russia. The evidence presented suggests that the four "experts" on Russia, each for his/her own reasons, tended to oversimplify the actual situation to American audiences. As a result, many Americans believed that all Russian radicals wanted to make Russia into a carbon copy of the United States.

GOOD, Jane E., Assistant Professor, "**E. K. Breshkovskaia and the Russian Revolutionary Cause in America**," *Red River Valley Historical Journal*, 5 (Summer, 1981), 299-313.

This article is a detailed analyses of Breshkovskaia's 1904-1905 visit to the United States. The purpose of her visit was to raise money for the Socialist Revolutionary Party. Although personally an advocate of terrorism, she passed herself off in the U.S. as a harmless "babushka" who had been a victim of tsarist abuse. She became the symbol of the Russian revolution in America and helped convince many prominent Americans to support the cause.

HAGAN, Kenneth, Associate Professor, *American Foreign Policy: A History*, 2nd edition. Lexington, Massachusetts: D. C. Heath, 1983, Chapters 4 and 7.

The revision is moderately extensive. The bibliography is fully updated. This book now is apparently the leading text in the country for upper division college courses in American diplomatic history. It spans the entire period of our nation's existence.

LOVE, Robert W., Jr., Associate Professor, "**Naval History: A Changing Field**," *Marine Corps Gazette*, (April 1983), 26-27.

This brief article argues that the recent proliferation of scholarship and renewed interest in the history of the Marine Corps makes extremely difficult the development of a post-Mahanian synthesis. It also chronicles the efforts of the History Department at the Naval Academy to encourage midshipmen to study naval history.

SWEETMAN, Jack, Assistant Professor, "**Monarchism and National Socialism: August Wilhelm of Prussia-the 'Nazi Prince'**," in Michael Barret (ed), *Proceedings of the Citadel Symposium on Hitler and the National Socialist Era.* Charleston, South Carolina: The Citadel, 1982, pp. 53-60.

In 1930 Prince August Wilhelm of Prussia, the fourth son of Kaiser Wilhelm II, joined the National Socialist Party. During the following three years prior to the National Socialist seizure of power, he played a prominent political role as a propaganda speaker. This paper describes the prince's activities and attempts to assess their impact on the German body politic.

SWEETMAN, Jack, Assistant Professor, co-author, "**Demobilization and Change: Naval Personnel Problems, 1945-47**," *Shipmate*, 45 (January-February 1983), 14-16.

At the end of World War Two the rapid demobilization of the U.S. Navy produced many problems in personnel matters. This memoir describes Admiral Holloway's experiences during these years and the part he played in solving these problems.

SWEETMAN, Jack, Assistant Professor, "**The Novel Situation: American Neutrality and the Merchant Submarine**," *Shipmate*, 46 (May 1983), 25-26.

In 1916 Germany built several unarmed, merchant submarines, one of which, the *Deutschland*, was sent to the United States to buy strategic materials. Great Britain protested that any submarine was by its nature a combatant vessel and should not be treated as a merchant ship. This paper examines the embarrassing problem to American neutrality posed by the appearance of the *Deutschland*.

WILLIAMS, James W., Lieutenant Commander, "**Sociology in the Technical Curriculum**," Laurence W. Mazzeno (ed.), *Liberal Learning in a Technical Curriculum*, Annapolis: U.S. Naval Academy Press, 1983, 55-58.

Teaching sociology can be justified in a technical curriculum because of contributions the perspectives and methods of the discipline make to intellectual and emotional development. Without coordinating development in these areas, a technical curriculum, such as that at the Naval Academy, cannot produce a mature person. Sociology offers some tools to coordinate development in these areas. The discipline, by its content, challenges the simplistic view that reality exists tangibly and unambiguously, to be mastered by sheer effort—a view most freshmen in a technical curriculum hold. The encounter with relativism provides the opening for intellectual growth but also creates pain—an emotional experience—for most students. In the methodologies it employs, sociology offers the student a mature way to cope with this experience. He is offered the solution of contributing directly to expanding both his own knowledge and that of others. The solution, in turn, points to greater intellectual challenges, each of which may demand further emotional growth. Thus, sociology creates an unusually complete learning cycle.

Presentations

BOGACZ, Theodore W., Assistant Professor, "**Soldier Poets of the First World War**," Churchill Society, U.S. Naval Academy, 8 December 1982.

BOGACZ, Theodore W., Assistant Professor, "**A Crisis of Language: Poetry and the First World War**," *English Department, Principia College, Illinois*, 4 January 1983.

CALDERHEAD, William, Professor, "**Black Annapolitans and The Artifacts They Left Behind**," Department of Archaeology, University of Maryland, College Park, Maryland, 29 June 1982.

CALDERHEAD, William, Professor, "**The Quarry that Escaped: British Efforts to Recapture Burgoyne's Army Force of Prisoners, December, 1778**," Carolinas Symposium on British Studies, Tenth Annual Conference, Appalachian State College, Boone, North Carolina, 10 October 1982.

COLETTA, Paolo, Professor, "**Reagan and the Rearming of America**," American Association of Retired Persons, Annapolis, January 1983; and Daughters of the American Revolution, Annapolis, February 1983.

COLETTA, Paolo, Professor, "**The Naval War of 1812**," U.S. Daughters of 1812, Annapolis, February 1983.

CULHAM, Phyllis, Associate Professor, "**The Battle of Italy**," Great Battles of Antiquity Series, Smithsonian Associates, Washington, D.C., 17 February 1983.

DARDEN, William M., Associate Professor, "**Union Troops in Annapolis**," Baltimore Round Table of American Military History, Baltimore, November 1982.

GILLMOR, Carroll, Assistant Professor, "**The Seine as a Frontier: the Norse Incursions and Riverine Defense, 841-886**," Southeastern Medieval Association, Dallas, Texas, October 1982.

GILLMOR, Carroll, Assistant Professor, "**War on the Rivers: Viking Numbers and Formations on the Seine and Loire, 862-869**," Haskins Society, Houston, Texas, November 1982.

GILLMOR, Carroll, Assistant Professor, "**War on the Rivers: the Frankish Military Response to the Vikings on the Loire, 862-869**," Conference of the Rocky Mountain Medieval and Renaissance Association, Provo, Utah, April 1983.

GILLMOR, Carroll, Assistant Professor, "**The Frankish Military Response to the Northmen: the Logistics of Fortified Bridge Building on the Seine, 862-869**," University of Minnesota, Minneapolis, May 1983.

GOOD, Jane E., Assistant Professor, "**American Perception of Revolutionary Russia**," American Historical Association Annual Meeting, Washington, D.C., 30 December 1982.

HARROD, Fredrick H., Associate Professor, "**Law and Society**," Maryland Committee for the Humanities, Easton, Maryland, October 1982.

HUSTON, John W., Professor, "**Annapolis and the Revolution**," Daughters of the American Revolution, Severna Park, February 1983.

HUSTON, John W., Professor, "**Dedication: A New Meaning**," 8th Air Force Historical Society, Dayton, Ohio, October 1983.

HUSTON, John W., Professor, "**The Wartime Leadership of General Arnold**," Air Command and Staff College, Maxwell Air Force Base, Alabama, August 1982.

HUSTON, John W., Professor, "**The Wartime Leadership of General Spaatz**," Air Command and Staff College, Maxwell Air Force Base, Alabama, August 1982.

HUSTON, John W., Professor, "**Jonas Green, Colonial Printer**," Friends of St. John's, Annapolis, February 1983.

HUSTON, John W., Professor, "**What Then This Colonial American**," Anne Arundel County Historical Society, Annapolis, March 1983.

LOVE, Robert William, Associate Professor, "**New Evidence on Pearl Harbor**," Baltimore Rotary Club Pearl Harbor Anniversary Luncheon, Baltimore, December 1982.

WILLIAMS, James W., Lieutenant Commander, "**The Educated Warrior—Contradiction in Terms?**" Society for Values in Higher Education Annual Conference, Guilford, North Carolina, 9 August 1982.

WILLIAMS, James W., Lieutenant Commander, "**The Vietnam Memorial Controversy: A Study in American Values**," Lions' Club, Severna Park, Maryland, 24 May 1983.

ZEIMET, Roger T., Lieutenant Commander, "**The Fight in the Cedar Woods: Philip H. Sheridan and the Battle of Stones' War**," Confederate History Institute, Murfreesboro, Tennessee, 6 May 1983.

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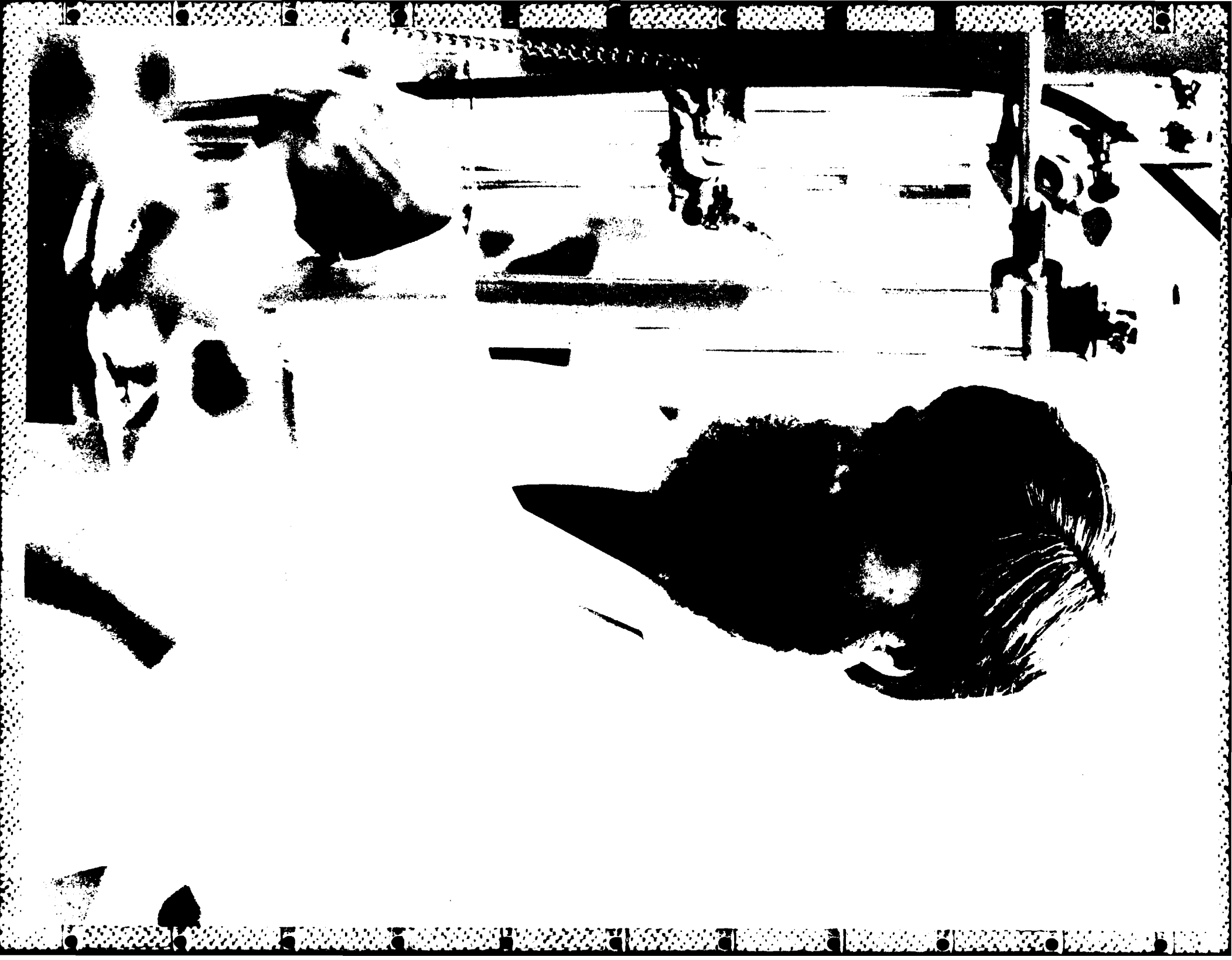


DEPARTMENT OF

Chemistry

COMMANDER WILLIAM H. RIVERA, USNR
CHAIRMAN

With the continuation of the change in the Department's faculty as older faculty members retire and new faculty are hired, the nature of the research activity, its distribution of support, and student participation all show differences from preceding years.

The nature of support for research has moved from a strong involvement in the more applied work of the Naval R&D community to a more fundamental research emphasis. As the more mature faculty members retired, their contacts were lost to some extent and the new faculty brought with them new agendas. There is still considerable Navy support even for the more esoteric work. This year that includes support from the David W. Taylor Naval Ship Research and Development Center for work in fuels and polymers, and support from the Naval Research Laboratory in theoretical and structural studies and in electrochemistry. The Naval Academy Research Council provided support to get some of the new people started in organic reaction mechanisms, natural products, and new organometallic studies. The Research Corporation provided funding to two of our personnel. Three studies were undertaken without support from external sources in organic synthesis, laser dyes and theoretical reaction kinetics.

Fourteen student projects resulted from these and other interests of the faculty. They covered organometallics, heteropolytungstates, antifouling polymers, anti-malarial agents, electrochemistry in molten salts, theoretical calculations of structure and kinetics, and a biological study done by Midshipman Mark Olson as a Trident Scholar under the direction of Professor Reece Corey. His work examined the details of fouling development on various materials and won the Trident Scholar Prize.

The department published 10 articles in the open literature and one faculty member contributed a chapter in a seminal monograph in his specialty. The department read more than 17 papers in a variety of professional settings.

Sponsored Research

Taft Substituent Constants of Organometallic Compounds

RESEARCHER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF
SPONSOR: RESEARCH CORPORATION

Substituent constants are a measure of the ability of a chemical group to attract or donate electrons and, when applied to a series of similar chemical species, may be used to establish trends in chemical behavior and reactivity. Organometallic compounds are frequently air or water sensitive; thus the number of techniques available to measure their substituent constants is limited. Of particular interest is the Taft method in which a fluorophenyl substituted compound is used as a probe. Using the 19-F NMR chemical shift of fluorobenzene as a reference, the chemical shift of both a meta- and para- fluorophenyl substituted organometallic compound is measured.

The substituent constants of three arene chromium carbonyl compounds (areneCr(CO)$_2$L, where L = carbon monoxide, triphenylphosphine and triphenylarsine) have been determined and reported. Three additional compounds in this series (L = trimethylphosphine, triphenylphosphite and trimethylphosphite) have been prepared and their substituent constants will be reported shortly. Model compounds for a series of cyclopentadienyl manganese carbonyl compounds have been prepared by a new route involving a thallium cyclopentadienyl intermediate.

Synthesis and Chemistry of Bimetallic Compounds

RESEARCHER: ASSISTANT Professor THOMAS E. BITTERWOLF
SPONSOR: RESEARCH CORPORATION

Bimetallic compounds have recently been shown to be involved in the reactive centers of several enzymes such as those which convert atmospheric nitrogen to ammonia and oxidize water to oxygen in the course of photosynthesis. Their presence in the enzymes responsible for fixing carbon dioxide has been known for some time. Bimetallic species are also thought to be involved in several surface reactions such as the Fischer-Trolpsch synthesis of short chain alkanes and alkenes from synthis gas (H_2 and CO). It is also likely that liberation of dihydrogen from the surface of metals during corrosion is a bimetallic process.

This research seeks to prepare a series of compounds in which two metal atoms are held in close proximity by a set of at least two bridging groups. The introduction of ligands (hydrogen, alkyl groups) onto these metal centers will position the ligands in immediately adjacent sites where they may be able to interact to yield products. Attempts are also underway to prepare compounds which will bind and activate dinitrogen or carbon dioxide and activate these compounds for reaction with reducing agents.

The synthesis of biphenylbisd(chromiumtricarbonyl) bis(diphenylphosphido) methane and its arsenic analog has been reported along with a study of its interaction with strong acids. Four more compounds have now been prepared in this series and their reactions with acid and with methyltfluorosultonate will be examined in the immediate future. Mixed metal compounds containing chromium-molybdenum and manganese-chromium have been prepared, and a diphosphine bridge has been introduced into the mixed maganese-chromium compound. A dimanganese compound has been prepared and a bridging reaction attempted. A small amount of the bridged product was detected by 31-P NMR, but the major product from this reaction was a compound with the phosphine bound at only one end.

Electrochemistry at Phenol-Coated Platinum Electrodes

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK
SPONSOR: NAVAL RESEARCH LABORATORY

In this work, platinum electrodes were coated with a surface film by oxidation of phenol at the electrodes. The pH response of the platinum electrodes, coated and uncoated, was approximately the same (52 mV pH unit), indicating that the response is actually due to the existence of an oxide layer on the platinum surface and that protons are able to penetrate the surface film rather easily. In related work, it has also been found that reduction of benzoquinone at phenol-coated platinum electrodes involves inhibition of the second reduction step of the quinone. Similar studies for N, N-dimethyl-p-phenylenediamine showed that the response for the second oxidation process of this compound is only somewhat decreased compared to that of the first oxidation step. These results suggest selective exclusion of anionic species from the surface film, with some of the effect being attributed to a steric exclusion of the charged species with their associated counterions.

Electrochemistry of Organic Compounds at $(SN)_x$ Electrodes

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK
SPONSOR: NAVAL RESEARCH LABORATORY

Hydroquinone (H_2Q) was chosen as one of the compounds for study at $(SN)_x$ paste because it has been extensively studied at platinum and vitreous carbon electrodes as well as at $(SN)_x$ single crystal electrodes, the electrochemical behavior being similar at all of these electrodes. At $(SN)_x$ paste, however, it was observed that the current density for the reduction process following H_2Q oxidation was much smaller, by a factor of approximately six, than that of the other electrodes. Since this reduction process corresponds to the reduction of the protonated quinone, this phenomenon was studied by adding proton donors (for example, perchloric acid) to a solution containing benzoquinone, the oxidized form of hydroquinone. The reduction process under these conditions corresponded to that observed in the work on H_2Q; in addition, the observed current level was smaller than that observed at the other electrodes. These results are thought to indicate slow kinetics for this reduction; that is, in this case the $(SN)_x$/Apiezon paste electrode behaves differently from the $(SN)_x$ single-crystal electrodes.

An interesting effect was observed for certain heterocyclic aromatic compounds at potentials approaching the positive (anbodic) background limit for the $(SN)_x$ paste electrode. An oxidation peak, rather poorly resolved from the anodic background process, appeared at potentials approximately 100 mV negative of background upon addition of pyridine, quinoline, or acridine, the current for the process increasing with heterocycle concentration. Smaller effects were seen for thiazole, while thiophene showed very little effect. The interpretation of this effect involves a "complexation" of the oxidized $(SN)_x$ species by nucleophiles, thereby promoting easier oxidation of the $(SN)_x$. This is in accord with the effects seen for the compounds studied, since the extent of the effect increases with increased nucleophilicity of the compound.

In a study of other heterocyclic systems, pyrrole oxidation was observed at a potential corresponding to the anodic potential limit for $(SN)_x$ and, while no separate oxidation process was seen, led to the formation of a black deposit on the $(SN)_x$ paste electrode surface. Previous work (Diaz et al.) at other electrodes has shown that pyrrole oxidation produces a conducting, polymeric film on the electrode surface. The cyclic voltammetric behavior of the film on $(SN)_x$ paste was found to be qualitatively similar to that seen in the previous studies, the redox processes being much broader and less well-defined at $(SN)_x$ paste. One interesting aspect of the present work is that the concurrent oxidation of $(SN)_x$ and pyrrole may have some effect on the nature of the film produced, possibly explaining the broader redox processes for the polypyrrole film formed at $(SN)_x$ paste compared to that at platinum.

Effects of Structural Disorder on the Electronic Structure of Polyacetylene

RESEARCHER: ASSISTANT PROFESSOR MARK L. ELERT
SPONSOR: NAVAL RESEARCH LABORATORY

The unusual conductivity of polyacetylene is due to the delocalized π bonding along the carbon backbone of the polymer. Any defect or distortion which interrupts the delocalization is expected to have a significant effect on the electrical properties of the material.

The effect of disorder can be modeled as a random fluctuation in the interaction energy between adjacent carbon atoms. Solving for the density of states in the presence of a random interaction energy fluctuation using a Green's function approach, it was found that soliton-like excitations (which are important components of the conduction mechanism) are surprisingly stable in the presence of disorder. Solitons still give rise to a narrow, well-defined band at mid-gap even in the presence of interaction energy disorder sufficient to smear the Peierls band edges appreciably. This result offers important support for recent theories of conduction in polyacetylene, which postulate the formation and persistence of solitons in amorphous polyacetylene films where the individual monomer units are expected to be exposed to variable chemical environments.

Mobility Fuel Properties (Fuels Chemistry Evaluation)

RESEARCHER: ASSOCIATE PROFESSOR FRANK J. GOMBA
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

A rapid and reliable shipboard method of determining both nitrogen and sulfur in synthetic fuels was sought. An Antek Nitrogen Analyzer is under evaluation and gas chromatographic techniques were also tried.

Determination of sediment in synthetic fuels using neat fuels plus additives such as 2, 5-dimethylpyrrole was compared with work done by others using the same additive with JP-5 fuel. Preliminary infrared work tends to indicate some similarity between the two sediments which may show that a polymer of oxidized pyrroles may form. The adherent gum ASTM D381 test-apparatus was put into operation to set comparison with the so-called 150°F oven test. Work on this was to be continued by others during the academic year.

Synthesis and Studies on 2-AZA-4-Thio-Bycyclo-(4, 3, 0)-Nonatetraene

RESEARCHER: CAPTAIN RALPH D. HADDOCK, USMC
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Theoretical calculations (MNDO) suggest that 3-methyl-2-aza-4-thiobi-cyclo(4,3,0) monatetraene should have approximately 35 kcal/mole aromatic stabilization energy. Preparation of the aromatic compound by dehydrogenation of the diene prepared by the scheme below is to be attempted. The following scheme has been used to prepare the precursor. Starting with methyl 2-cyclopentanoncarboxylate, protection of the carbonyl is provided by ethylene glycol. The ester function is reduced with lithium aluminum hydride and the resulting alcohol converted to the methyl ether. After removal of the ketone protecting group, the ether is eliminated to give the exocyclic terminal olefin. Treatment with thioacetamide gives the bicyclic product.

Stereochemistry of Grignard Reagent Coupling with Alkyl Tosylates

RESEARCHER: ASSISTANT PROFESSOR TAYLOR B. JONES
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The absolute orientations of molecules during the course of chemical reactions have long been of interest to chemists. In order to elucidate how the absolute orientations are affected by a given process, one must know the absolute orientations of reactants and products. From a comparison of the changes, if any, that occur during the reaction, a commentary on what has transpired on a molecular level can be advanced. The aim of this project is to gain more insight into the course of the chemical reaction between Grignard reagents and alkyl tosylates, two common classes of organic compounds, using the absolute configurations as a probe.

Investigations of Insect Defensive Chemistry

RESEARCHER: ASSISTANT PROFESSOR TAPPEY H. JONES
SPONSORS: RESEARCH CORPORATION AND NAVAL ACADEMY RESEARCH COUNCIL

An investigation of the defensive chemistry of the Fire Bee has been completed. This insect produces several novel 2-ene-1, 4-diketones, which were prepared by alternate synthesis, and provided to biologists who are studying their role in the insect's behavior. These compounds are powerful irritants and repellents.

Completed are the early stages of a study of the chemistry of some ants in the genus *Mesoponera*. These ants contain an array of acyclic amines and amides, whose biological purpose is unknown at this time.

Also completed is a detailed study of the structure of several novel ant venom alkaloids from thief ants in the genus *Solenopsis*. These studies indicate that these ants possess a biosynthetic mechanism for these compounds that is similar, if not identical, to that utilized by ants in the genus *Monomorium* for producing similar compounds.

Possible Field Trips for the USNA Interdisciplinary Energy Course

RESEARCHER: PROFESSOR EDWARD KOUBEK
SPONSOR: NAVAL SEA SYSTEMS COMMAND

A two-week study was made of possible field trip sites for midshipmen enrolled in the USNA Interdisciplinary Energy Course. Several local sites were visited to determine if they were of sufficient interest to warrant a class sponsored field trip. Trip times and routes were considered. Also considered was the possibility of including some of the sites on TV tape for classroom use. Sites investigated were: Three Mile Island Nuclear Power Plant, Harrisburg, Pennsylvania. Baltimore, Gas & Electric Coal Fired Power Plant, Chalk Point, Maryland. Getty Oil Refinery, New Castle, Delaware. Cove Point Liquid Methane Terminal, Cove Point, Maryland.

The Examination of Oils by High Pressure Liquid Chromatography

RESEARCHER: PROFESSOR SAMUEL P. MASSIE
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

A growing need of the U.S. Navy is the development of methods and techniques for studying the effects of high temperatures and pressures on the composition of oils, especially in aircraft engines and ships in extreme temperature conditions, without dismantling the aircraft or ship engines. Studies were conducted to ascertain if very minute changes in the composition of oils could be detected by HPLC methods. High temperature conditions with metallic catalysts were simulated to ascertain the relationships between time temperature chemical changes in the oils.

Satisfactory progress was made and the studies are continuing.

Organometallic Coatings Program

RESEARCHER: ASSOCIATE PROFESSOR JOHN W. SCHULTZ
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER ANNAPOLIS LABORATORY

The purpose of the program is to develop analytical techniques for characterizing organometallic polymers. The present work has shown that Raman spectroscopy is useful in quantitative measurements of the ratio of methyl methacrylate to tributyltin methacrylate moieties in copolymers of these materials. In addition, Raman spectroscopy can be used to measure residual unpolymerized material that may be present.

Synthesis and Characterization of Several New Iron and Ruthenium Complexes by Phase-Transfer Catalysis and Photochemistry

RESEARCHER: ASSISTANT PROFESSOR JOYCE E. SHADE
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The purpose of this research is the synthesis and characterization of several iron and ruthenium complexes, with an emphasis on two major synthetic techniques, phase-transfer catalysis and photochemistry. The project is divided into the two parts as defined by the technique being employed. The research done thus far has involved preliminary investigation of a simple iron-cyclopentadienyl-carbonyl-bromide species, which can be synthesized through published methods. Phase-transfer catalysis conditions have been used which involve using an aqueous base-organic solvent system where a quarternary ammonium salt acts as catalyst. Addition of methyl iodide, under the conditions just described, afforded the substitution product of $\{C_5H_5)Fe(CO)_2CH_3\}$ as desired. The optimum conditions necessary for maximum yield, reaction time, and temperature, have not yet been determined. Amounts of reagent, normality of the base solution, time and temperature all seem to have an effect on the reaction proceeding and also on the product yields.

Surface Energies and Chemical Analysis of the Initial Stages of Microbiological Fouling

RESEARCHER: MIDSHIPMAN 1/C MARK J. OLSON
ADVISER: PROFESSOR R. REECE COREY
SPONSOR: TRIDENT SCHOLAR PROGRAM

A series of three interrelated experiments were conducted which analyzed the initial stages of marine microbiological fouling in the Severn River estuary. In the first experiment, glass microscope slides were exposed to natural fouling organisms at "sampling stations" located along the length of the estuary. Slide and water samples were collected at set intervals, and a comparison was made between the relative degree of fouling and individual water parameters experienced at each station. Results of the analysis showed low fouling to occur in waters which were relatively low in temperature and oxygen content, but high in salinity.

The second experiment compared the surface energies of a set of substances to the degrees of fouling and organism attachment they demonstrated. Surface energies were determined using a contact goniometer, samples were exposed to natural fouling organisms in a controlled environment, and degrees of fouling and organism retention were determined using dissection and scanning electron microscopes (SEM), and a hydrous bacterial sprayer (HBS). Results showed definite surface energy ranges which would experience low degrees of fouling or organism retention.

In the third experiment, an artificial sea water solution was created and organically enriched in order to analyze solutions which would support life and promote the transfer of fouling bacteria. It was discovered that each of the nutrient solutions would support life for an extended period of time, while straight artificial sea water and distilled water would only allow bacterial transfer for a limited period of time. During each of the experiments, common or significant fouling organisms were observed and noted. One such observation in experiment two, discovered extraordinary organisms, referred to as "sheep," which were significant due to their strength of adhesion on substrates, and their composition of primarily metals.

Independent Research

Preparation of Substituted Acridones as Laser Dyes

RESEARCHER: LIEUTENANT PETER JOHNSTONE, USN

Acridones are molecules whose fluorescence spectra offer potential as laser dyes in as-yet inaccessible portions of the spectrum. Unfortunately, the absorption bands quench this fluorescence too well. It is hoped that adding substituents to the acridone nucleus will shift the two wavelength regions relative to each other.

Preparation of several 3, 5- and 2, 6- substituted compounds have shown promise but wider separations are needed.

Mode-Specificity in HNC → HCN Unimolecular Isomerization: A Classical + Tunneling Model

RESEARCHER: ASSISTANT PROFESSOR BOYD A. WAITE

Microscopic unimolecular isomerization rate constants are calculated for bond-specific preparation of the HNC → HCN system. The dynamical model is that of Waite and Miller, which incorporates computed classical trajectories coupled with vibrationally adiabatic WKB tunneling probabilities calculated at classical turning points in the reaction barrier region. Rate constants are obtained via a probability branching analysis, utilizing Monte Carlo sampling of initial conditions. Results indicate that at lower energies, mode-specificity is significant, especially for excitation in the weakly coupled CN stretching mode. Mode specificity is reflected by a somewhat restricted distribution of turning point locations at the reaction barrier. At higher energies, the exact dynamical results correspond more closely with the statistical RRKM model, there being a more random sampling of turning point locations at the reaction barrier. By projecting the classical trajectories (which reveal the effects of intramolecular mode-mode coupling) onto the reaction barrier region and allowing semi-classical tunneling to occur (which includes the reactive aspect of the overall unimolecular process), one can infer the relative importance of the two effects as well as obtain (at least semi-quantitatively) vibrational relaxation rates as a function of energy and mode. Similar calculations were carried out for the Henon-Heiles model unimolecular system. Results indicate very little mode specificity in the unimolecular decay rates, which correlates well with quantum mechanism results. The existence of three barriers to reaction for this system prevents any trajectories from sampling a particular range of tunneling probabilities, thus leading to the statistical-like rate constant profile.

Research Course Projects

Protonation of Cobalticium Compounds in Super Acids

RESEARCHER: MIDSHIPMAN 1/C DAVID BLIESNER
ADVISER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF

Many transition metal species are known to undergo protonation at the metal center in strong acids. The strength of the acid determines the position of equilibrium between the free metal species and the protonated form. Ferrocene is known to undergo protonation in HBF_3OH, an extremely strong acid, but there is no evidence that the isoelectronic cobalticium ion can be protonated in this medium.

Cobalticinium, methyl cobalticinium and 1, 1'-dimethylcobalticinium were examined in a series of strong acids including HBF_3OH, $HFSO_3$, HF_3CSO_3 and $HSbF_6$. No evidence for protonation was found in the nmr spectra. Preparation of bis(pentamethylcyclopentadienyl) cobalticium was not successful.

Synthesis and Characterization of New Iron Complexes by Phase-Transfer Catalysis

RESEARCHER: MIDSHIPMAN 2/C DOUGLAS J. BROWN
ADVISER: ASSISTANT PROFESSOR JOYCE E. SHADE

The purpose of this research is the synthesis and characterization of several new iron complexes using a technique known as phase-transfer catalysis. Phase-transfer reactions are done in an aqueous base-organic solvent, two-phase system where a quarternary ammonium salt acts as catalyst. The research done thus far this semester has involved preliminary investigation of the simple system of $(\eta\text{-}C_5H_5)Fe(CO)_2X$, where X equals a halide with CH_3I, under phase transfer catalysis conditions. While the application of phase-transfer techniques to such systems does indeed work, the optimum conditions necessary have not yet been discerned. Amounts of reagents, normality of the base medium, time and temperature all seem to have an effect on the yields of product. Work on this project continues, with more attention being directed towards it with the researcher as a Trident Scholar for 1983-1984.

New Heteropolytungstates

RESEARCHER: MIDSHIPMAN 1/C ROBERT J. CHASTANET
ADVISER: PROFESSOR ORVILLE W. ROLLINS

The following new heteropoly tungstates have been synthesized and purified:

$(RbNa)_8\ (GaO_4ErO_6W_{11}O_{10}) \bullet x\ H_2O$ (I)

$(NH_4Na)_8\ (GaO_4ErO_6W_{11}O_{10}) \bullet x\ H_2O$ (II)

$(NH_4Na)_8\ (GaO_4(Co^{2+}_{0.5}\ Pr^{3+}_{0.5}O_6)W_{11}O_{10}) \bullet x\ H_2O$ (III)

These new compounds contain the rare earths, erbium (Er) and praesodynium (Pr) as indicated. To our knowledge, the only heteropoly anion known to contain a rare earth is the molybdate of Cerium (IV) $\{CeMo_{12}O_{42}\} \bullet 12H_2O$. These new anions are also unique because they are undecatungstogallates (III).

Each preparation has been subjected to chemical analysis. The analysis for preparation (II) has been completed (except for Na) and the true formulation is:

$(NH_4)Na_4(Ga_{0.4}O_4Er_{1.1}O_6W_{11}O_{10})\ 12\ H_2O$

The calculated composition is:

NH_4, 21.9%; $NH_3 + H_2O$ loss at 500 C: 9.5%;

Ga, 1.91%; Er, 5.59%; W, 61.5%; and Na 2.79%. The experimental results are:

NH_4, 21.2%; NH_3 + H_20 loss at 500°C, 9.30%;

Ga, 1.70%; Er, 5.78%. W, 58.9%, and Na?

Preparation (I) is crystalline and was subjected to a line-focus X-ray study using Ni filtered CuKα radiation. The X-ray pattern, containing many strong lines, is unlike those of other salts containing Keggin-type heteropoly anions, which are surely isomorphic with the anion of this preparation. The crystal system is one of lower symmetry (than cubic), and if only one (or two) space groups are possible, then a refinement of earlier structural of Keggin-type anions might be performed.

Crown Ether Catalyzed Synthesis of Tri Butyl Tin Methacrylate

RESEARCHER: MIDSHIPMAN 1/C GERALD ESPER
ADVISER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF

Tributyltinmethacrylate is used in one synthesis of tin containing polymers used in preparation of anti-fouling paints for the Navy. This synthetic route involves a Dean-Stark dehydration of a benzene mixture of tributyl tin oxide and methacrylic acid. While yields were good, the workup of the reaction was difficult and the benzene solution precluded commercial acceptance.

Crown ethers are known to catalyze the formation of esters with metal carboxylates and trialkylsilyl chlorides. Thus, it seemed reasonable that they would catalyze a reaction between sodium methacrylate and tributyl tin chloride in acetonitrile. Good yields were obtained with the 18-crown-6 as catalyst. Rates were favorable as well.

Heterocyclic Thiosemicarbazones as Potential Antibacterial Agents

RESEARCHERS: MIDSHIPMEN 1/C ROBERT GAMBRILL, ROBERT HERZOG, AND TOMOKO ISHIKAWA
ADVISER: PROFESSOR SAMUEL P. MASSIE

In cooperation with the Walter Reed Army Institute of Research on the preparation of heterocyclic thiosemicarbazones, $He\text{-}C(R')=N-NH-C=S-N(R_2R_3)$ was made. These compounds showed activity against gonorrhea, malaria, leprosy and meningitis. Related compounds also showed interesting preliminary activity against Herpes.

It was, therefore, of interest to study derivations derived from pyridine-2-carboxaldehyde and pyrrole-2-carboxaldehyde.

Studies of the Lithium/Benzoyl Chloride Cell System

RESEARCHER: MIDSHIPMAN 1/C JAMES B. HART
ADVISER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

A lithium cell system employing benzoyl chloride as the cathode active material and lithium tetrachloroaluminate as the electrolyte salt has been studied and found to possess an open-circuit cell voltage of 3.0 V. The discharge characteristics of the cell depend markedly on the surface area of the carbon used in fabricating the cathodes. Cathodic reduction of benzoyl chloride in acetonitrile has been found to yield aromatic di esters as products, the rather unreactive nature of which suggests that the lithium/benzoyl chloride cell may be safer in operation than previous lithium cell systems. A Disclosure of Invention has been made of these results.

Oxidation Potentials in N-Butyl Pyridinium Chloride: Aluminum Chloride Ionic Liquids

RESEARCHER: MIDSHIPMAN 1 C ROBERT B. HERZOG
ADVISER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

When n-butyl pyridinium chloride or the salt of methyl imidazole and 1-chlorobutane are combined with $AlCl_3$, the resulting system is an ionic liquid. By manipulating the ratios of the components of the liquid, the ionic system can be made neutral, basic, or acidic in nature. These ionic liquids are useful for electrochemical studies of oxidation and reduction potentials and mechanisms. These systems are particularly useful for the study of certain organic molecules such as aromatic ketones which have oxidation and reduction potentials which fall outside the range of potentials available in aqueous solutions. An area of considerable interest is the interaction of the ionic melts with the aromatic ketones and their intermediates in both oxidation and reduction reactions under various degrees of acidity and basicity.

Reduction of Aromatic Carbonyl Compounds in a Room - Temperature Molten Salt

RESEARCHER: MIDSHIPMAN 1 C ROBERT HERZOG
ADVISER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

Benzyl reduction was studied extensively in both basic and acidic melts of the $AlCl_3$: 1-methyl-3-butylimidazolium chloride system. In the basic melt, two-electron reduction of benzyl leads to a complexed stilbenediolate intermediate which rearranges rather rapidly to a benzoin dianion species. As the melt acidity is increased, profound changes occur in the electro-chemical and spectroscopic properties of benzyl due to complexation of the carbonyl oxygens by $AlCl_3$. It appears that the stilbenediolate formed upon reduction is stable in the acidic melt. Benzoin and benzophenone were also studied and showed a similar dependence of electrochemical behavior on melt acidity.

Electrochemical Studies of Benzoyl Chloride and Benzoyl Fluoride

RESEARCHER: MIDSHIPMAN 1 C PAMELA A. HORINE
ADVISER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

Upon reduction at platinum or vitreous carbon, benzoyl chloride consumes one Faraday of charge per mole, resulting in the formation of a mixture of cis- and trans- stilbenediol dibenzoate. A similar study was conducted on benzoyl fluoride reduction in order to assess the effect of the halogen atom on the reduction process, the principal product being benzyl benzoate in this case. Mechanisms for the reduction processes, involving a longer litetime for the benzoyl fluoride anion radical than that of benzoyl chloride, were proposed. Further work on phthaloyl dichloride was also carried out, leading to identification of cis- and trans- biphthalyl, phthalic anhydride, and benzocyclobutadione as electrolysis products.

Mode-Specificity in Unimolecular Reaction Dynamics, Theoretical

RESEARCHER: MIDSHIPMAN 2 C JEROME STEFANKO
ADVISER: ASSISTANT PROFESSOR BOYD A. WAITE

This research endeavored to answer questions involving the rate at which molecules decompose upon being energized into a specific energy distribution. A classical treatment including quantum mechanical tunneling developed by Waite and Miller serves as the basis for this study. The major goal was to apply this technique to "real" molecular systems, such as the unimolecular isomerization of HNC.

The research involves computer programming in the FORTRAN language, both on a developmental level and manipulation of existing FORTRAN files. Since it is a classical trajectory technique, numerical integration of coupled differential equations is employed, as well as statistical sampling of molecular initial conditions upon energization and statistical analysis of results. The inclusion of quantum mechanical tunneling via the WKB method requires use of such numerical techniques as root-finding and numerical integration of one-dimensional integrals.

MNDO Calculations on Crosslinked Polyacetylenes

RESEARCHER: MIDSHIPMAN 1 C ROBERT W. TOLBERT
ADVISER: ASSISTANT PROFESSOR MARK L. ELERT

Experimental evidence indicates that isomerization of polyacetylene from the *cis* configuration to *trans* at elevated temperatures is accompanied by the appearance of unpaired spins in the material. The formation of crosslinks during isomerization is a possible source of the spin production and provides a plausible low-energy pathway for isomerization. To test this hypothesis, a series of MNDO (modified neglect of diatomic overlap) semiempirical electronic structure calculations was carried out for polyacetylene chain fragments at possible crosslinking orientations. It was found that crosslink formation at favorable geometries does produce unpaired spins with a relatively low activation energy. However, there appears to be an additional energy barrier against migration of these spins away from the crosslink site, which suggests that they may not be able to initiate isomerization of an entire polyacetylene chain. This result merits further investigation by *ab initio* techniques, since the spin migration barrier may, in fact, be an artifact of the MNDO method which employs very limited configuration interaction for the diradical cross-linked state.

Synthesis of Phenylcyclopentadienyl Derivatives of Vanadium and Copper

RESEARCHER: MIDSHIPMAN 1 C JEFFREY S. WEIS
ADVISER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF

Phenyl substituted derivatives of cyclopentadienyl metal complexes have been reported for several metals. These compounds serve as models for the synthesis of m- and p-fluorophenyl compounds used in Taft substituent constant studies and as starting materials for the synthesis of bimetallic complexes.

The chemistry of cyclopentadienyl-vanadium-tetracarbonyl and cyclopentadienyl copper phosphines has been generally ignored because of the air sensitivity of the former and the lack of reactivity of the latter. In the present work, progress was made toward the synthesis of phenylcyclopentadienyl vanadium tetracarbonyl and on starting material for the copper complexes. Problems of air sensitivity remain to be solved.

Publications

CHEEK, Graham T., Assistant Professor, co-author, "**Preparation and Characterization of a Substituted Alkylpyridinium Chloroaluminate Molten Salt System,**" *Inorganic Chemistry*, 21 (1982), 3581.

Measurement of the properties of this organometallic salt melt permits utilization of this system for an electrochemical medium. Potentials at which the molten solvent undergoes chemistry and its nature were determined.

CHEEK, Graham T., Assistant Professor, co-author, "**An Electrochemical and Infrared Study of Chloranil in n-Butylpyridinium chloride: Aluminum Chloride Ionic Liquid,**" *Journal Electrochemical Society*, 129(1982), 2739.

The electrochemical behavior of tetrachlorobenzoquinone (chloranil, Q) has been studied in the aluminum chloride-n-butylpyridinium chloride (BuPyCl) ionic liquid system. The reduction of chloranil proceeds in a two-electron step, giving rise to the dianion. Both the electrochemistry and infrared spectroscopy appear to indicate that, depending on the acidity of the system, chloranil is complexed by $AlCl_3$, initially on the carbonyl oxygen, and on the ring chlorines. The second carbonyl appears to remain uncomplexed. Large shifts in the reduction potential for chloranil are observed as the solvent acidity (mole/ratio of $AlCl_3$ to BuPyCl) is varied, indicating the extensive degree of interaction of the solute with the solvent. Cyclic voltammetry indicates the presence of one or as many as three species, depending on the acidity, which are concluded to be in rather slow equilibrium. Nernst plots of the potential of an indicator electrode as a function of the Q/Q = ratio indicate potentiometric reversibility; at a fixed Q/Q" ratio, the potential variation as a function of melt acidity indicates a gain of three $AlCl_3$ molecules per Q = relative to Q, suggesting that it is complexed by six $AlCl_3$ molecules in the acid system.

CHEEK, Graham T., Assistant Professor, co-author, "**Electrochemical and Spectroscopic Studies of 9, 10-Anthraquinone in a Room Temperature Molten Salt,**" *Journal Electrochemical Society*, 129(1982), 2488.

The electrochemical and spectroscopic properties of 9, 10-anthraquinone (AQ) in the low temperature $AlCl_3$: n-butylpyridinium chloride (BuPyCl) molten salt system have been studied as a function of melt acidity. Infrared spectroscopic data indicate that AQ exists in the uncomplexed state in the basic melt (0.8 $AlCl_3$:1.0 BuPyCl). The electrochemical behavior in this region involves a single-process two-electron reduction (with slow electron transfer) of AQ to its dianion, the reduction mechanism probably proceeding by an ECE pathway. Oxidation of the dianion back to AQ occurs at a potential considerably positive (600 mV) of the potential for AQ reduction, thus indicating some interaction of the dianion with the melt. The complexation of AQ by $Al2Cl_7$- in the acidic melt (1.2 $AlCl_3$:1.0 BuPyCl) produces $AQ(AlCl_3)_2$ as indicated both by infrared spectroscopy and chemical analysis. This complexation results in a shift in potential for the reduction process compared to the corresponding potential for AQ reduction in the basic melt of +1.4V. The reduction of $AQ(AlCl_3)_2$ also involves a single-wave two-electron process (with faster electron transfer than in the basic melt), thought to proceed by a disproportionation mechanism. Since the same separation in potentials for $AQ(AlCl_3)_2$ reduction and subsequent oxidation in the acidic melt was observed as that seen for AQ in the basic melt, some interaction of the dianion with the acidic melt is also evident. As the composition of the melt was varied through the neutral region (approx. 1.0 $AlCl_3$:1.0 BuPyCl), in which the acidity is changing rapidly, an additional process due to reduction of $AQ(AlCl_3)$ was observed; by adjustment of melt acidity by small additions of $AlCl_3$ or BuPyCl, a melt containing all three species AQ, $AQ(AlCl_3)$, and $AQ(AlCl_3)_2$ could be obtained. Electrochemical studies of this system indicated that interconversion among the various species upon reduction is rather slow, an observation reflecting the low levels of Al_2Cl_7- present as well as the unbuffered nature of the melt in this region.

CHEEK, Graham T., Assistant Professor, co-author, "**pH Response of Platinum and Vitreous Carbon Electrodes Modified by Electropolymerized Films,**" *Analytical Chemistry*, 55(1983), 380.

Preparation of films polymerized on the surface of standard electrode materials by imposition of electric potential provided modified electrode properties in further chemical studies. The changes in pH responses are reported in this paper and must include both underlying substrate and polymer as part of the consideration.

JONES, Tappey H., Assistant Professor, co-author, "**Photochemistry of Alkyl Iodides. 8. Formation of a Bridgehead Alkene**," *Journal American Chemical Society*, 104(1982), 3972.

Photochemical reaction of bridgehead iodides in the (2, 2, 2), (2, 3, 1) and (3, 3, 1) series gave unrearranged substitution products as the major result with some hydrocarbon reduction by-products. Use of deuterated methanol as solvent gave no isotope inclusion in these products. More complicated cases did include deuterium in the product and required bridgehead alkene intermediates for explanation.

JONES, Tappey H., Assistant Professor, co-author, "**Ant Venom Alkaloids from *Solenopsis* and *Monomorium* Species: Recent Developments**," *Tetrahedron*, 38(1982), 1949.

The chemistry and biology of the ant venom alkaloids from the genera *Solenopsis* and *Monomorium* are briefly reviewed. The usual 2, 6-dialkylpiperi-dines found in four as yet unstudied species of *Solenopsis* are described. In addition, a monoalkylated 1-piperideine, that is a new natural product, is described from a fifth *Solenopsis* species. Finally, the venoms of *Monomorium latinode* and *M. subopacum* are shown to contain an array of 2, 5-dialkylpyrrolidines.

JONES, Tappey H., Assistant Professor, co-author, "**Chemistry and Possible Defensive Roles of Cuticular Alchols of the Larval Atlas Moth**," *Comparative Biochemistry and Psysiology*, 73B(1982), 797.

Cuticular wax from abdominal tubercles of *Attacvus atlas* (Lepidoptera; Saturniidae) is primarily composed of 1-triacontanol in combination with 1-hexa-decanol, 1-heptadecanol, 1-nonadecanol and 1-dotriacontanol.

Evidence for the roles of wax in water conservation and defense against predators and parasitoids, and the defensive behavior associated with an additional thoracic defensive secretion are discussed.

1-Triacontanol at 2.28 × 10-8 M, but not larval wax containing this compound at the same concentration, increased the number of leaves, and leaf and stem fresh and dry weight of *Ailanthus altissima* seedlings, a host-plant of the Atlas moth.

MASSIE, Samuel P., Professor, "**Historically Black Higher Educational Institutions and the Marine Sciences**," *Current*, 4(1982), 23-29.

A survey of marine science offerings at four institutions was made and discussed, especially as models for similar programs.

VERZINO, William J., Commander, USNR, co-author, "**High-Energy (Neodymium) Laser Pyrolysis of U.S. Coals**," *Journal of Analytical and Applied Pyrolysis*, 4(1982), 21-31.

As part of a study exploring conditions that influence coal pyrolysis, the effects of neodymium laser heating upon five different rank coals have been studied. Gaseous products from neodymium-laser pyrolysis of all coal types can be explained by condensation reactions during the cooling of high-temperature systems. The use of neutral or reducing atmospheres (helium, hydrogen or deuterium at two atmospheres) does not significantly alter the product distributions, although some deuteration of products was observed. High-speed photography was used to determine the dynamics of the laser interactions.

WAITE, Boyd A., Assistant Professor, co-author, "**Mode-Specificity in the Unimolecular Dissociation of Formaldehyde (H_2 + CO), a Two-mode Model**," *Journal of Chemical Physics*, 78(1983), 259.

The reaction path (the minimum energy path in mass-weighted Cartesian coordinates), and all the coupling functions which fully characterize the reaction path Hamiltonian of Miller, Handy, and Adams have been calculated for the unimolecular dissociation of formaldehyde ($H_2CO \rightarrow H_2 + CO$) in its ground electronic state. The reaction coordinate and the four other in-plane vibrational modes are strongly coupled to each other, but the out-of-plane vibration is coupled directly only to the reaction coordinate. Calculations of the type of Waite and Miller for the state-specific unimolecular rate constants are carried out for a two-mode model consisting of the reaction coordinate and the out-of-plane vibration, and one observes a significant degree of mode-specificity, i.e., the unimolecular rate constant for a given metastable state is not a smooth function of the energy of the state. It is suggested that this mode-specificity may persist in the complete six-mode system.

WEINGARTNER, D. Lawrence, Assistant Professor, "**A Field-tested Internal Tag for Crayfish**," *Crustaceana*, 43 (1982), 181-188.

A brief review of tagging methods is followed by a description of a new type of tag for crayfish. This injected, color-coded, nylon rod features permanence through several molts, recognition of individuals, and identification without sacrificing the marked animals. Field testing of this tagging method indicated that no interference with the behavior, growth or longevity of the crayfish occurred. The principal drawback of this tagging system is the time involved in preparing and applying the tag.

Presentations

BITTERWOLF, Thomas E., Assistant Professor, "**Synthesis and Dihydrogen Evolution from Basic Metal Dimers**," Maryland Section, American Chemical Society, Baltimore, Maryland, October, 1982.

BITTERWOLF, Thomas E., Assistant Professor, "**Chemistry of Bimetallic Compounds**," Rider College, Lawrenceville, New Jersey, 14 April 1983.

BITTERWOLF, Thomas E., Assistant Professor, "**Synthesis and Chemistry of Basic Metal Dimers**," NSF Organometallic Workshop, Tucson, Arizona, 1-5 June 1983.

CHEEK, Graham T., Assistant Professor, "**Reduction of Aromatic Ketones in a Room-Temperature Molten Salt**," Poster session, Gordon Conference on Electrochemistry, Santa Barbara, California, January 1983.

CHEEK, Graham T., Assistant Professor, "**Electrochemical Studies at Phenolcoated Platinum Electrodes**," 17th Mid-Atlantic Regional Meeting, White Haven, Pennsylvania, 6 April 1983.

CHEEK, Graham T., Assistant Professor, "**Electrochemical Studies of Selected Organic Systems**," Seminar, North Carolina State University, Raleigh, North Carolina, January 1983.

ELERT, Mark L., Assistant Professor, "**Tight-Binding Studies of Electroactive Organic Polymers**," International Conference on the Physics and Chemistry of Conducting Polymers, Bourg Saint Maurice, France, 10-14 December 1982.

ELERT, Mark L., Assistant Professor, "**Cross-links and Unpaired Spins in Polyacetylene**," International Conference on the Physics and Chemistry of Conducting Polymers, Bourg Saint Maurice, France, 10-14 December 1982.

ELERT, Mark L., Assistant Professor, "**The Effect of Off-diagonal Disorder on Soliton- and Polaron-like States in trans-Polyacetylene**," International Conference on the Physics and Chemistry of Conducting Polymers, Bourg Saint Maurice, France, 10-14 December 1982.

ELERT, Mark L., Assistant Professor, "**Electronic Structure and Properties of Polyacetylene**," Maryland Section, American Chemical Society Meeting, College of Notre Dame of Maryland, Baltimore, Maryland, 23 February 1983.

ELERT, Mark L., Assistant Professor, "**Tetrahedral Cross-links in Polyacetylene**," American Physical Society National Meeting, Los Angeles, California, 21-25 March 1983.

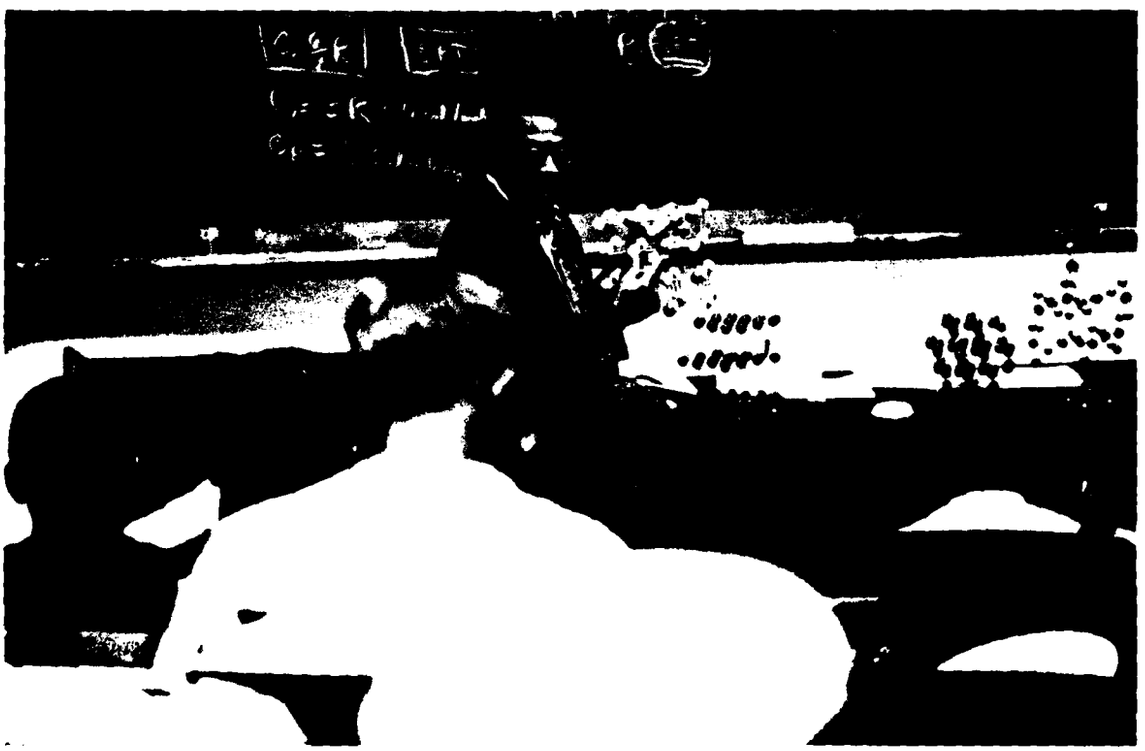
HERZOG, Robert, Midshipman 1 C, "**Reduction of Aromatic Ketones in a Room-Temperature Molten Salt System**," 17th Middle Atlantic Regional Meeting of American Chemical Society, White Haven, Pennsylvania, 7 April 1983.

HORINE, Pamela A., Midshipman 1 C, "**Electrochemical Reduction of Benzoyl Chloride and Benzoyl Fluoride**," 17th Middle Atlantic Regional Meeting of American Chemical Society, White Haven, Pennsylvania, 7 April 1983.

KOUBEK, Edward, Professor, "**Honors Chemistry at USNA**," Biennial Conference on Chemical Education, Oklahoma State University, Stillwater, Oklahoma, August 1982.

MASSIE, Samuel P., Professor, "**Black Americans in Science; Afro-Americans in Science**," Afro-American Black History Month Observations, Middle East Division, Corps of Engineers, U.S. Army, Winchester, Virginia, 22 February 1983.

WEINGARTNER, D. Lawrence, Assistant Professor, "**Determining Respiration Rates in Aquatic Organisms**," Workshop on Biology Laboratory Education, Clemson, South Carolina, 14 June 1983.



DEPARTMENT OF

Computer Science

COMMANDER WILLIAM L. LUPTON, USN
CHAIRMAN

Research in the Applied Science Department was performed in Computer Science, Management, and Operations Analysis. The research activity described on the following pages provided the students with valuable experience and an appreciation of the applications of their particular academic disciplines.

The bulk of the midshipmen research was supported by an annual grant from the Chief of Naval Operations (OP-953) and administered by the Operations Analysis faculty. Their funds allowed the faculty members to work closely with operational units and development agencies within the Navy to provide projects of current interest for midshipmen research.

Faculty research was funded by a wide range of interests, both government and civilian, and encompassed many areas of scientific study. As is always the case, the ultimate beneficiaries of these studies are the midshipmen whose educations are enriched by the constant study of the faculty.

During the Academic Year 1982-1983, the name of the department was changed from Applied Science to Computer Science. The change was made to reflect the fact that beginning with the Class of 1986, Computer Science will be the only major offered by the department. Research in the Computer Science Department will continue to play a vital role in the professional enrichment of both the midshipmen and the faculty.

Sponsored Research

Calculation of the Sea-Floor Conductivity Using Measured Electric Fields and Potentials

RESEARCHERS: ASSOCIATE PROFESSOR FRANK L. K. CHI AND ASSISTANT PROFESSOR FREDERICK A. SKOVI
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

Existing electric and magnetic Monopole mathematical ship model computer programs, developed at the Naval Research Laboratory for shallow water, were adapted to the Naval Academy Time-Sharing System. These programs were then modified to produce field components as a function of bottom conductivity vice distance from the source. The electric model was then used, together with the actual shallow water test results, to predict bottom conductivity.

Heating, Ventilation, and Cooling General

RESEARCHER: LIEUTENANT COMMANDER DAVID C. ENDICOTT, USN
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The purpose of this project was to assist in the installation of a data acquisition software system for compressor and air conditioning system development; develop software graphics for flow diagram demonstrations of heating, ventilation, air conditioning (HVAC) laboratory experiments; develop software for computer-aided bearing design and data analysis; and provide consulting services on software development, data acquisition, system analysis, system integration, and computer schemes related to HVAC program (DDGX AC Plant).

Accuracy of Software Development Activity Data: The Software Cost Reduction Project

RESEARCHER: ASSISTANT PROFESSOR ANTHONY F. NORCIO
SPONSOR: NAVAL RESEARCH LABORATORY

This paper addresses the accuracy of self-reported activity data and valid ways to analyze such data. A one-week experiment was conducted in which the activities of five Software Cost Reduction (SCR) project engineers were sampled. The sampled data was compared with the activity data submitted "as usual" by the five engineers on the Weekly Activity Reports (WAR). The results indicated that the engineers report relatively accurate data on the WAR if they make notes on their activity or if they are prompt in submitting their WAR. If engineers do not keep notes on their activity, then prompt reporting is critical for ensuring the accuracy of weekly self-reported data. The results also indicate that ratios between activity categories are valid metrics of project activity.

An Analysis of Academic Grades in SM212 and SM202

RESEARCHER: MIDSHIPMAN 1/C ROBERT A. ARONSON
ADVISER: MAJOR MALCOLM W. FORDHAM, USA
SPONSOR: MATHEMATICS DEPARTMENT

At the request of the Mathematics Department Chairman, the academic grade histories for SM202, (Elements of Differential Equations) and SM212 (Differential Equations) were analyzed. All grades awarded for the academic years 1972-1982 were used first to determine the distribution of grades for both courses. A second part to the project involved comparison of each midshipman's grade in SM212 or SM202 with his performance in all other math courses (excluding SM202 and SM212) and then making this comparison among the various academic majors as well.

Statistical Analysis of Naval Messages

RESEARCHER: MIDSHIPMAN 1/C MICHAEL BLASIK
ADVISER: LIEUTENANT COMMANDER CRAIG M. IANNUSCH, USN
SPONSORS: NAVAL ELECTRONICS SYSTEMS COMMAND, AND CHIEF OF NAVAL OPERATIONS (OP-95)

The purpose of this research was to uncover letter characteristics and probability distributions in naval messages for both single letters and digraphs and to conduct additional analysis necessary to develop 95 percent confidence intervals and determine required sample size for conclusive results. The project was patterned after Bell Laboratory Studies of the New York *Times*. Underlying information essential was studied to determine susceptibility of U. S. Navy message traffic to exploitation by unauthorized persons. Approximately 2,000 unclassified naval messages provided on tape were read by Naval Academy Time-Sharing System (NATS).

Naval messages have dramatically different characteristics from those in standard written English. Large (relatively) amounts of numbers, spaces, abbreviations and a flatter distribution of characters occur in naval messages. Although the analysis was completed on only 167 messages, the results were so dramatic that further analysis and research is essential.

Project RUMIC Research Report

RESEARCHER: MIDSHIPMAN 1/C PAUL A. BOYNE
ADVISER: LIEUTENANT COMMANDER WILLIAM E. EAGER, USNR
SPONSORS: NAVAL COASTAL SYSTEMS CENTER AND CHIEF OF NAVAL OPERATIONS (OP-95)

Modern mine warfare necessitated the development of an unmanned, low-risk mine hunter. Current Soviet strategy has forced the United States Navy to allocate more of its mine-warfare budget to the development of deep-ocean minesweepers. Consequently, the aging coastal mine-sweepers are leaving a gap in the coastal mine-countermeasures force.

The Naval Coastal Systems Center (NCSC) is currently planning for the development of an inexpensive, autonomous, undersea vehicle with mine reconnaissance and neutralization capabilities. Additionally, the concept provides the United States with a covert capability not attainable with conventional surface-type mine hunters.

NCSC has integrated existing hardware and technology to equip an old swimmer-delivery vehicle (a two-man submarine) with a search sonar and an auto-pilot. The project has been named RUMIC for Remote Undersea Mine Countermeasures. The RUMIC autopilot drives the submarine along a pre-programmed search pattern while the sonar scans the bottom for possible mines. The navigational information (heading, speed, location, etc.) and the sonar output are recorded by an outboard tape recorder. The tape is thus a record of the mission, which is later analyzed to determine the location of mines in the area searched.

In order to demonstrate system feasibility, it is necessary to develop a means of determining the overall system accuracy. "How close did the system predict the actual locations of the mines?" is the test question. To solve this problem, an algorithm was developed to determine the latitude and longitude of detected mines. A comparison was then made between the derived coordinates and the known locations in the constructed test file to address the stated question.

The Supply/Budget Stocking Problem

RESEARCHER: MIDSHIPMAN 1/C JOHN HUGHES
ADVISER: LIEUTENANT COMMANDER CHARLES A. PERKINS, SC, USN
SPONSOR: CHIEF OF NAVAL OPERATIONS (OP-95)

The project undertaken was in fulfillment of a course requirement in the operations analysis curriculum. The major objective was to simulate in a simple model the budget and supply problem faced by project and program managers in determining how and where to spend the available repair parts money. The model considered failure rates, cost, and critical nature of the equipment to the ship's mission.

There were two methods of approaching the problem identified. The first involved the use of linear programming and a simple cost trade-off approach. The second involved the use of advanced dynamic programming with the goal of determining the exact optimum point of funds allocation. The researcher chose this approach and learned a great deal about the uses and limitations of the method to a real world problem.

After the limitations of the dynamic model used and the absurd answer it produced were analyzed, work was concentrated on a better understanding of the methods currently being used in the Navy to deal with this problem.

Case Study in Naval Battle Group Anti-Air Warfare

RESEARCHER: MIDSHIPMAN 1/C STEPHEN JACKSON
ADVISER: COMMANDER JAMES D. BUTTINGER, USN
SPONSOR: CHIEF OF NAVAL OPERATIONS (OP-95)

The purpose of the project was to develop a case study for use in the "Analysis of Naval Tactics" course in the operations analysis curriculum. The case study goal was to develop a narrative scenario of the outer air battle with current ranges, threats, and other parameters. The plan was to obtain the current information from sources engaged in research, primarily the Center for Naval Analyses. Included in the case study was also a solution guide and a supplemental teaching package as well as a documented computer program. The project was successfully completed and the finished report submitted.

Placement Procedures for Plebe Chemistry

RESEARCHER: MIDSHIPMAN 1 C KATIE A. PODOLAK
ADVISER: MAJOR WILLIAM J. HAFFEY, USMC
SPONSOR: CHEMISTRY DEPARTMENT

The objective of this study was to investigate alternative procedures for placing Midshipmen Fourth Class into one of the three chemistry tracks - high, middle, and low.

Currently, placement is based on the results of a Placement Exam. The researcher created a data base containing information such as Scholastic Aptitude Test (SAT) scores, high school chemistry grades, on several plebes in each of the tracks and employed the discriminant analysis technique to see if an optimal classification system based on these information variables could be determined. Such a classification technique was constructed and briefed to the Chemistry Department.

Development of Software Package to Determine Underlying Distribution and Parameters of a Sample of Data

RESEARCHER: MIDSHIPMAN 1 C JOHN POLK
ADVISER: LIEUTENANT COMMANDER GREGORY R. HAMELIN, USN
SPONSORS: OPERATIONS ANALYSIS FACULTY, AND CHIEF OF NAVAL OPERATIONS (OP-95)

The purpose of the project was to develop a software package which performs analysis on a data sample in order to determine the underlying distribution. It does so by constructing probability plots.

It then uses an R^2 coefficient to determine which of the plots is the straightest. It tests the following distributions: exponential, normal, uniform, lognormal, Weibull, and gamma. Once the most likely is determined, the parameters are computed and a chi-squared goodness-of-fit test is performed. The user is then given the most likely distribution and its parameters, as well as the chi-squared statistic.

Exploratory Data Analysis Package

RESEARCHER: MIDSHIPMAN 1/C MICHAEL MELILLO
ADVISER: LIEUTENANT COMMANDER CRAIG M. JANNUSCH, USN
SPONSORS: OPERATIONS ANALYSIS FACULTY, AND CHIEF OF NAVAL OPERATIONS (OP-95)

Exploratory Data Analysis (EDA) is an important aspect of statistical analysis. The Minitab statistical package currently on the Naval Academy Time-Sharing System (NATS) is insufficient for many applications requiring EDA. This project comprised selected techniques such as stemleaf plots, number summaries, scatter plots, curve fitting, boxplots, and multiple boxplots. The package is designed to be both interactive and user friendly. It is also designed to handle most common size data files. At this time about 50 percent of all the desired techniques have been implemented. A user's guide is in draft form. The algorithms implemented have been subjected to preliminary verification.

A Statistical Analysis of Majors Change at the U. S. Naval Academy

RESEARCHERS: MIDSHIPMEN 1/C TODD C. DAVIS AND GARY D. MCCARTHY
ADVISER: ASSOCIATE PROFESSOR RANDALL K. SPOERI
SPONSOR: OFFICE OF THE ACADEMIC DEAN

The process by which midshipmen change majors is of interest to the Office of the Academic Dean. Complete records of all major changes since 1974 have been kept by the Assistant Dean for Academic Affairs, and were made available for analysis. Each record contains identification number, date the major change was made, losing major, and gaining major. This data was entered into the computer for subsequent analysis. From this information, trends and predictive features were identified. Frequency distributions, bar graphs, and histograms were used to organize and analyze the data. These methods provide a useful summary of this historical data.

The major findings of this study were:

- A greater number of midshipmen have been changing majors in recent years.
  - The number has increased approximately 40 percent since the Class of 1978.
- Each graduating class analyzed gained an average of six humanities majors due to changes.
  - Each class lost an average of six science/engineering majors.
  - Increasing numbers of humanities majors have been gained in recent years.
- A sizable shift from engineering to science occurred in all years analyzed.
- A small percentage of majors accounts for a large percentage of changes.
  - The majors most commonly transferred into include General Engineering (EGE) and Physical Science (SPS).
  - The majors most commonly dropped are the engineering majors.

Design and Documentation of a Curriculum for a "Short Course" in Naval Operations Analysis for Naval Tactical Research and Development Personnel

RESEARCHERS: MIDSHIPMEN 1/C MARK L. STONE AND KENNETH WILSON
ADVISER: ASSOCIATE PROFESSOR RANDALL K. SPOERI
SPONSORS: NAVAL COASTAL SYSTEMS CENTER AND CHIEF OF NAVAL OPERATIONS (OP-95)

Other branches of the armed services have historically developed, documented, and offered curricula in the techniques of operations analysis for various military and civilian personnel in their commands. Civilian universities and other organizations have also routinely offered such instruction. Personnel at the Naval Coastal Systems Center, in Panama City, Florida, have expressed the desire to see such a curriculum designed specifically for Naval Tactical Research and Development personnel.

This project involved four basic steps:

1. Establishing liaison with key personnel at the Naval Coastal Systems Center to determine their needs in such a course, and the needs they would anticipate for other naval commands having similar research and development missions. Other commands were also contacted as a part of the project.
2. Identifying current and previous offers of such courses, both military and civilian. These organizations were then contacted to acquire information, documentation and or advice regarding their experiences in the development and conduct of their courses in this area.
3. Evaluating the needs of the Navy, and comparing past and present curricula offered by others, as well as a personal knowledge of Naval Operations Analysis, to design a comprehensive "short course" for Naval Tactical Research and Development personnel.
4. Documenting the recommendations to include both general and specific content of the course, giving suggested text(s), references and other anticipated or required instructional materials and/or aids.

Antisubmarine Warfare Tactics: The Passive Sonobuoy and the LAMPS Helicopter

RESEARCHER: MIDSHIPMAN 1/C CLASS VANCE S. TISDALE
ADVISER: ASSOCIATE PROFESSOR W. CHARLES MYLANDER
SPONSOR: CHIEF OF NAVAL OPERATIONS (OP-95)

This project explored several tactics to use in the placement of sonobuoys by a LAMPS helicopter after initial detection has been made on a sonobuoy. Two factors are considered in the development of sonobuoy patterns. First, the maximum area of uncertainty of the target is to be minimized. Secondly, the pattern must provide ease of geographic description of the localized area so further prosecution of the contact can be carried out.

After demonstrating the superiority of a tactic called the "TRI-TAC" pattern, an interactive microcomputer program was written as an aid for use of this tactic. The program is written for a microcomputer carried on a frigate directing the operations of the sonobuoy laying helicopter.

Minefield Density Estimation

RESEARCHER: MIDSHIPMAN 1 C CHARLES S. YOUNGBLOOD
ADVISER: ASSOCIATE PROFESSOR RANDALL K. SPOERI
SPONSORS: NAVAL COASTAL SYSTEMS CENTER, AND CHIEF OF NAVAL OPERATIONS (OP-95)

Minefield reconnaissance provides data necessary for the estimation of the density of mines in a known or suspected minefield. Mine density estimates are important in the planning of mine countermeasures (MCM) warfare and in the prediction of the effectiveness of these countermeasures. Line transect sampling had been used in biological studies since the early 1930's but had not been considered for use in minefield reconnaissance. A comparison of the characteristics of mines laid in a minefield to the characteristics of biological populations to which line transect sampling has been successfully employed shows that there is similarity between the two.

The objective of this research project was the verification or disqualification of line transect sampling as a theoretical and practical method for the mine warfare community to employ in estimating the density of a minefield. To meet this objective, the following tasks were performed: (1) Review and evaluate MCM literature and related problems from the tactical operational perspective; and (2) review and evaluate line transect sampling as a statistical methodology. This evaluation included both theoretical and practical considerations regarding its potential in MCM reconnaissance.

Research Course Projects

The Flowchart Translator System

RESEARCHER: MIDSHIPMAN 1/C TIMOTHY A. BATZLER
ADVISER: ASSOCIATE PROFESSOR ANTHONY F. NORCIO

The Flowchart Translator System (FTS) is a programming system designed for a non-programmer. By using an interactive graphics terminal, standard flowcharting symbols and user-friendly menus, FTS easily allows the user to create and modify any flowchart of an algorithmic process. FTS then translates the flowchart into a high-level language such as PASCAL. This is in effect a translation from one high-level language to another. FTS allows the user to specify nested DO and IF constructs as well as subprocedure calls. FTS always produces structured code. In addition, FTS software is designed such that it can be rather easily expanded to include more sophisticated language features and program constructs. FTS demonstrates how an extremely large and complex system can be constructed using all of the features of the target language.

An Investigation of Possible Relationships Between Participation in Varsity Athletics at the Naval Academy and Retention in the United States Navy and Marine Corps

RESEARCHER: MIDSHIPMAN 1/C FRAZIER W. FRANTZ
ADVISER: MAJOR RALPH C. ROSACKER, USMC

The purpose of this study was to determine if a statistically significant relationship exists between participation in varsity athletics at the Naval Academy and retention in the United States Navy and Marine Corps. To accomplish this task, the statistical relationships between retention rates associated with varsity and non-varsity athlete graduates of the Naval Academy and between participation in specific varsity sports and active military duty retention were investigated. The perceived subjective relationships between varsity sports participation and active military retention, as viewed by knowledgeable individuals of both the career service and non-service sectors, were introduced in this study and served to add a great degree of insight and comprehensibility to the retention figure comparisons.

For the most part, the analysis of variance tests on the control and the treatment groups indicated that no statistically significant difference exists between the mean retention figures for each graduating class (1963-1975) and the corresponding figures for varsity letter-winner graduates. An analysis of all U. S. Naval Academy graduates who had attained the rank of Captain (0-6) and above revealed a proportionately higher percentage (27.06 percent) of varsity athletes under the assumption that only 16.48 percent of each class consisted of varsity athletes on graduation day.

Most importantly, ground work was laid for further investigation into the area of retention figure comparisons under the recommendations to increase the number of sample population inputs and to provide for more analysis of variance and correlation testing than that included in this study.

Installation of the UNIX Circuit Design System

RESEARCHER: MIDSHIPMAN 1 C JOSEPH E. TOFALO
ADVISER: MAJOR MALCOLM W. FORDHAM, USA

A tape containing the UNIX Circuit Design System (UCDS) was purchased from Bell Laboratories by the Computer-Aided Design and Interactive Graphics (CADIG) support group in Rickover Hall. The research project involved installing as much of this system as possible. Despite major differences between the system on which UCDS was created, and the system at CADIG on which it is now installed, a majority of the system is currently available. Primarily this includes the circuit editor DRAW, which allows a user to easily draw a logic or electronic circuit and rapidly update or edit it. Information on how to use UCDS, and user-friendly documentation for the editor DRAW, has been prepared and pared and is available at CADIG.

As a result of this research project, steps are being taken to correct the shortcomings of the current CADIG system. This will facilitate installing the remainder of UCDS at a later date.

Publications

CHI, Frank L. K., Associate Professor, and Frederick A. SKOVE, Assistant Professor, "**Calculation of the Sea-Floor Conductivity Using Measured Electric Fields and Potentials**," Computer Science Department Report CS-1-83, January 1983.

Existing electric and magnetic Monopole Mathematical Ship Model Computer Programs, developed at the Naval Research Laboratory for shallow water, were adapted to the U.S. Naval Academy Time-Sharing System. While the models existed in their original form, predicting field strength as a function of distance, comparison testing was performed between Naval Research Laboratory results and the Naval Academy results in order to assure that the transportation and adaptation efforts were successful.

When satisfied that the models were producing acceptable results, an effort was begun to modify them so that they would produce field components as a function of bottom conductivity vice distance from the source. The electric model (ASE) was then used, together with actual shallow water tests, to predict bottom conductivity. All results obtained refer only to a simple dipole, and no implication that these results extend to any configuration beyond a simple dipole should be inferred.

NORCIO, Anthony F., Assistant Professor, co-author, "**Human Memory Organization for Computer Programs**," Journal of the American Society for Information Science, 2 (March 1983), 109-115.

Human memory organization has been shown to be important in the processing of natural language. Evidence is provided in this investigation which suggests that human memory organization is also important in processing programming languages. Subjects were divided into experimental groups which studied programs with or without documentation, and with or without hierarchically indented statements. Subjects studied and recalled five Fortran programs. The pattern of recalled statements at logic segment boundaries was compared to the recalled pattern within segments. In addition, the recalled boundary patterns of the experimental groups were compared to each other. The results indicate that algorithmic logic segments form a cognitive organizational structure in human memory for computer programs. Statement indentation and internal program documentation did not apparently enhance the organizational process or the recall of programming statements.

SPOERI, RANDALL K., Associate Professor, and Malcolm W. FORDHAM, Major USA. "**An Analysis of Academic Grades at the United States Naval Academy 1971-1981**," *Proceedings of the 1982 Section on Statistical Education*, American Statistical Association, Washington, D.C., August 1982, 167-171.

In the past decade, an item of concern to educators has been whether or not grades awarded in academic courses have steadily been increasing. This is frequently referred to as "grade creep." This potential problem was an item of concern to the Office of the Academic Dean of the United States Naval Academy. In order to address this concern, a study was conducted in which academic records for years 1971 through 1981 were analyzed. All grades given during this period were used to check for grade creep, as well as to analyze grade patterns for selected courses, majors, and departments.

This paper provides an overview of the study. It was determined that there has not been any appreciable grade creep during this period. However, several interesting patterns were detected for specific courses and majors.

SPOERI, Randall K., Associate Professor, "**Statistical Modelling of Historical Shore Erosion Patterns**," Appendix D in *Assessment and Management Plan for Shore Erosion Control in Queen Anne's and Talbot Counties, Maryland*, Coastal Resources Division, Tidewater Administration, Maryland Department of Natural Resources, 1983, D-1 - D-7.

This report describes a technical and planning study which was coordinated by the Maryland Department of Natural Resources to help two counties of the Maryland Coastal Zone (Queen Anne's and Talbot Counties) in managing new erosion-control projects on shorelines of the Chesapeake Bay. Portions of the report describe the pattern of historic shore erosion, the shoreline terrain, and shoreline sediments, coastal processes, trends in the installation of existing structures, "case studies" of existing structures, and vegetative alternatives that are available for developing new shore protection plans. Included are summaries of the legal and planning strategies which have been developed to insure that proper shore-protection is anticipated in relation to the future development plan.

A particular component of the report is the application of statistical methods to historical shore erosion data, for these counties, in an effort to mathematically model shore erosion processes and identify factors related to coastal retreat.

YOUNG, Robert J., Lieutenant, USN, SI100 Class Notes. Annapolis: USNA Print Shop, 1983.

This publication is an extensive rewrite of a previous edition. This is written exclusively for the Dartmouth BASIC Edition Seven Language. All examples and text have been redesigned to highlight the structured methods of BASIC 7, including the FOR-NEXT, DO-WHILE, IF-THEN-ELSE, SUB-ROUTINE and FUNCTION. In addition, ARRAYS, TABLES, FILES, NATS COMMANDS, GRAPHICS, SEARCHING, and SORTING are also covered in detail. The text is written for the novice computer user with each new concept explained thoroughly. Many complete example programs are presented as well as sets of homework problems at the end of each chapter, with solutions in an appendix. This will be the primary text for the Introduction to Computing course (SI100).

Presentations

SPOERI, Randall K., Associate Professor, and Malcolm W. FORDHAM, Major, USA, "**An Analysis of Academic Grades at the United States Naval Academy, 1971-1981**," 142nd Annual Meeting of the American Statistical Association, Cincinnati, Ohio, 18 August 1982.

FORDHAM, Malcolm W., Major, USA, and Randall K. SPOERI, Associate Professor, "**An Analysis of Academic Grades at the United States Naval Academy, 1971-1981**," National Educational Computing Conference/'83, Baltimore, Maryland, 6 June 1983.

DEPARTMENT OF

Mathematics

ASSOCIATE PROFESSOR FREDERIC I. DAVIS
CHAIRMAN

The following pages should illustrate that mathematics is a rather broad discipline and that the faculty of this department is involved in many of its branches. The past year has seen activity in pedagogical and philosophical studies as well as considerable research in both pure and applied mathematics. This has resulted in a large number of presentations and publications. The publications included two books, one a compilation of mathematics contest problems, and the other a treatise on partial differential equations. The scholarship reported on here serves several purposes; in addition to furthering basic human knowledge, it invigorates the teaching of those involved in it and it enhances the reputation of the Naval Academy as an academic institution.

While some of the work in this department was done independently, much of it was supported. For the most part this support has come for research in areas of direct application to naval problems. Research was sponsored by the Naval Academy Research Council, the David Taylor Naval Research and Development Center at Annapolis, the Anti-Submarine Warfare Systems Projects Office, the American Society for Engineering Education, and the Nuclear Regulatory Commission.

Sponsored Research

Optimal Use of Difar Buoys in a Mixed Difar-Lofar Field

RESEARCHER: ASSOCIATE PROFESSOR PETER ANDRE
SPONSOR: NAVAL SEA SYSTEMS COMMAND
(ANTI-SUBMARINE WARFARE SYSTEMS PROJECTS OFFICE)

The decision to build only DIFAR sonobuoys will result in the gradual decay of the stockpile of LOFAR sonobuoys. Thus it will become increasingly common to use a mixture of LOFAR and DIFAR buoys in the initial search phase of airborne ASW operations. It is, therefore, helpful to be able to place the DIFAR buoys at those points in the buoy field in which the increased capabilities of the DIFAR buoys can best be used. In the present investigation, a small Monte Carlo model was built to analyze the capabilities of a DIFAR buoy at each of the field's positions. The model's results indicated that there was a slight advantage to the positions which lay on the outside of the sonobuoy field. The advantage of the exterior positions over the interior positions is slight, however. Thus other considerations such as particular knowledge of the target's position may cause the DIFAR buoys to be best placed in some of the interior positions of the field.

Fundamental Orbits

RESEARCHER: ASSISTANT PROFESSOR CRAIG K. BAILEY
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Trees (connected graphs with no cycles) are used as models of organic molecules. The frequency of occurrence of a molecule in nature varies inversely as the number of symmetries of the molecule.

A tree needs to be weighted with a number related to the size of its automorphism group (which roughly counts its symmetries). Fundamental orbit is a concept defined to help determine the size of the automorphism group of a tree.

Fundamental orbit size is a characteristic that can be assigned to each point in a tree. Points with a given fundamental orbit size can be counted and used to determine the size of the automorphism group of the tree. Results have been obtained to determine the average size of the automorphism group for a collection of trees used to model organic molecules.

Inhomogeneous Cauchy-Riemann Equations

RESEARCHER: ASSISTANT PROFESSOR JAMES L. BUCHANAN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The investigator is considering the following problems:

1. The similarity principle for Douglis systems. The investigator is seeking to show that solutions to $d^*w + Qdw + Aw + Bw^* = 0$ (d^* is the Cauchy-Riemann operator, Q is quasidiagonal) have the representation $w = S\phi$, ϕ an analytic vector, S an invertible operator. He has the result for one case and has found an integral equation for the operator S which he hopes will yield more information on the problem.

2. The investigator has derived, by matrix factorization, integral equations for the solutions to the Hilbert and Riemann - Hilbert boundary value problems for Pascali systems: $D^* w + Aw + Bw^* = 0$. Fredholm analysis of these equations gives theorems on the number and form of the solutions to these problems and on the consistency conditions that data must satisfy. These results are being written up for publication. The investigator is presently exploring the feasibility of solving these and related problems by symbolic manipulation of computer programs.

Applications of Aspect Graphs to Robot Vision Systems Design

RESEARCHER: ASSISTANT PROFESSOR CAROL G. CRAWFORD
SPONSOR: U.S. NAVY AND THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION FACULTY FELLOWSHIP PROGRAM

The aspect graph, or visual potential, of a regular solid is a graph whose vertices represent aspects of the object. In terms of the division of space generated by the object, the vertices of the aspect graph represent cells, while two vertices are joined by an edge if the cells have a common wall. The concept of aspect graph construction has been developed by J. J. Koenderinck (State University of Utrecht, Netherlands) to explain human perception.

Aspect graphs can be applied to the design of robot vision systems. In particular, this researcher is investigating methods of application of the theory to recognition of objects by robotic systems using sensory feedback devices, the compatibility of the theoretical structure with existing internal computer representation of objects, and the informational limits on the use of real time sensory feedback.

Acoustical High Frequency Scattering from Elastic Prolate Spheriodal Shells

RESEARCHER: ASSOCIATE PROFESSOR JAMES M. D'ARCHANGELO
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

Acoustical scattering resulting from a high frequency plane—wave incident upon an elastic prolate spheroidal shell cannot be determined by summing "classical" series for special functions due to the slowness of convergence associated with high frequencies. In previous work on finite cylindrical shells, the researcher associated poles located in the complex frequency plane with resonances of repeatedly circumnavigating surface waves. This association of poles with resonances of repeatedly circumferential (or "creeping") waves was made via the Sommerfeld—Watson transformation. This technique, however, does not seem to extend to the prolate spheroidal case. In electromagnetic theory, the complex frequency poles constitute the basis for the so-called "Singularity Expansion Method" (SEM), which predicts acoustic response in the form of damped sinusoids (using a time dependent LaPlace transform) of the individual target resonances caused by the incident pulses. The researcher wishes to use SEM to predict the acoustical high frequency scattering from elastic prolate spheroidal shells.

Nonparametric Tests of Dependence

RESEARCHER: ASSISTANT PROFESSOR GARY FOWLER
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The purpose is to develop a nonparametric test for dependence of random variables. The test would require a distribution-free consistent estimator of dependence. Further, it is desired that the measure of dependence be invariant under monotone transformations of the random variables, so that the test could be used with ranks. This problem led to a more general problem: Can reasonably weak conditions be found that imply a given statistic is distribution-free?

Some progress has been made toward the required estimator of dependence. If $X_1, \ldots, X_m$ are random variables with distributions $F_1, \ldots, F_m$ respectively and joint distribution H, then,

$$\int_0^1 \cdots \int_0^1 H(F^{-1}(u_1), \ldots, F^{-1}(u_m)) - u_1 \cdots u_m \, du_1 \cdots du_m$$

is a measure of dependence invariant under monotone transformations. An estimator of this measure has been constructed. It is not known if this estimator is distribution-free.

Noise Source and Path Identification for Beams and Fluid-Filled Pipes Using Recompressed Impulse Response

RESEARCHER: ASSOCIATE PROFESSOR JOHN S. KAMEL

SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

New procedures have been developed for identifying sources and paths of structure-borne noise in structures built up from wide flange I-beams, as well as piping systems conveying compressible and incompressible fluid. These structures occur typically in ships. For example a ship hull-frame structure can be modelled as parallel wide flange I-beams.

One method involves the use of partial coherence spectra, and the other method uses a recompressed impulse response. Both methods have been described in detail, together with computer programs and experimental results.

The use of impulse response to estimate time delays frequently is of little value because the wave propagation in ship hull-frame and other structures is dispersive. That means the phase and group velocities are frequency dependent.

By using the mathematical theory of elasticity, one can obtain dispersion relations (equations connecting frequency and wave number) for traveling waves in various structures. In the estimated frequency response function, one expresses the frequency in terms of the wave number and then takes the inverse Fourier transform with respect to the wave number. The resulting "recompressed" impulse response (with respect to path lengths) can be used to identify sources and paths of structure-borne noise.

Dispersion relations for various structures are analyzed together with theoretical justification and practical implementation.

Quasitriangularity of 2-Tuples of Operators

RESEARCHER: ASSISTANT PROFESSOR GAIL KAPLAN

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A classical problem in operator theory is to determine if every operator on a Hilbert space has a nontrivial invariant subspace. In 1967 Halmos introduced the concept of quasitriangularity to simplify some of the known results. Apostal, Fois, and Voiculescu's major result in this area is elegantly stated. The operator H is quasitriangular if and only if the Ind $(H - \lambda I) \geq 0$ whenever $H - \lambda I$ is Fredholm. Brown, Douglas, and Fillmore obtained the same result for essentially normal operators by applying their work on extensions of $C^* -$ algebras. The researcher examined 2-tuples of operator (U, H) where U is essentially unitary, H essentially selfadjoint and U and H essentially commute, obtaining necessary and sufficient conditions for quasitriangularity in this setting. This result seems to generalize to the class of pairs of operators whose joint essential spectrum is a subset of a surface of revolution. The researcher is currently examining the following questions: can necessary and sufficient conditions be found for the quasitriangularity of pairs of operators whose joint essential spectrum is another type of 2 - manifold, and can these techniques be used to characterize operators with closed range?

Sensitivity Analysis of Acoustic Processors (ASW-PM4 Report. Classified Research)

RESEARCHER: ASSOCIATE PROFESSOR ARTHUR A. KARWATH

SPONSOR: NAVAL SEA SYSTEMS COMMAND, ANTI-SUBMARINE WARFARE SYSTEMS PROJECTS OFFICE

This study concerns the sensitivity of existing acoustic processors and the new prototype acoustic processor to sound pressure levels. The comparison is accomplished through statistical analysis of the output of a Monte Carlo model which utilizes the real life data measured in different environments and the comparison is done in each of the environments. At present the comparison is associated with only one ocean.

Dynamical Properties of Fibred Knots and Braids

RESEARCHER: ASSISTANT PROFESSOR MARK E. KIDWELL
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Fibred knots and closed braids are two classes of objects in three - dimensional space that can be studied by means of mappings of surfaces. There has been a large resurgence of interest in Nielsen's classic work on the dynamical properties (fixed points, sources, sinks, etc.) of surface mappings due to the ideas of Thurston. Work has been done by the investigator and J. Birman, concentrating on the branched one - manifolds that Thurston calls train tracks. They use these to distinguish fibred knots that cannot be distinguished by the usual homology invariants. The investigator would like to extend these methods to the surface mappings arising from braids. A large part in this work should be played by some maps of the unit circle invented by Nielsen.

C*-Algebra Compactifications of Semidirect Products of Semigroups

RESEARCHER: ASSISTANT PROFESSOR BAO-TING LERNER
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project is a continuation and expansion of the problem funded by the NARC during previous fiscal years.

Let S_1, S_2 be semitopological semigroups with identity and $S_1 \tau S_2$ a semidirect product. The investigator formulated the necessary and sufficient conditions under which the F-compactifications of $S_1 \tau S_2$ could be decomposed into a semidirect product, where F is a closed translation invariant sub - C* - algebra of $C(S_1 \tau S_2)$ containing the constant functions.

The investigator applied the compactification decomposition to the almost periodic, strongly almost periodic, and left-uniformly continuous functions. For the weakly almost periodic case, the investigator found that amenability conditions had to be imposed on the C*-algebras of functions on $S_1 \tau S_2$.

The investigator has also discovered applications of these results to Wreath Products as well as to the field of fuzzy sets and systems. Many fruitful results are anticipated in the following areas: (1) Compactifications of Tranformation Semigroups, (2) Fuzzy Transformation Semigroups, and (3) Applications to Von Neumann Algebras.

Decision Theoretic Criteria for Multidimensional Scaling in Riemannian Spaces

RESEARCHER: ASSISTANT PROFESSOR ROBERT L. MANICKE
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

It is proposed to develop an interpretable analytic strategy of a theory of decisions with multiple objectives. This strategy will be based on various types of proximity information obtained under conditions of uncertainty. This manifest information will be used as a means of identifying the latent underlying geometric structure which defines the metric of multidimensional scales. The project will involve an investigation of the criteria for the identification of a geometric structure which provides an optimal representation of the data. Based on the identified criteria, algorithms will be developed to explain or discover the underlying attributes or dimensions of the data.

Applications of Stochastic Estimation and Control Theory

RESEARCHER: ASSISTANT PROFESSOR PAUL B. MASSEL
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Control theory has been applied to numerous areas of biology and medicine. One of the most important applications is the modelling of the growth of cancer cells which one tries to arrest with the periodic administration of some drug known to be capable of killing cancer cells. This treatment method is called chemotherapy. To employ control theory for this problem, models for normal and cancer cell growth before and after administration of a drug dosage must be known from experiment. A quantity to optimize must be agreed upon (e.g. normal cells minus cancer cells) and then Pontryagin's maximum principle can be used to determine the optimal scheduling of the drug. Models that assume continuous drug administration have been investigated; the researcher plans to investigate discrete-time models.

Tribology - Mathematical Study of Friction and Wear

RESEARCHER: ASSOCIATE PROFESSOR PETER A. MCCOY

SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

Any machinery that utilizes moving parts on a microscopic level has components in dynamic contact. The energy dissipated by the frictional process can appear as waste heat that causes random temperature fluctuations at the contact surfaces resulting in degradation. As a consequence, both physical properties and wear characteristics of the materials comprising the surfaces change. Usually the materials are affected in an adverse manner. Thus, it is important to have a predictive capability for the temperature distribution at the surfaces of the materials.

To be more specific, let the two surfaces in sliding contact be flat plates having random roughness. One of the planes is fixed and corresponds to the surface of a semi-infinite solid. The temperature fields at the surface and in the bulk of the solid and the vicinity of the surface are required. To accomplish this, statistical models of the temperature fluctuations are developed from known distributions that measure the surface roughness. The resulting solutions are statistical models.

Finite Element Analysis of Stresses at Crack Tip

RESEARCHER: ASSOCIATE PROFESSOR MARK D. MEYERSON

SPONSOR: NUCLEAR REGULATORY COMMISSION

Finite element methods were used to analyze stress near the tip of a crack. This enables one to find the strength of a cracked specimen without expensive testing. Of special interest was the start of applying non-linear methods in this analysis.

Base Change for SL(2)

RESEARCHER: ASSISTANT PROFESSOR COURTNEY H. MOEN

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

It has been conjectured that there is a correspondence between automorphic representations for the F-rational points of a reductive group G defined over F and those for the E-rational points of G, where E F is an extension of number fields. This conjecture has been proved when G is GL(2) or GL(3) and E F is a prime cyclic extension, and is essentially completed when G = SU(2, 1) and E F is a quadratic extension. This project proposes to study the conjecture in the case when G = SL(2) and E F is a prime cyclic extension. This case is important due to the fact that complications which have not arisen in the previously studied cases and which will appear in resolving the general problem occur for the group SL(2), although not to an intractable extent. The method to be employed is that of the global form of the Selberg Trace Formula.

Diophantine Approximation

RESEARCHER: ASSISTANT PROFESSOR MICHAEL L. ROBINSON

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The investigator is working on constructing explicit polynomials $A_1(x), \ldots, A_k(x)$ of respective degrees $d_1, \ldots, d_k$ such that

$$\sum_{i=1}^{k} A_i(x)\log(1 + \alpha_i x) = O(x^{d_1 + \cdots + d_k + k + 1}).$$

This would produce effective measures of linear independence over Q for certain logarithms.

With a co-investigator, the author is working on the following conjecture of D. Cantor:

Let $\{a_n\}$, $\{b_n\}$ be sequences of integers which satisfy linear recurrences. Suppose $c_n = a_n b_n \in Z$ for all n. Show c_n satisfies a linear recurrence. By putting a growth restriction on the a_n we hope to deduce the stronger result that in fact

$$c_n = \sum_{i=1}^{\ell} P_i(n)\zeta_i^n$$

where $P_i(x)$ are polynomials and ζ_i are certain roots of unity.

Extension of a Characteristic Class

RESEARCHER: ASSISTANT PROFESSOR JAMES M. STORMES
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A Riemannian manifold M with a spin-structure possesses a characteristic class A(M) which generalizes the numerical invariant Spin(M), defined to be the index of the Dirac operator on M.

The objective of this research has been to find and characterize a family of singular spaces for which the A class may be defined.

The method has been to investigate methods of constructing the closely related Todd class which are also applicable in the real case. Two conjectures were formulated relating operator - theoretic constructions to the geometry of singular spaces.

No conclusion was reached regarding the validity of these conjectures.

Background study of ellipic partial differential equations and boundary value problems is a prerequisite to further progress.

Odd Univalent Functions

RESEARCHER: ASSISTANT PROFESSOR ANNA TSAO
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Let U denote the unit disk and S the class of functions $f(z) = z + a_2z^2 + \cdots$ analytic and univalent in U. An important function S is the Koebe function, $k(z) = z/(1 - z)^2 = z + 2z^2 + 3z^3 + \cdots$. Zalcman recently conjectured that for any $f \in S$, $|a_n^2 - a_{2n-1}| \leq (n - 1)^2$. This conjecture, if true, would imply the famous Bieberbach conjecture which asserts that for each $f \in S$, $a_n \leq n$. The investigator has now given strong evidence in favor of the conjecture of Zalcman.

Closely related to the class S is the subclass $S_{(2)}$ of odd univalent functions in S. In order to consider the extreme points and support points of S, extensive use has been made of Schiffer's boundary variation. The variation gives a differential equation describing the omitted set Γ of an extremal function in S. The investigator is developing analogous techniques in the class $S^{(2)}$ in order to obtain the desired geometric information about the omitted sets of extremal functions in S(2).

Linear Chair

RESEARCHER: ASSOCIATE PROFESSOR JOHN C. TURNER
SPONSOR: DAVID TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

During the summer of 1982, this confidential project was completed and reports written. The investigator's involvement consisted of statistical data analysis. In this phase of the project attempt was made to determine which of the several experimental conditions had a significant effect on the measurement s. The nature of the data required that new methodologies based on maximum likelihood be developed for comparison to classical techniques.

A separate aspect of the project involved the correlation of experimental data with model calculations. This was done using regression analysis.

Computer Analysis of Point Defects in Solids

RESEARCHER: ASSISTANT PROFESSOR PETER J. WEICHER
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

In a previously funded Naval Academy Research Council project, Major R. J. Kimble, USMC, prepared a computer simulation package (FKMODEL) for study of fluorite-structured crystalline lattices. The programs model a finite portion of the lattice; ion positions are adjusted in the model to minimize the total energy of the crystal. This gives information as to relative stabilities of various configurations, prediction of concentrations of such defect structures, and approximation of ion migration enthalpies. The information thus gained has proved to be a useful adjunct to experiment in helping to understand the relaxation mechanisms which occur in the crystals studied: calcium, strontium, barium fluoride, and others.

Work has centered on simple rare earth and alkali metal defect structures in the above crystals. Good results have been obtained and there is much more to be investigated in this area. An application of interest to the Navy is that the materials studied are used for radiation monitoring on board nuclear vessels since any radiation causes measurable damage to the defect structures in these crystals. This project is currently investigating such radiation-induced defects in calcium fluoride.

The program, MMI, by N. Allinger of the University of Georgia, has been used to model the structure of organic compounds. It will be modified extensively for use in studying conduction mechanisms in crystalline polymers. These mechanisms are now the subject of intense research interest and controversy. Anticipated applications are to light-weight, high-capacity batteries and to semi-conductors. The goal of this work is to provide theoretical work complementing experimental work already underway at the Naval Academy.

Algorithms for Discrete Fourier Transforms and Convolutions

RESEARCHER: ASSISTANT PROFESSOR WILLIAM E. YANCEY
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The purpose of this project is to develop efficient algorithms for discrete Fourier Transforms (DFT) and Convolutions. For finite sequences x_n, h_n, these are defined respectively as

$$x_k = \sum_{n=0}^{N-1} x_n W_N^{kn} \text{ and } y_k = \sum_{n=0}^{N-1} j_n x_{k-n};$$

$k = 0, 1, \ldots, N-1$ where $W_n = \exp(-i\pi/N)$. These are standard computations in digital signal processing, and if they are carried out directly, a complete set requires N^2 operations for a length N sequence. This process is too slow, so more efficient algorithms are developed to enable a computer to process a given signal in real time, i.e. without a substantial delay. Methods from number theory and algebra have been introduced to design more sophisticated algorithms. There is interest in developing such algorithms for the multi-dimensional analogue of the above DFT's and convolutions.

The Values of Negative Integers of Zeta Functions of Algebraic Number Fields

RESEARCHER: ASSISTANT PROFESSOR WILLIAM E. YANCEY
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project investigates the special values of Zeta functions associated to algebraic number fields. It is known that the values of such Zeta functions at negative integers should be rational numbers with bounded denominators. By applying a lattice-basis decomposition to the fundamental domain of totally positive units, one can eliminate the superfluous index dominators that arise in the terms of Shintani's method for evaluating Zeta-functions for totally real number fields. Then it is shown how the terms from this decomposition can be arranged in the totally real cubic case to eliminate the vertex norm denominators, and an explicit formula for the special values is obtained involving integers associated to the geometry of the basic decomposition of the fundamental domain. This method is then applied to a one-parameter family of totally real cubic fields, the explicit decomposition is obtained, and the formula is computed for the Zeta function associated to the principal order evaluated at -1.

Independent Research

An Analysis of the Game of Even

RESEARCHERS: ASSISTANT PROFESSORS CRAIG K. BAILEY AND MARK E. KIDWELL

Sid Sackson has described a game called Even, played with checkers on a finite subset of the usual square lattice in the plane. Each checker played, after the first, must be adjacent to the previously played checker, and each checker played, after the second, must be adjacent to an even number of checkers already played. We prove that the board proposed by Sackson *cannot* be filled according to this procedure, nor can any rectangular board larger than 1×2 be filled.

Finite Manuals and Their Event Structures

RESEARCHER: ASSISTANT PROFESSOR CAROL G. CRAWFORD

This research is an ongoing investigation into the applications of graph theory to empirical logic. This field generalizes the conventional notion of sample spaces by providing a mathematical model for the simultaneous representation of the outcomes of a set of related random experiments. This model is defined to be a generalized sample space. Finite manuals and event structures are two sets of graphs associated with a generalized sample space. The major objective of this research has been to develop and refine an algorithm to determine the structure of a finite manual given an unlabeled event structure and to investigate further graph theoretic questions associated with the problem.

Current research is being carried out by this investigator to examine specific graph theoretic structures, such as cycles and intersection chains, related to manuals and event structures. Products of manuals and the resulting event structure are also being examined.

A Conjecture of Tarski in Group Theory

RESEARCHER: ASSOCIATE PROFESSOR ANTHONY M. GAGLIONE

The area of mathematics under investigation here might be called the borderland between group theory and mathematical logic. The research centers around a well-known and very difficult conjecture of A. Tarski. The conjecture can be stated as follows: the non-Abelian free groups are elementary equivalent in a language appropriate for group theory. This means that exactly the same sentences of first-order logic hold in free groups of any ranks greater than or equal to two. It is known that free groups of infinite rank satisfy the conjecture (established by R. L. Vaught in 1957), whereas the conjecture is false for Abelian groups (first shown by W. Szmielew in 1955). Since it would probably be much too difficult to attack the conjecture directly, it is the object of this research project to study the truth or falsity of the conjecture for various classes of relatively free groups: e.g., free nilpotent groups, free solvable groups, etc. The hope is that the resolution of the conjecture in several of these special classes of groups will shed some light on its resolution in an arbitrary variety.

This research has been and will continue to be done in collaboration. The methods to be used are based on model theory and combinatorical group theory. At present, quite a few unrelated results in certain varieties of groups have been proven. Unfortunately, none of these results seems to shed any light on the Tarski conjecture in general; thus the research is continuing.

The Commutator Calculus Applied to Nilpotent Products

RESEARCHER: ASSOCIATE PROFESSOR ANTHONY M. GAGLIONE

Let G be a free product of a finite number of cyclic groups at least one of which is of finite order. Let G_n denote the nth subgroup of the lower central series of G. (The lower central series of G is defined inductively by putting $G_1 = G$ and G_{n+1} = group generated by all commutators $(a, b_n) = a^{-1} b_n^{-1} a b_n$ where $a \in G$ and $b_n \in G_n$.) The main objective of this research project is to study the factor groups $\bar{G}_n = G_n / G_{n+1}$ for n = 1, 2, 3, · · · . These $\bar{G}_n$ are called nilpotent products of cyclic groups. The goal of this investigation is to completely determine all the nilpotent products G_n for all positive integers, n. The statement "completely determine" here means to find presentations for these groups in terms of generators and defining relators.

The Spline-Weighted Least Squares Method in Parameter Estimation

RESEARCHER: ASSISTANT PROFESSOR MARLENE E. GEWAND

The purpose of this project was to determine an efficient method of estimating aerodynamic parameters for reentry bodies. The technique under consideration was a spline-weighted least squares (SWLS) method in which the coefficient histories and the state are approximated by cubic splines. In this method, the state histories are reestimated after all of the measurements have been processed and then they are used to look for a better history with a lower cost function. The SWLS algorithm which was being tested chose to ignore second partials in the computations of the state expecting their values to be insignificant.

By including all of the theoretically correct terms in the computations, the researcher was able to show the proposed algorithm was faulty. While the values of the second partials were indeed quite small, their absence did lead to false convergence. Several integration techniques tested on a simple one-dimensional example showed that the proposed SWLS algorithm had the potential to yield pathological results.

As a result of this portion of the project, it was decided to turn away completely from the SWLS method and to look for another technique.

Homogeneous Systems of Parameters

RESEARCHER: ASSISTANT PROFESSOR CHARLES C. HANNA

Let R be commutative ring with identity graded by the non-negative integers. Zariski and Samuel define a "homogeneous system of integrity" for R to be a finite set S of homogeneous elements of positive degrees such that R is an integral extension of its subring $R_0[S]$. A "homogeneous system of parameters" for R is a homogeneous system of integrity S with a minimal number of elements; the number of elements in S is the "homogeneous dimension" of R.

The objectives of the research are relationships between the homogeneous dimension of a graded ring R and other invariants of R; and some criteria whereby it can be determined whether a given homogeneous element of positive degree is part of a homogeneous system of parameters for R. The ultimate goal is to use the homogeneous dimension to define an "optimal" dimension function for graded rings, which can then be used to improve known results on locally free sheaves over quasi-projective schemes.

The investigation has begun by focusing on attempts to understand simple examples in detail. Some preliminary inequalities have been obtained.

Mathematics and the Word

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

In this research the Extended Grundlegend Structure is constructed. Moreover, all of the formal mathematics for the interpretations that appear in the articles "Mathematical Philosophy and Developmental Processes" and "The Word" are obtained. This includes a mathematical model for a quantized description for a developing system called a Developmental Paradigm and the properties for this type of system description with respect to subtle logic and nonstandard choice sets. Further, discussion is given of: the creation of a superword that logically generates such a quantized description; the creation of a superword that logically generates a countable set of developmental paradigms; and the concept of supercontinuous deduction. Finally, a special hypercontinuously differentiable function G is constructed and related to discrete real valued functions.

Supernear Functions

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

In this research the H-integral for a bounded function on a closed interval I is defined and shown to be equivalent to the Riemann integral. The concepts of quasi-additivity, admissibility, and supernearness are introduced. Various necessary and sufficient conditions for an H-integrable function to satisfy these definitions are studied. Finally it is shown that a function f that is bounded and defined on I is continuous if and only if there exists a function B that is defined $I \times I$ and B is supernear to f.

Mathematical Philosophy and Developmental Processes

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

This research investigates three fundamental notions associated with natural systems. First, even though the eminently creative scientists of the past and present from Archimedes to Newton to Bohr, Einstein, Heisenberg as well as Wheeler, Feynman and Weinberg, among many others, have developed remarkable mathematical theories that predict behavior patterns for numerous complex natural systems, it is a more remarkable fact that their astounding achievements are based upon an argument that is essentially incorrect. This research explains this fundamental error. Second, this research reveals exactly how the correct argument unifies certain quantum and continuum notions and yields a solution to the long standing discreteness paradox for developmental processes. Thirdly, there have been many philosophical arguments for the uncompromising acceptance of the concept of a humanly comprehensible (time-independent) "uniformity" for various natural processes. This research is also designed to produce a mathematical model that will refute these arguments but will show that there could actually exist a more uniform nonhumanly comprehensible process for natural system development.

The Word

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

This research logically analyzes the meaning of the Greek (transliterated) *rhema* and the Hebrew word *'amar*. It is shown that these two words have a literal meaning when viewed from a mathematical model called the D-world model. They correspond to objects within a D-world language. They also satisfy certain D-world logical processes.

The Work of a Supreme Mathematical Logician

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

This is a writing project designed to explain to college graduates from various disciplines certain concepts in the new discipline entitled Mathematical Philosophy. It explains the content of various successful investigations and discusses science and hypotheses. The concept of the developmental paradigm is fully explained. Universal event numbers are introduced when needed. Various descriptions for the creation of natural systems are analyzed and the D-world mathematical interpretation is introduced. Methods for the indirect verification of the existence of D-world processes are explained. Long-term developmental processes are analyzed and interpreted within the D-world. Finally, quotations are utilized to show that these new mathematical findings directly imply that certain highly significant modern philosophies are logically inconsistent.

National Security and Mathematical Philosophy

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

This investigation mathematically establishes that such systems as modern Marxism are inconsistent. Moreover, a "ranking" is obtained for the specific overt and observed irrational behavior associated with these inconsistent philosophies.

Coefficients and the Schwarzian Derivatives of Certain Classes of Analytic Functions

RESEARCHER: ASSISTANT PROFESSOR EDWARD J. MOULIS, JR.

Recent results due to Kirwan and Schober as well as Fukui are being generalized to larger classes of functions analytic in the unit disk. In addition to results on the modulus of the coefficients and the Schwarzian derivatives of these classes, the researcher hopes to obtain results on the radius of convexity and starlikeness. Recent work on extreme point theory and convolution theory will also be considered.

Computer Graphics as an Aid to the Teaching of Mathematics

RESEARCHER: ASSOCIATE PROFESSOR HOWARD L. PENN

The purpose of this project is to produce computer graphics presentations which can be used to help illustrate certain topics in the mathematics courses. These topics include the heat equation, the vibrating string equation, and drawing polar coordinate graphs. The main tool used this year was the TERAK 8e00 color microcomputer and the TEKTRONIX graphics terminals connected to NATS. The main method of presentation of the material was by video tape.

Numerical Invariants of Hopf Maps

RESEARCHER: ASSISTANT PROFESSOR JOANN S. TURISCO

The theory of quadratic forms is a well-developed area of mathematics. However, relatively little has been done in the study of systems of quadratic forms. In this project, systems of quadratic forms or quadratic mappings, are studied by associating to each map either a single quadratic form or family of forms and investigating the numerical invariants of these forms. Of special interest are those mappings between spheres whose form resembles that of the classical Hopf fibrations.

For any continuous map of real vector spaces, a quadratic form is defined by integrating products of the coordinate functions over the unit sphere. The quadratic form invariants are calculated, in terms of the dimensions of the vector spaces, for the forms associated to various Hopf maps. In this way, some insight is obtained into the question of the existence of such maps in various dimensions. This problem is closely related to that of composition of quadratic forms, which has received much attention over the last sixty years.

Integral Hopf maps correspond to a family of forms which are mutually orthogonal over the unit sphere. T. Ono discovered a family of forms of degree p (p positive integer) associated to any continuous map of real vector spaces. Particularly interesting is the family of such forms associated to maps which are deformations of the classical Hopf maps. The mean value over the unit sphere of these forms can be written as a hypergeometric polynomial. This project involves the calculation of the mean value of forms associated to more general Hopf maps. The results are certain variations of the hypergeometric polynomial, such as a double hypergeometric polynomial.

An Evaluation and Comparison of Integer Programming Techniques

RESEARCHER: ASSOCIATE PROFESSOR CARVEL S. WOLFE

This study investigated two algorithms, a fractional cutting plane algorithm and a branch and bound algorithm, for solving integer programs by applying them to a variety of integer problems. The cutting plane algorithm easily solved a large and important class of integer problems called scheduling problems. This contrasts with the belief that branch and bound methods are superior in solving practical integer programs. Scheduling problems were constructed with 14 to 189 integer variables and with 14 to 21 constraints for the assigning of personnel to work shifts over a fixed period. All of the realistic cases were solved by the cutting plane code within 15 cuts.

Cutting plane techniques are known to fail to converge in a reasonable number of iterations due to massive dual degeneracy in many problems. It was possible to create such degeneracy in the scheduling problem by using random cost coefficients in a very narrow range. On a few such cases the cutting plane code failed; otherwise it found integer solutions rapidly.

Branch and bound was slow and ineffective on scheduling problems. In a majority of the scheduling cases the branch and bound method could not complete a tree search within a 10 minute time limit. On the other hand, branch and bound was very effective on most of the classical problems found in the literature of integer programming, while the cutting plane algorithm failed in many cases.

This research concludes that both cutting plane and branch and bound methods are needed in integer programming since each one can solve problems for which the other is inadequate.

Compound Entities

RESEARCHER: ASSISTANT PROFESSOR KAREN ZAK

An entity is a manual, representing some physical system, together with a mathematical object representing the possible states of the system. Foulis and Randall have explored the quantitative (statistical) approach to systems of this type. Here the investigator takes a qualitative approach (some states may not have a corresponding "probability distribution function") investigating these systems.

Boolean Like Rings

RESEARCHER: ASSISTANT PROFESSOR KAREN ZAK

A Boolean - like ring is a commutative ring of characteristic 2 satisfying the equation $xy(1 + x)(1 + y) = 0$. Results have been obtained on the structure of such rings, including the ideal structure of the rings and the structures of related rings, for example, rings of quotients.

Publications

ANDRE, Peter P., Associate Professor, "**Optimal Use of Mixed DIFAR-LOFAR Field**," Anti-Submarine Warfare Special Projects Office Report, March 1983.

In a sonobuoy field composed of DIFAR buoys and LOFAR buoys, it is best to place the DIFAR buoys in the exterior positions of the field. The advantage for DIFAR placement of the outside positions is enhanced if the flight pattern of the P3 lies inside those exterior buoys. The advantage of the exterior positions over the interior positions is not great, so information about the likely position of the target may suggest placing some DIFAR buoys in interior positions.

ANDRE, Peter P., Associate Professor, "**An Educational Plea**," *Liberal Learning in a Technical Curriculum*, U.S. Naval Academy Press, 1982.

This paper offers a plea for in-depth learning and teaching in both humanistic and technical education. The paper argues that only the mental capabilities acquired by learning ideas carefully are of any practical use outside the narrow views of a college class.

BUCHANAN, James L., Assistant Professor, "**Bers-Vekua Equations of Two Complex Variables**," *Contemporary Mathematics II*, (1981), 71-88.

Systems of the form $d^*,w = Bjw^*$, $j = 1, 2$ where the coefficients $B_j(z_1, z_2, z_1, z_2)$ are real analytic and d_j^* is the Cauchy-Riemann operator with respect to the variable z_j are considered. All sets of consistency conditions on the coefficients B_j which permit the system to have solutions are derived and the degree of arbitrariness of solutions is established for each case.

BUCHANAN, James L., Assistant Professor, "**A Similarity Principle for Pascali Systems**," *Complex Variables*, 1 (1983), 155-165.

It is shown that when the matrices A and B have bounded support, any solution to the Pascali system $d^*w + Aw + Bw^* = C$ has the representation $w = S\psi$ where S is a nonsingular matrix continuous in the complex plane, and ψ is a vector analytic in the domain of w. Preliminary to this, a generalization of Liouville's theorem is established.

BUCHANAN, James L., Assistant Professor, co-author, *First Order Elliptic Systems*, New York: Academic Press, 1983.

The volume explores the analogies between solutions to elliptic systems and analytic functions. The first three chapters treat elliptic systems in the plane. Topics considered are the behavior of solutions near zeros, integral representations of solutions, similarity principles, Liouville theorems, and boundary value problems. The last two chapters concern higher dimensional systems, in particular, functions on Clifford algebras and functions of several complex variables. Local properties and integral representations are considered. Research on many other topics which are not given full exposition is synopsized. These include numerical analysis of elliptic systems, alternatives to the Clifford algebra formulation, non-linear equations, and more general notions of ellipticity.

CHAMBERLAIN, Michael W., Assistant Professor, "**Minimally Favorable Games**," *Two Year College Mathematics Journal*, 14 (March 1983), 159-164.

This paper was written for students and instructors of undergraduate courses in probability and statistics. It attempts to answer a student's question on what happens when other than six-sided dice are used in an old game ("chuck-a-luck") now commonly found in the examples and exercises of probability textbooks. More specifically, when does the game go from being unfavorable to favorable as the number and nature of the dice change? The results are derived using the computer to suggest answers and elementary real analysis to verify them.

GAGLIONE, Anthony M., Associate Professor, et al., *The Contest Problem Book IV*. Washington, D.C.: Mathematical Association of America, 1982.

The Annual High School Mathematics Examination (AHSME, now the American H.S. Math Exam) began as a local contest in New York City in 1950. By 1960, 15,000 students throughout the U.S. and Canada took the AHSME. The 1982 exam was taken by 418,000 students in the U.S. and Canada and by 20,000 students in various other countries. In the U.S. and Canada, one use of the AHSME is to select participants in the U.S.A. Mathematical Olympiad (also used to select participants in the America Invitational Math Exam). The U.S.A. Olympiad is used in the selection of a team to represent the U.S. in the International Mathematical Olympiad. Since the difficulty of problems appearing in the AHSME varies over a wide range, they are a valuable teaching aid for all high school students interested in mathematics.

This volume contains the 1973-1982 exams and solutions. The questions for these AHSME's were compiled by the authors who co-chaired the committee from 1973-1977. This volume contains some changes from the originally published solutions. Alternate solutions and explanatory notes have also been added.

HERRMANN, Robert A., Associate Professor, "**Extensions of Maps Defined on Convergence Spaces**," *Rocky Mountain Journal of Mathematics*, 12 (Winter 1982), 23-37.

This is a foundational study of the extendability of various continuous type maps defined on a dense subspace X of a preconvergence space Z. A minimal property (weak-admissibility) for such extensions is established and is applied for the case where the remainder $R = Z - X$ is U-principal. Major results include necessary and sufficient conditions for the extendability of continuous (resp. weakly-continuous) mappings, a general Taimanov type characterization for extendability, and a general result which shows that a weakly-admissible map defined on X can be extended to a weak-n-continuous map on Z where Z is any extension of X. Finally, numerous examples are given which show that the major results obtained are nontrivial and have many well-known propositions as corollaries.

HERRMANN, Robert A., Associate Professor, "**Closed Graphs on Convergence Spaces**," *Glasnik Matematicki*, 17 (1982), 133-142.

This is the fourth in a series of investigations answering various unsolved problems relative to convergence spaces. The major goal of this present research is not only to investigate convergence space closed theory but also to show that many recent results relative to generalizations of the topological concept of the closed graph such as the strongly closed graph or maps with property S are, in reality, simple corollaries to the appropriate convergence space propositions.

HERRMANN, Robert A., Associate Professor, "**Mathematics and the Word**," *Institute for Mathematical Philosophy Monograph #120*. Annapolis, 1983.

In this monograph the Extended Grundlegend is constructed and all of the formal mathematics for the interpretations that appear in the articles "Mathematical Philosophy and Developmental Processes" and "The Word" are obtained. The mathematical structures utilized are nonstandard models for logical systems, systems of consequence operators, and the real numbers.

MCCOY, Peter A., Associate Professor, "**H^p Representatives of Ultraspherical Expansions**," *Journal of Applicable Analysis*, 13(1983), 139-148.

Ultraspherical expansions are viewed as boundary values of n-analytic functions V on the open unit sphere D. Let $V \in H^{(n)}(1 \leq p \leq \infty)$ and E be a positive measure set on the boundary of D. A sequence of functions is constructed from the restriction of V to E that converges uniformly to V in D. Those functions that are the restrictions to E of functions V are characterized. An application expands V that is continuous on the closure of D in terms of its means and shifted means on an arc of the boundary of D.

MCCOY, Peter A., Associate Professor, "**Converse Initial Value Problems for a Class of Heat Equations**," *Ordinary and Partial Differential Equations*, Springer-Verlag Lecture Notes in Mathematics, #964 (1982), 494-502.

A classical heat equation is considered on an open segment. This paper considers the converse to the initial value problem by identifying the initial data from the solution. The solutions of the equation are isomorphic to a space of hyperfunctions that form the set of initial values. Also, a characterization of the temperature as a series whose terms depend on a sequence of continuous functions on the segment is given. This theory utilizes special function methods and relies on function-theoretic antecedents in classical harmonic function theory.

MCCOY, Peter A., Associate Professor. "**Best Approximation of Solutions to a Class of Elliptic Partial Differential Equations.**" *Houston Journal of Mathematics*, 8 (1982), 517-523.

Necessary and sufficient conditions are given for a local solution to the canonical second order elliptic PDE in the plane to be the restriction of an entire function solution on simply-connected symmetric domains about the origin. The method is based on the growth properties of a sequence of "Best L^∞ - Polynomial" approximate solutions and is modelled after a classical theorem of S. N. Bernstein in analytic function theory.

MCCOY, Peter A., Associate Professor. "**Approximation of Solutions of an Elliptic Equation on Select Domains.**" *Plane Ellipticity and Related Problems*, Contemporary Mathematics, American Mathematics Society, 11 (1982), 177-190, Providence, Rhode Island.

Integral operators are used to generate a set of basis functions in order to obtain an analog of the Favard-Achieser-Krein theorem for a canonical elliptic PDE on a hypercube.

MCCOY, Peter A., Associate Professor. "**Mini-Max Approximations of the Dirichlet Problem for a Class of Second Order Elliptic Partial Differential Equations.**" *Transactions of the Illinois State Academy of Science*, 74, (1983), 73-78.

Convolution methods are used to generate best approximate solutions of classical solutions of an elliptic PDE with radial symmetry on a disk.

MOORE, C. Edward., Associate Professor. "**Some Remarks on the Krein-Milman Property and Lexicographic Maxima.**" *Rendiconti del Circolo Matematico di Palermo*, 32 (1983), 1-6.

The Krein-Milman (KM) Theorem states that a nonempty compact convex subset C of a locally convex space is the closed convex hull of the extreme points of C. The author showed previously that C is also the closed convex hull of the lexicographic maxima of C. Because the latter result is the strongest known with the same hypothesis, he shows how lexicographic maxima relate to a question of J. Diestel's concerning Krein-Milman type theorems. The concept of r-space is introduced and it is shown that r-spaces are lexicographic spaces. An example to distinguish L^1 spaces from KM spaces is provided.

SANDERS, Thomas L., Associate Professor. "**A Whitehead theorem in CG-Shape.**" *Fundamenta Mathematicae*, 113 (1981), 131-140.

With each α-compact, locally compact metric space is associated a sequence of bigraded homotopy groups. These bigraded homotopy groups are used in a Whitehead theorem for compactly generated shape theory.

SCHWENK, Allen J., Associate Professor, co-author. "**How Small can the Mean Shadow of a Set Be?**" *American Mathematical Monthly*, 253 (1983), 325-329.

Consider the projections of a finite set of n points in Euclidean d-space onto various s-dimensional subspaces. It is shown that for any set the geometric mean of the sizes of these projections is at least n and this bound is attained for all selections of n, s, and d.

SCHWENK, Allen J., Associate Professor. "**On Unimodal Sequences of Graphical Invariants.**" *Journal of Combinatorial Theory B.*, 30 (1981), 247-250.

Let b_i denote the number of ways to select a subset of i independent edges in a given graph. It is shown that the sequence of B_i's is unimodal, that is, there exists an r such that

$$b_0 < b_1 < \ldots b_r \geq b_{r+1} > \ldots > b_m.$$

Similarly, for any bigraph, the nonzero coefficients in the characteristic polynomial are shown to be unimodal in magnitude. Finally, it is suggested that the approach used here might be applied to verify the conjecture that the coefficients in the chromatic polynomial are unimodal in magnitude.

SCHWENK, Allen J., Associate Professor, co-author. "**Pseudosimilar Vertices in a Graph.**" *Journal of Graph Theory*, 5 (1981), 171-181.

Dissimilar vertices whose removal leaves isomorphic subgraphs are called pseudosimilar. The investigator constructed infinite families of graphs having identity automorphism group, yet every vertex is pseudosimilar to some other vertex. Potential impact on the Reconstruction Conjecture is considered.

Also constructed, for each n, were graphs containing a subset of vertices of size n which are mutually pseudosimilar. The analogous problem for mutually pseudosimilar edges is introduced.

SCHWENK, Allen J., Associate Professor, co-author, "**On Universal Caterpillars**," *The Theory and Applications of Graphs*, (G. Chartrand et. al., eds.), New York: Wiley, 1981, 437-448.

A universal tree is a smallest tree containing all trees of order n. Both rooted and unrooted versions of the universal tree problem have been studied. The researchers examined the analogous problem of finding the smallest size C_n sufficiently large,

$$\frac{n^2}{4c \log n} < C_n < \frac{3\, n^2 \log \log n}{\log n}.$$

TSAO, Anna, Assistant Professor, "**Disproof of a Conjecture for Meromorphic Univalent Functions**," *Transactions of the American Mathematical Society*, 274 (December 1982), 783-796.

Let Σ denote the class of functions $g(z) = z + b_0 + b_1 z^{-1} + \ldots$ analytic and univalent in $|z| > 1$ except for a simple pole at ∞. A well-known conjecture asserts that $|b_n| \leq 2/(n + 1)$ $(n = 1, 2, \ldots)$ with equality for

$$g(z) = \frac{(1 + z^{n+1})^{2/(n+1)}}{z} = z + 2z^{-n}/(n + 1) + \cdots.$$

Although the conjecture is true for $n = 1, 2$ and certain subclasses of the class Σ, the general conjecture is known to be false for all odd $n \geq 3$ and $b = 4$.

In this paper, the investigator generalizes a variational method of Goluzin and develops second-variational techniques. This enables one to construct explicit counterexamples to the conjecture for all $n > 4$. In fact, the conjectured extremal function does not even provide a local maximum for $\mathrm{Re}\{b_n\}$, $n > 4$.

TURNER, John, Associate Professor, "**USR Functions from FORTRAN**," *TRS 80 Microcomputer News*, 5 (March 1983), 43-44.

This article describes a method for calling Z80 machine language subroutines from Microsoft Fortran without using the macrolevel assembler. The format of relocatable object files is discussed and a Basic program is included that will produce the desired object code. An example Fortran program is also included that demonstrates the use of interrupts from the real time clock to detect the break key.

WELCHER, Peter J., Assistant Professor, co-author, "**Computer Modelling of Simple Point Defects in Rare Earth Doped Alkaline Earth Fluorides**," *Journal of Physics C: Solid State Physics*, 15 (1982), 3441-3453.

The results of a package of Fortran computer programs for modelling defects in ionic crystals and for fitting experimental data are described. The fundamental concept of the defect simulation is similar to that of the well-known Hades program, except that the minimization procedure is different since the package is designed to run on small computers. As an example of the use of this package, the relative stabilities of nn and nnn (nearest neighbor and next nearest neighbor) complexes are considered, for various rare earths, lanthanum, and yttrium. First, the data-fitting routine was used to analyze relaxation data for nn and nnn complexes in rare earth doped strontium fluoride. The experimental results for strontium fluoride were then used in conjunction with the defect simulation program to determine potentials for all of the rare earths, yttrium, and lanthanum. Those rare earth potentials were then used in the simulation of calcium fluoride and show that the nnn complex should not be observable, except for possibly the smallest rare earths. Also, the potentials were used in the simulation of barium fluoride, showing that the nn complex should be observable only for the largest rare earths or lanthanum. The nn-nn reorientation enthalpies via the interstitialcy mechanism were calculated for rare earths in calcium and strontium fluoride. In general, the calculated reorientation enthalpies are larger than the experimental values. However, the variation of the enthalpy with the size of the rare earth is in reasonable agreement with experiment. Finally, conclusions are drawn about the assignments of reorientation mechanisms to experimentally observed relaxations.

Presentations

ANDRE, Peter P., Associate Professor, "**Problems in Air ASW**," Anti-Submarine Wartare Systems Projects Office, Crystal City, Virginia, 10 May 1983.

BAILEY, Craig K., Assistant Professor, "**Fundamental Orbits**," 14th Southeastern Conference on Combinatorics, Graph Theory, and Computing, Boca Raton, Florida, 14-17 February 1983.

BAILEY, Craig K., Assistant Professor, "**Adjacency Games-Squares**," Mathematics Association of America Sectional Meeting, Hampton, Virginia, 16 April 1983.

BUCHANAN, James L., Assistant Professor, "**A Similarity Principle for Pascali Systems**," American Mathematical Society Special Session on "**Function Theoretic Methods in Partial Differential Equations**," Denver, Colorado, 10 January 1983.

CRAWFORD, Carol G., Assistant Professor, "**Finite Manuals and their Event Structures - A Reconstruction Problem in Empirical Logic**," 86th AMS-MAA Summer Meeting, Toronto, Canada, 15 August 1982.

CRAWFORD, Carol G., Assistant Professor, "**Determining the Structure of Finite Manuals from their Event Structures**," 14th Southeastern Conference on Combinatorics, Graph Theory and Computing, Boca Raton, Florida, 16 February 1983.

CRAWFORD, Carol G., Assistant Professor, "**Graph Theoretic Problems in Empirical Logic**," Colloquium of the Departments of Mathematics and Electrical Engineering, George Washington University, Washington, D.C., 7 October 1982.

CRAWFORD, Carol G., Assistant Professor, "**Mathematics as a Critical Filter in the Job Market**," Frederick Community College Colloquium, Frederick, Maryland, 28 April 1983.

CRAWFORD, Carol G., Assistant Professor, "**Math Without Fear**," Conference: Transitions III - Women in Change, Arnold, Maryland, 6 November 1982.

D'ARCHANGELO, James M., Associate Professor, "**Acoustic High Frequency Scattering by Elastic Cylindrical Shells**," American Mathematical Society Meeting, New York City, 14 April 1983.

GEWAND, Marlene E., Assistant Professor, "**Totally Lindelöf Spaces**," American Mathematical Society Western Section Meeting, Monterey, California, 19 November 1982.

HANNA, Charles C., Assistant Professor, "**Hilbert Sets**," Session on Commutative Algebra, American Mathematical Society Annual Meeting, Denver, Colorado, January 1983.

HERRMANN, Robert A., Associate Professor, "**The Miraculous Model**," American Scientific Affiliation Washington, D.C., 21 January 1982.

HERRMANN, Robert A., Associate Professor, "**Nature: The Work of a Supreme Mathematical Logician**," Essex Community College, Baltimore, 4 June 1983.

KAPLAN, Harold M., Professor, "**Sturdier Confidence of Monte Carlo Integration**," Regional Probability and Statistics Day, College Park, Maryland, 7 May 1983.

KARWATH, Arthur A., Associate Professor, "**A Sensitivity Analysis of ASW Processors**," Anti-Submarine Wartare Systems Projects Office, Crystal City Virginia, 10 May 1983.

KIDWELL, Mark E., Assistan, Professor, "**Adjacency Games Hexagons**," Mathematics Association of America Regional Conference, Hampton Virginia, 16 April 1983.

LERNER, Bao Ting, Assistant Professor, "**Fuzzy Semigroups**," 86th Summer Meeting of the American Mathematical Society, Toronto, Canada, 23 August 1982.

LERNER, Bao-Ting, Assistant Professor, "**Fuzzy Semitopological Semigroups**," 803rd Meeting of the American Mathematical Society, New York City, 14 April 1983.

MASSELL, Paul B., Assistant Professor, "**The Diverse Applications of the Linear Stochastic Control Model**," Society for Industrial and Applied Mathematics Summer Conference Palo Alto, California, 20 July 1982.

MASSELL, Paul B., Assistant Professor, "**Optimization of Cancer Chemotherapy and Radiotherapy**," Mathematics Association of America Fall Meeting, Washington, D.C., 13 November 1982.

MCCOY, Peter A., Associate Professor, "**Characterization of Solutions to the Generalized Cauchy-Riemann System**," Special Session on Complex Analysis, American Mathematics Society East Coast Regional Meeting, College Park, Maryland, October 1982.

MCCOY, Peter A., Associate Professor, "**Hyperbolic Boundary Value Problems that Arise in Conjunction with Symmetric Poisson Processes**," Special Session on Function-Theoretic Methods in Partial Differential Equations, 89th Annual Meeting of the American Mathematics Society, Denver, Colorado, January 1983.

MCCOY, Peter A., Associate Professor, "**Converse BVP for Associated Elliptic and Parabolic Fractional Partial Differential Equations**," UAB-International Conference on Differential Equations, Special Session on Applications of Partial Differential Equations to Mathematical Physics, Birmingham, Alabama, March 1983.

MOUTIS, Edward L. Jr., Assistant Professor, "**Some Coefficient Results for a Class of Functions Containing Functions with a Positive Real Part**," 797th Regional Meeting of the American Mathematical Society, College Park, Maryland, 30 October 1982.

PENN, Howard L., Associate Professor, "**The Heat Equation with a Radiating End**," American Mathematical Society-Mathematical Association of America Summer National Meeting, Toronto Canada, 20 August 1982.

ROBINSON, Michael L., Assistant Professor, "**Effective Irrationality Measures for Certain Algebraic Numbers**," 803rd Meeting of the American Mathematical Society, New York City, 14 April 1983.

SCHWENK, Allen J., Associate Professor, "**How to Minimize the Largest Shadow of a Finite Set**," First Colorado Graph Theory Symposium, Boulder, Colorado, 15 -16 October 1982.

SCHWENK, Allen J., Associate Professor, "**The Group Reduced Chromatic Polynomial of a Graph**," 14th Southeastern Conference on Combinatorics, Graph Theory, and Computing, Boca Raton, Florida, 14 - 17 February 1983.

TARACEVICZ, Steven, 2nd Lieutenant, USMC, "**Semigroups and Automata**," 797th Meeting of the American Mathematical Society, College Park, Maryland, 31 October 1982.

TSAO, Anna, Assistant Professor, "**Disproof of a Conjecture for Meromorphic Univalent Functions**," Complex Variables Seminar, University of Maryland, College Park, Maryland, 24 March 1983.

TSAO, Anna, Assistant Professor, "**On a Conjecture of Zalcman**," Meeting of the American Mathematical Society, New York City, 15 April 1983.

TSAO, Anna, Assistant Professor, "**Evidence on a Conjecture of Zalcman**," Conference on Univalent Function Theory, Lexington, Kentucky, 12 May 1983.

WARDLAW, William P., Assistant Professor, "**Almost Isosceles Pythagorean Triples**," Spring Meeting of the Md-Va-DC Section of the Mathematical Association of America at Thomas Nelson Community College in Hampton, Virginia, 1 - 2 April 1983.

DEPARTMENT OF

Oceanography

COMMANDER JOHN P. SIMPSON, III, USN
CHAIRMAN

During the 1982-1983 Academic Year, faculty research (in a broad range of atmospheric and oceanographic areas) was regularly undertaken by both civilian and military members of the Oceanography Department. Not only does this research provide the opportunity for the faculty to keep abreast of current technology and theory, but it also serves as a basis for qualified midshipmen to undertake related research projects, particularly those dealing with the Chesapeake Bay, where their work can be supported by the Departmental research vessel.

Funding for these research activities has been available from a number of sources, including grants from or contracts with the Office of Naval Research, Defense Mapping Agency, Naval Air Systems Command, Naval Sea Systems Command, and the Naval Academy Research Council.

Specific areas of research activity within the Department include but were not limited to: sedimentation processes and properties, light attenuation, bioluminescence, estuarine ecology, marine biofouling, dredging, environmental effects on electro-optic systems, climatology, statistical weather forecasting, and remote sensing.

Sponsored Research

Fronts and Eddies in ASW

RESEARCHER: VISITING RESEARCH PROFESSOR BEN I. CAGLE
SPONSOR: OFFICE OF NAVAL RESEARCH

Fleet operations and exercises are conducted in the Pacific and Indian Oceans in which ocean fronts and eddies are important in the presentation of Anti-Submarine Wartare. The basic concepts for incorporating oceanographic knowledge into these operations and exercises are generated by a small group of ONR employees in California, and the data base for advice and documentation is obtained at the Scripps Institution of Oceanography in La Jolla, California. The researcher provides the remote sensing descriptions of ocean fronts and eddies for this group.

Evaluation of a Single Station Fog Model for OWS-P

RESEARCHER: LIEUTENANT ROBERT L. CLARK, USN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A single station model for the prediction of restricted visibility in the Gulf of Alaska is tested on archived data from Ocean Weather Station Papa. The majority of parameters remain valid such as air, sea ΔT and inversion height. Wind direction and advection index need further evaluation. Research is ongoing.

Interactive Computer Methods in Oceanographic Instruction

RESEARCHER: LIEUTENANT COMMANDER PATRICK R. DRAKE, USN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The objective of this project is to write a series of interactive programs which will cover basic subjects in Oceanography. The methodology will be a leading of the student user through basic subjects which lend themselves to a building block approach to comprehension. The sonar equations, basic fluid dynamics, and wave theory are all subject areas where a step by step approach with the timely reinforcement of interaction can be utilized to instruct. Outside reading or preparation will be required to some areas to reduce the storage requirements of the programs. It is envisioned that the programs could be used in conjunction with conventional classroom instruction, could serve as an extra instruction asset or could be used as a knowledge base for any interested user. Currently programs are being written in a user-friendly format and will be distributed to the Naval Postgraduate School on magnetic tape and will be held in Oceanography Departmental retrievable storage for use at the Naval Academy. No other publication or dissemination is anticipated.

Cenozoic Development of the Southeast Georgia Embayment

RESEARCHER: ASSOCIATE PROFESSOR DOUGLAS W. EDSALL
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A high resolution seismic reflection survey of the Florida-Hatteras Shelf, Slope and inner portion of the Blake Plateau, lying with the Southeast Georgia Embayment, was completed in 1976 by the U. S. Geological Survey. Seismic reflection data and geologic dating control from additional offshore wells has been incorporated with the original data in order to update our knowledge of the Cenozoic development of this regions.

In general, as global sea level has fluctuated, so has the position of the Gulf Stream and thus the location of zones of deposition and erosion within the Embayment. Times of higher sea level (transgressions) are characterized by a westward movement of the Gulf Stream until it impinges against the inner part of the Plateau, Florida-Hatteras Slope and Shelf. The contact of the bottom of the Gulf Stream with the sea floor results in the formation of erosional channels in the older sediments. In times of lower sea level (regressions) the Gulf Stream is displaced to the east into deeper waters, and this allows the depocenters to be shifted into deeper waters.

The division of the Southeast Georgia Embayment into three distinct sections, southern, middle, and northern, reflects these major migrations in the axis of the Gulf Stream and clearly demonstrates that the Embayment's physiographic features, unconformities, and sedimentary accumulations are a result of the Cenozoic shifts in global sea level and Pleistocene eustatic changes in sea level.

Environmental Impact Assessment of Tin Containing Antifoulant Paints

RESEARCHER: ASSOCIATE PROFESSOR JOHN W. FOERSTER
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

Preparation of environmental assessment for implementation of tin containing antifoulant paints was made for USS NIMITZ as well as future fleet-wide application.

Chesapeake Bay Turbidity Studies

RESEARCHERS: PROFESSOR JEROME WILLIAMS AND ASSOCIATE PROFESSOR JOHN W. FOERSTER
SPONSOR: DEFENSE MAPPING AGENCY

Studies of the type and size of sediments affecting light penetration in coastal waters were completed.

Rapid Method for Decreasing Turbidity

RESEARCHERS: PROFESSOR JEROME WILLIAMS AND ASSOCIATE PROFESSOR JOHN W. FOERSTER
SPONSOR: NAVAL SEA SYSTEMS COMMAND

A system for using the flocculation system for particles was researched. A procedure for lessening turbidity was offered.

Environmental Effects on the Performance of the Tomahawk Cruise Missile

RESEARCHER: PROFESSOR JOHN F. HOFFMAN
SPONSOR: NAVAL AIR SYSTEMS COMMAND

An investigation of environmental effects on the performance of the submarine ship Tomahawk Cruise Missile, was completed.

Aircraft Icing Studies

RESEARCHER: VISITING PROFESSOR WAYNE R. SAND
SPONSOR: FEDERAL AVIATION ADMINISTRATION

The researcher is making an investigation of the atmospheric parameters which affect aircraft icing. This includes a detailed study of a larger body of data to determine statistical properties as well as a detailed examination by geographic area to look for peculiar effects. Detailed examinations of the microphysical and synoptic processes are also carried out on a case study basis.

The effects on aircraft performance degradation is examined through a detailed study of ice on the aircraft versus observed rate-of-climb capability. These studies begin with the equations of motion and determine coefficients of lift and drag such that a prediction of performance for the entire flight envelope is possible.

Changes in the Geomagnetic Field, Cosmic Radiation, and the Earth's Electric Field as Possible Related Mechanisms for the Enhancement of Cirrus Cloudiness

RESEARCHER: LIEUTENANT COMMANDER WARREN T. SPAETH, USN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Numerous correlative studies have been conducted to establish solar influences on weather and thus climate. Many have successfully established significant relationships, such as the 22-year Sunspot Cycle and drought in the Midwest region of the United States. Another example is the relationship between the Solar magnetic field sector boundary passage and the increase in vorticity area index in the northern hemisphere. Although these relationships have been established, few physical mechanism theories have been proven. With the advent of additional solar-terrestrial satellite data over the last ten years, great strides are now being taken in this direction. Conclusions reached at the Symposium Workshop on Solar-terrestrial Influences on Weather and Climate in 1978 include as potential physical mechanisms: (1) solar induced changes in O_3 content and distribution; (2) solar constant variations, either regular or irregular; (3) solar UV variations; (4) changes in the thermal or dynamic structure of the upper atmosphere; and (5) changes in the atmospheric electric field. Research is now proceeding to investigate most all of these areas in order to devise an input to present day forecasting models of climate and weather. An exhaustive search over the last year has revealed that item (5), changes in the atmospheric electric field, may be a key trigger mechanism in regulating the other items listed with the exception of number (2). One way in which changes in the atmospheric electric field may regulate our weather and climate is the enhancement of ice crystal or cloud droplet growth. Meterologists have alluded to this fact, and in particular, have pointed out how the ice crystals of the high cirrus cloud may act as a seeding mechanism for lower clouds in the condensation-precipitation process. This could be an important factor in the earth's radiation balance because clouds dominate the albedo of the earth-atmosphere system, and also in the earth's hydrological cycle due to regulation of the precipitation processes.

As of May 1983, final computations in making correlations between cirrus cloudiness in an area situated in the Gulf of Alaska area and an area off the Northeast coast of the United States were still being made. No final conclusions to the project have yet been made.

Optical Properties of Coastal Waters

RESEARCHER: PROFESSOR JEROME WILLIAMS
SPONSOR: DEFENSE MAPPING AGENCY

Optical data taken over the period 1980-1983 have been analyzed with particular attention being given to the effect of meteorological parameters such as wind and rain on turbidity. Particle size analysis of typical samples has also indicated the presence of two discrete particle populations: the suspended silt and the plankton. It is therefore of some interest to relate turbidity measurements to the presence of dissolved nutrients such as nitrate and phosphate. Due to these two populations, which vary in relative size with season, weather, location, etc., there is some indication that the ratios between the various optical parameters should be specified for varying environmental conditions.

Independent Research

Ocean Weather Station Vessels, Pacific

RESEARCHERS: LIEUTENANT ROBERT L. CLARK, USN AND ENSIGN DAVID CLOPP, USN

This research completed a historic search of locations and data bases made by Ocean Weather Station vessels in the North Pacific of the 20th Century. Common names of stations as well as technical names are listed, as are locations given by latitude and longitude for each occupied station. Additionally, ship tracks are plotted for continuity.

The United States Aquaculture Industry

RESEARCHERS: LIEUTENANT ROBERT L. CLARK, USN, AND ENSIGN DAVID CLOPP, USN

This report details the most up-to-date listing of fish farming in the United States. The U. S. Aquaculture Industry is rapidly expanding. Presented are all known ventures including type of fish or organism grown, location, production levels and future growth projections. A comprehensive bibliography encompassing the entire industry to date is compiled.

Research Course Projects

Upper Atmospheric Winds on Mount Washington

RESEARCHER: MIDSHIPMAN 1 C DAVID R. DIORIO
ADVISER: LIEUTENANT ROBERT L. CLARK, USN

To date a model for the precise prediction of upper atmospheric winds on Mount Washington does not exist. Local surface wind, actual summit recorded wind, and 500mb level wind data are processed by computer for 1982. Data are presented in graphical and tabular form to view possible correlations of wind levels. Parameters examined include wind accelerations due to the Bernoulli effect and wind accelerations due to the upper atmospheric Polar Front Jet (PFJ). To aid in diagnosis of the extremely high wind velocities experienced on Mount Washington, a two-dimensional numerical model is applied to the task of simulating air flow across a mountain range. The limitations of the model prevent a complete solution; however, there are indications that the Polar Front Jet and Bernoulli factor influence the summit winds on Mount Washington causing these wind velocities to be high.

Mathematically Modelling the Rise of Submarine Condenser Coolant

RESEARCHER: MIDSHIPMAN 1 C GARY L. DOUGLAS
ADVISER: LIEUTENANT COMMANDER PATRICK R. DRAKE, USN

This report provides a mathematical model simulating the rise of condenser coolant seawater injected into the water surrounding a submerged submarine. An equation, based upon Stoke's Law for settling velocities of particles, is proposed. However, since Stoke's Law is used for particles less than one millimeter in diameter and the condenser coolant is cylindrically shaped with a diameter of approximately twenty centimeters, an equation based on inertial settling velocity is required. Sophistications are made to this equation to account for (1) growth of the cylinder; (2) change in the density of the cylinder and (3) change in the density of surrounding water as the cylinder rises. Results include height of use, cylinder size, and time of rise as functions of density gradient, mixing rates, and submarine speed. It is concluded that optimum conditions for detection require a weak density gradient, a submarine operating near the mixed layer depth, and low mixing rates.

Fog, Low Ceiling, and Poor Visibility

RESEARCHER: MIDSHIPMAN 3 C MARK R. HENDERSON
ADVISER: LIEUTENANT COMMANDER PATRICK R. DRAKE, USN

The purpose of this study is to compare the meteorological condition for selected sites on dates of known Instrument Meteorological Condition (IMC), some of which are associated with aircraft accidents. A better understanding of what causes the bad weather to occur or how particular environmental conditions can lead to the undesirable weather is sought. Archived meteorological data including surface weather observations, radiosonde data and surface analysis charts has been obtained for various airports on days of weather related aircraft incidents. These data are being reduced and conclusions based upon these reductions will be encapsulated in a Naval Research Lab Technical Report.

Predicting the Formation of Stratocumulus Clouds Over the Western Atlantic During Cold Air Outbreaks

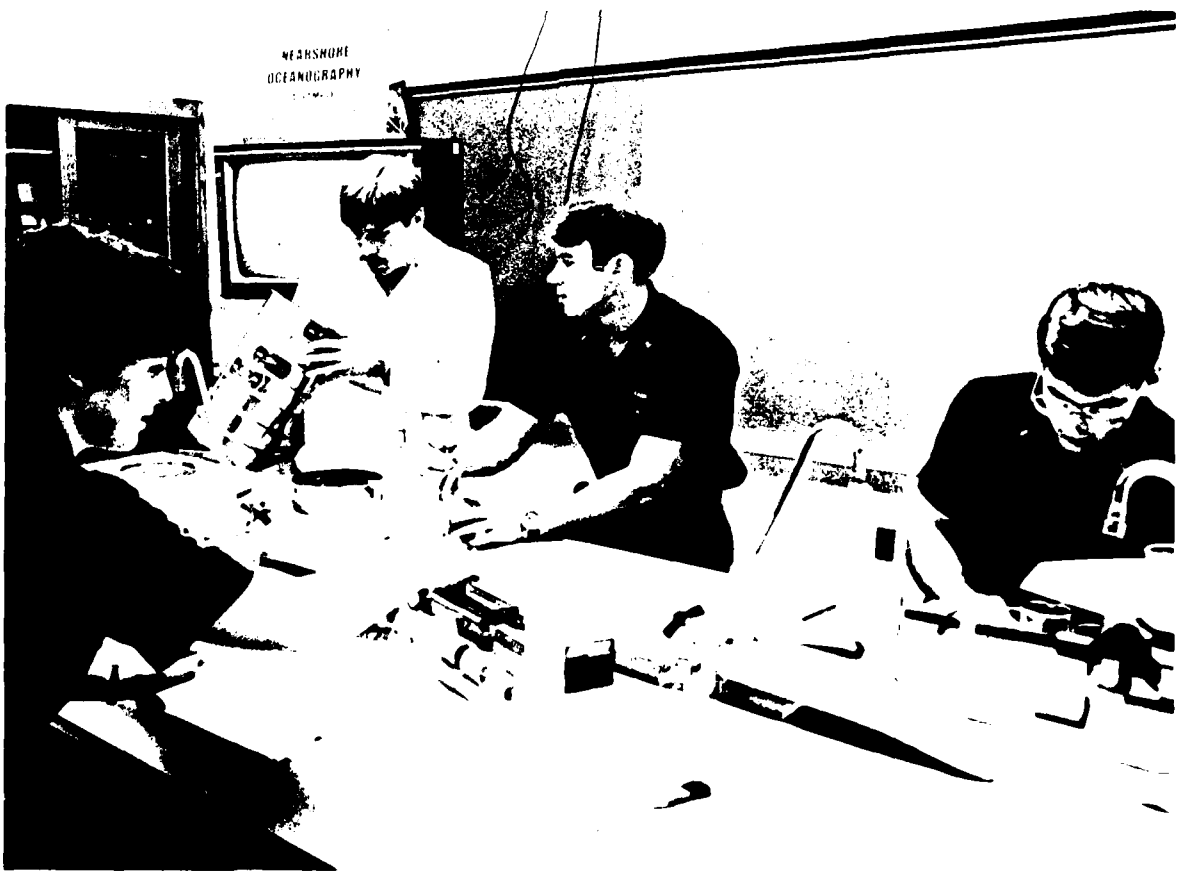
RESEARCHER: MIDSHIPMAN 1/C RAYMOND F. HOFFMANN
ADVISER: LIEUTENANT ROBERT L. CLARK, USN

Stratocumulus clouds that form in the winter months over the Western Atlantic Ocean during cold air advection appear to be related to the air-sea ΔT. A four-month comparison (November 1981-February 1982) of the air-sea ΔT's from four selected buoys in the Atlantic Ocean with Sc consisting of both open and closed cells, showed some correlation between the formation of Sc and air-sea T. Other observations during the study revealed several other possible parameters involved in the formation of Sc clouds. These parameters include: vorticity advection, the litted index, vertical velocity and the relative humidity. Each of these parameters is computed daily by computer models for most coastal stations along the Atlantic seaboard. As this was a limited study of four months, the prediction model remains to be tested.

A/C Icing Studies

RESEARCHER: MIDSHIPMAN 2/C PETER C. MAYER
ADVISER: LIEUTENANT COMMANDER PATRICK R. DRAKE, USN

The purpose of this study is to determine susceptibility to aircraft icing through a statistical analysis of Naval Safety Center data. Data is reduced by aircraft type and normal theater of operations to provide areas of concern for aircraft icing. Preliminary results indicate that aircraft icing is not surprisingly, highly variant upon aircraft type, hours flown, missions assigned, time and location. Research will continue as a SO490 series directed studies with the results being detailed in a research paper and submitted for publication.



Surface Energies and Chemical Analysis of the Initial Stages of Marine Microbiological Fouling

RESEARCHER: MIDSHIPMAN 1 C MARK J. OLSON
ADVISER: LIEUTENANT ROBERT L. CLARK, USN

In this analysis, a series of three interrelated experiments were conducted which analyzed the initial stages of marine microbiological fouling in the Severn River estuary. In the first experiment, glass microscope slides were exposed to natural fouling organisms at "sampling stations" located along the length of the estuary. Slide and water samples were collected at set intervals, and a comparison was made between the relative degree of fouling and individual water parameters experienced at each station. Results of the analysis showed low fouling to occur in waters which were relatively low in temperature and oxygen content, but high is salinity. The second experiment compared the surface energies of a set of substances to the degrees of fouling and organism attachment they demonstrated. Surface energies were determined using a contact goniometer, samples were exposed to natural fouling organisms in a controlled environment, and degrees of fouling and organism retention were determined using dissection and scanning electron (SEM) microscopes, and a hydrous bacterial sprayer (HBS). Results showed definite surface energy ranges which would experience low degrees of fouling or organism retention. In the third experiment, an artificial sea water solution was created and organically enriched in order to analyze solutions which would support life and promote the transfer of fouling bacteria. It was discovered that each of the nutrient solutions would support life for an extended period of time, while straight artificial sea water and distilled water would only allow bacterial transfer for a limited period of time.

Preparation of Turbid Water with Predetermined Optical Characteristics

RESEARCHER: MIDSHIPMAN 1/C MARJORIE ZAP
ADVISER: PROFESSOR JEROME WILLIAMS

There is a need for a methodology to produce artificial turbid water of predetermined optical characteristics in laboratory studies involving underwater visibility, marine plant growth, and other aspects of water clarity. By using commercially available solutions of suspended latex particles, it is shown that combinations of different particle sizes will result in mixtures that accurately reproduce the optical properties of natural waters. These artificial samples are easily reproduced, and they exhibit long term stability, making them ideal for use in the laboratory.

Publications

CAGLE, Ben J., Visiting Research Professor, et al., "**ASW Environment of the Northwestern Indian Ocean,**" Office of Naval Research Pasadena Report 82-1, October 1982.

The oceanographic environment affecting underwater acoustics important to Anti-Submarine Warfare is described.

CAGLE, Ben J., Visiting Research Professor, "**Arctic Expendable Technology,**" Office of Naval Research Pasadena Report 82-5, November 1982.

The results of a workshop on Expendable Technology for Arctic oceanography are presented.

FOERSTER, John W., Associate Professor, "**Searching the Denmark Strait,**" *Explorers Journal*, 60 (1983), 102-106.

Discussion of whale and oceanography research in Denmark Strait is presented.

HOFFMAN, John F., Professor, "**Sedimentation Problems and Their Control in U.S. Navy Pier Slips in Selected Harbors of the United States,**" in *Estuarine Comparisons*, New York, N.Y.: Academic Press, 1982.

United States Navy pier slips in the harbors of Hampton Roads, Virginia; Charleston, South Carolina; Mayport, Florida; and Alameda, California, experience sedimentation problems.

SAND, Wayne R., Visiting Research Professor, co-author, "**Nature of Icing Conditions Encountered During Meteorological Research,**" Final report to Federal Aviation Administration, 220 pp.

An extensive examination of data from about 1100 hours of meteorological research flights and aircraft icing flights was conducted.

WILLIAMS, Jerome, Professor, co-author, "**Using Latex Sphere to Simulate Naturally Turbid Waters,**" *Human Factors*, 24(1982), 185-192.

Laboratory research on problems of underwater vision and display optimization for underwater systems has been hampered by the difficulty of representing the light-scattering effects of naturally turbid waters.

WILLIAMS, Jerome, Professor, et al. "**Determinants of Display Legibility in Dark, Turbid Waters.**" *Human Factors*, 24 (1982), 193-201.

The physical characteristics of naturally turbid nearshore and inshore waters were simulated by substituting latex spheres for natural suspensoids.

WILLIAMS, Jerome, Professor, "**Marine Waste Disposal Problems are Political, Not Scientific.**" *Sea Technology*, 23 (1982), 72.

Marine pollution problems are discussed and it is shown that most management decisions are based on political considerations rather than scientific ones.

Presentations

CAGLE, Ben I., Visiting Research Professor, "**Birth, Maturity, & Decay of Large Cold Eddy**," National Fall Meeting of American Geophysical Union, San Francisco, California, 10 December 1982.

CAGLE, Ben I., Visiting Research Professor, "**Arctic Expendable Technology**," OCEAN-82 Conference, Washington, D.C., 22 September 1982.

CAGLE, Ben I., Visiting Research Professor, Seminar on Arabia Sea Circulation, Johns Hopkins University Applied Physics Lab, Laurel, Maryland, January 1983.

CAGLE, Ben I., Visiting Research Professor, Seminar on Applied Satellite Oceanography, Naval Eastern Oceanography Center, Norfolk, Virginia, February 1983.

FOERSTER, John W., Associate Professor, "**North Atlantic Fin Whales**," Severn Technical Society, Naval Station, Annapolis, Maryland, November 1982.

FOERSTER, John W., Associate Professor, "**Fin Whale Studies**," Sigma Xi, U.S. Naval Academy, Annapolis, Maryland, January 1983.

FOERSTER, John W., Associate Professor, "**Dynamics of the Clupeid Fisheries in the Northern Chesapeake Bay**," American Fisheries Society Meeting, May 1983.

SAND, Wayne R., Visiting Research Professor Chaired special research coordination meeting between the Federal Aviation Administration, U.S. Bureau of Reclamation, University of North Dakota and University of Wyoming, Oakland, California.

SAND, Wayne R., Visiting Research Professor Special presentation to the U.S. Army at Edwards Air Force Base, California.

SAND, Wayne R., Visiting Research Professor Special briefing to Strategic Planning Group, Naval War College, Newport, Rhode Island.

WILLIAMS, Jerome, Professor, "**Is the Average Marine Science Student Being Filled with Misconceptions of the Sea?**" 1982 Meeting of the National Marine Education Association, San Diego, California August 1982.

WILLIAMS, Jerome, Professor, "**The Effect of Wind and Rain on Turbidity**," Fall Meeting of the Atlantic Estuarine Research Society, Richmond, Virginia October 1982.

WILLIAMS, Jerome, Professor, "**Preliminary Efforts at Optical Modelling for Coastal Waters**," Annual MC&G Base Technology Review, Bay St. Louis Mississippi, November 1982.

DEPARTMENT OF

Physics

PROFESSOR FRANK L. MILLER
CHAIRMAN

The increasing use of advanced technology by the Navy's operating forces places ever increasing responsibility on the Physics Department. Not only must all midshipmen be thoroughly grounded in many areas in basic physics, but also the faculty and the physics majors should be kept current in physics research. This latter requirement is accomplished by the ongoing participation of the physics faculty in a wide variety of research projects and the encouragement of midshipmen to participate in these projects. Present activities include studies in acoustics, merchant ship acoustic signature determination, electric and magnetic properties of materials, laser optics and technology, radiation effects in solids, solar energy studies, solar systems astronomy, galactic astronomy, and solid state physics.

This year the department's research efforts were supported by the David Taylor Naval Ship Research and Development Center, the National Aeronautics and Space Administration, the Naval Academy Research Council, the Naval Sea Systems Command, the Department of Defense—University Research Instrumentation Program, and Naval Surface Weapons Center.

Midshipmen majoring in physics are encouraged to participate in the Department's research programs either through the SP490 series or through the Trident Scholar Program. It should be noted that three of the six Trident Scholars for the year were physics majors.

Sponsored Research

$e^+ - H^-$ Scattering at Low Energy

RESEARCHER: PROFESSOR RUTHERFORD H. ADKINS
SPONSOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION-AMERICAN SOCIETY OF ENGINEERING EDUCATION FACULTY FELLOWSHIP PROGRAM

The researcher conducted a theoretical investigation of the energy dependence of the $e^+ - H^-$ scattering cross section at low positron energy to determine theoretical estimates or analytical formulations of the cross sections for the formation of positronium by scattering of low energy positrons by H^-. Initially the Born approximation is used with Coulomb wave function for the incoming positron. H^- and H are assumed to be in their ground states. It is assumed that there is negligible contribution to the scattering amplitudes for positronium states with $n = 4$ or more. Standard analytical strategies are supplemented by the MACSYMA symbolic manipulation system of the Massachusetts Institute of Technology Computation Center. Efforts to obtain analytical formulations of the scattering amplitudes have not been successful even for the simplest assumptions. Numerical approximation methods (standard) are just beginning.

Neutral Interstellar Gas in the Galactic Halo

RESEARCHER: ASSISTANT PROFESSOR C. ELISE ALBERT
SPONSORS: NAVAL RESEARCH LABORATORY AND NAVAL ACADEMY RESEARCH COUNCIL

The investigation of interstellar gas in the galactic halo, well above the visible flat stellar disk, is one of the most active research areas of both observational and theoretical astrophysics today. The goal of this project is to study the large-scale extent and structure of neutral halo material in two steps: First, a grid of stars with well-determined distances is necessary to measure the gas between them, which is observed in absorption lines superposed on the stellar spectra. Classification spectra of a sample of halo stars have been obtained, in collaboration with Professor R. F. Garrison of the University of Toronto, at the prime focus of the 3.6 meter Canada-France-Hawaii telescope on Maura Kea, Hawaii. These spectra will be analyzed in the next few months to provide their distances and to demonstrate that, contrary to traditional beliefs, stars like those in the galactic disk also do exist high in the halo. Second, these stars were used as the basis of a survey of the interstellar material in the far halo from observations of the radio 21-centimeter emission line of neutral hydrogen. In collaboration with Dr. F. J. Lockman of the National Radio Astronomy Observatory (NRAO) several thousand 21 cm spectra were obtained with the 140 foot telescope at NRAO, Green Bank, West Virginia. These spectra will be reduced in the ensuing months to provide high resolution maps of the neutral hydrogen distribution in the halo. Limited preliminary results suggest that the extent of the gaseous halo is greater by perhaps an order of magnitude than previously determined, and this survey is designed to provide sufficient data for a detailed modelling of material in this hitherto unobserved component of our galaxy.

Acoustic Resonance Scattering by an Elastic Cylinder

RESEARCHER: PROFESSOR DONALD W. BRILL
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The problem of sound scattering by an elastic cylinder in the light of the Resonance Scattering Theory (RST) is examined in order to further understand and improve these observations. These tests have isolated the modal resonances contained within a target's (a cylinder) backscattering cross section by means of a "background subtraction", experimentally accomplished by an ingenious time-gating technique. Present calculations (a) display the "whispering gallery" and Rayleigh-type poles in the complex-frequency plane, sometimes used in the radar literature, showing their connection with the target resonances they generate; (b) quantitatively explain why some of the modal resonances were not observed in the tests; (c) establish comparisons between RST-predicted and observed monostatic bistatic form-functions in a "direct-scattering" mode of operation; and (d) show ways to improve some of the measurements done at Le Havre in manners that are helpful toward the solution of the inverse scattering problem. It is concluded that these experiments have satisfactorily validated and implemented many of the RST-predications in the field of acoustics.

Mode Calculations in Large Aperture Unstable Optical Resonators

RESEARCHER: PROFESSOR GERALD P. CALIANI
SPONSOR: NAVAL RESEARCH LABORATORY

Lasers constructed with unstable resonators of very large aperture, and thus huge Fresnel numbers (of the order of 100,000) are of considerable current interest because their large active volumes should permit the generation of intense beams. However, the huge Fresnel numbers make the calculation of their modal properties totally unfeasible by conventional methods, such as Fast Fourier transform techniques. The purpose of this project is to search for other computational approaches. To date, the project has established that the Fresnel approximation, which serves as the basis for most computational methods (even those, such as the Horowitz asymptotic method, which has been extensively used for resonators with large Fresnel numbers), is seriously in error when the Fresnel number is as large as 10 . Other approaches, such as Southwell's virtual source method, are currently being investigated.

Oxidation of Ion-Implanted Titanium Alloys

RESEARCHER: ASSISTANT PROFESSOR FRANCIS D. CORBETT
SPONSOR: NAVAL RESEARCH LABORATORY

This work is part of a larger, continuing study of the effects of ion implantation on the oxidation of Ti and its alloys. The goal of this particular project was to investigate the effects of implantation with energetic Pt or Ba ions on the oxidation of the Alloy Ti811.

Samples of Ti811 alloy (by weight, 90% Ti, 8% Al, 1% V, and 1% Mo) were subjected to a variety of implantation and oxidation treatments in an effort to separate the effects of ion species and dose, surface preparation, oxidation temperature, and oxidation time. Rutherford backscattering (RBS) analysis was used to study the near-surface composition of the Ti811 samples after they had received their individual implantation and oxidation treatments. The energy spectra of the backscattered ^4He ions were analyzed to determine the depth profiles of the implanted ions and the alloy constituents, and to measure the thickness of the stoichiometric composition of the oxide layers formed.

In all of the Ti811 samples studied, a surface oxide layer formed with the stoichiometry TiO_2. In many

samples, a considerable amount of dissolved oxygen was observed to be incorporated beneath this surface layer. The concentration of the dissolved oxygen varied with depth, but phase diagrams of the Ti-O system suggest that the oxygen may be incorporated into suboxides such as TiO, possibly in nonuniform structures like dendrites extending into the metal.

In general, both implanted and unimplanted samples Ti811 were found to oxidize much more slowly than pure Ti at the corresponding temperatures, although implantation with either Pt or Ba ions seemed to hasten the oxidation process. Further, the oxidation rates for either implanted or unimplanted alloy samples were observed to be very sensitive to thermal cycling of the samples, with a greater effect at higher temperatures. Finally, oxidation of the Ti811 alloy usually resulted in rejection of the Mo alloy constituent from the TiO_2 surface layer, although the Al constituent remained well incorporated in the oxide layer at most temperatures.

Planned future work on this subject includes a continuing analysis of the data already obtained, using computer codes now being implemented at USNA, and new experimental work to further elucidate the effect of ion implantation on the oxidation behavior of Ti811 and other important Ti alloys.

Experimental and Theoretical Study of Underwater Tone Generation by Flow Over a Slot: Phase II

RESEARCHER: PROFESSOR SAMUEL A. ELDER

SPONSOR: NAVAL SEA SYSTEMS COMMAND GENERAL HYDROMECHANICS RESEARCH CONTRACT, ADMINISTERED BY: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The objective of the project is to perform an experimental and theoretical investigation of underwater tone generation by flow over a slot, with application to the control or elimination of slot tone effects in the design of ships. The prevention of vibration and acoustic radiation generated by flow over slots or cavities in hulls is a recurrent problem in ship performance. Making use of the Naval Academy's High Speed Tow Tank Facility, current studies are being directed toward understanding the coupling between sheartone oscillation and structural vibration modes. Measurements are being made with a towed model apparatus containing a free flooding cavity with one or more breathing mode resonances. Preliminary tests confirm that there are patterns of sheartone cavity tone coupling similar to that previously observed for air resonant cavities. In further tests an underwater accelerometer will be used to identify the structural vibration modes responsible for breathing mode cavity resonance. The theory is being modified to allow for dual feedback paths, as well as for the complications due to turbulence. In order to permit accurate sheartone amplitude prediction, an empirical nonlinear shear layer gain curve, similar to that derived from air cavity data, is being developed from underwater profile data. A proposal to extend the present contract (Phase III) until September 1984 has been submitted.

Dynamical Planetary Magnetospheric Field Modeling

RESEARCHER: ASSOCIATE PROFESSOR IRENE M. ENGLE

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A self-consistent magnetospheric field model of the "semi-inflated" state of the Jovian magnetosphere as experienced by the Voyager flybys was completed. Expansion parameters have been fit for the interior field due to the magnetopause currents. They consist of terms to 10th order of spherical harmonic functions analagous to the Engle-Beard fully-inflated Jovian magnetospheric field during the earlier Pioneer 10 flybys. Graphics work and text remain to be completed prior to publication of the results.

Low Temperature Electrical Studies of Materials

RESEARCHERS: ASSOCIATE PROFESSOR JOHN J. FONTANELLA AND ASSISTANT PROFESSOR MARY C. WINTERSGILL
SPONSOR: DEPARTMENT OF DEFENSE-UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM

The instrumentation is a dilution refrigerator and ultra sensitive impedance bridge. The initial purpose is to perform very low temperature electrical measurements on ion conducting polymers and other solid electrolytes. The goal is to search for and characterize disorder induced, low-frequency excitations in addition to other types of tunneling systems. The existence of such phenomena has already been shown in a wide variety of materials via the authors' previous studies down to liquid helium temperature. For example, this includes polymer electrolytes such as lithium conducting poly(ethylene oxide) and poly(vinylidene fluoride), other solid electrolytes such as lead fluoride, amorphous semiconductors, and fused silica. In all cases, it was not possible to fully study the phenomena because of temperature limitations. Next, future work is being planned on studies of NAFION and ion implantation in polymers. Very low temperature phenomena are expected in both cases. For NAFION, proton tunneling will almost certainly be important and for implantation, it is anticipated that both damage and motion of implanted light ions may give rise to low temperature phenomena. Consequently, it is proposed to do very low temperature studies on these and other systems for the purpose of materials characterization and the study of quantum phenomena. Finally, the ultra sensitive bridge (10^{-8} rad.) is necessary because most of the systems have very low loss. Our present apparatus, which is comparable to usual bridge sensitivities (10^{-6} rad.) is capable of revealing the losses, but a higher sensitivity is necessary for a proper characterization of the phenomena.

Activation Volumes and Electrical Relaxation in Ion Conducting Polymers

RESEARCHERS: ASSOCIATE PROFESSOR JOHN J. FONTANELLA AND ASSISTANT PROFESSOR MARY C. WINTERSGILL
SPONSOR: OFFICE OF NAVAL RESEARCH

The primary objective of the work proposed is to measure the effect of pressure on the conductivity of ion conducting polymers. These measurements will allow the determination of the activation volume of the ion motion. In PEO, the activation volume is relatively insensitive to the nature of the dopant material, although some ion size effects have been noted. In addition, the thermal expansion coefficient of the activation volume appears to be negative. A variety of dopant ions in PEO and other polymers will be studied in order to check this effect.

Secondly, electrical relaxation measurements will be performed both at zero pressure and at elevated pressures. Electrical relaxation spectroscopy at zero pressure is yielding a great deal of information about the PEO samples. First, some very low temperature relaxations have been found which appear to depend upon the solvent used in the preparation of the polymer. Next, it is observed that there may be an effect of the salt on the strength of the γ relaxation. Finally, it is found the the *β relaxation*, which is associated with the glass transition, depends strongly upon the addition of salts to the polymer. It is proposed to perform systematic studies of these relaxations using various salts in PEO.

In addition, the effect of pressure on some of the relaxations will be determined and the activation volumes calculated for comparison with the activation volumes determined from the effect of pressure on the conductivity. In addition to PEO, work will begin on ion conducting PVF_2, PAN, and possibly the crown ethers. In addition, a search for fast ion conduction will be made in copolymers of PVF_2, PVF, PVC and poly(vinyl acetate).

Concurrently, work will begin on a molecular mechanics approach to polymers. Specifically, an attempt will be made to adapt a computer program which has been used to model ionic crystals to the problem of ions in PVF and PEO.

Thermoluminescence in Calcium Fluoride Dosimeters

RESEARCHERS: ASSOCIATE PROFESSOR JOHN L. FONTANELLA AND ASSISTANT PROFESSOR MARY C. WINTERSGILL
SPONSOR: NAVAL SURFACE WEAPONS CENTER, WHITE OAK

The aim of the project is to elucidate the physical processes involved in the thermoluminescent (TL) dosimeters currently used in the Navy radiation monitoring program. This involves identifying the defect centers required for the TL observed in both the currently utilized dosimeter materials, that is, CaF_2:Mn and in related materials such as CaF_2 doped with rare earths. Experimental techniques used include dielectric relaxation, optical absorption and high temperature quenching treatments. Progress has been made in identifying additional impurities which are unspecified by the supplier but which may turn out to be essential, and in identifying the trapping and recombination centers in some of the materials under investigation.

Merchant Vessel Source Levels

RESEARCHER: VISITING RESEARCH PROFESSOR ROBERT L. JENNETTE
SPONSOR: NAVAL SEA SYSTEMS COMMAND

The acoustic emanations of transiting merchant vessels tend to degrade antisubmarine warfare capabilities by masking the presence of a target, or by mimicking a target. Thus, the amount of radiated acoustic noise and the signature of this noise is of current Navy interest.

The Physics Department is engaged in a measurement program for the gathering of the narrow-band source levels of numerous ships. A sonar laboratory (including a digital signal processing facility, plus two research vessels) is being developed.

To date, the feasibility of the methology has been proven with the obtaining of the first final result — a calibrated narrow-band source level of a representative merchant vessel.

Scattering of Crossed Ultrasonic Beams by Turbulence

RESEARCHER: ASSISTANT PROFESSOR MURRAY S. KORMAN
SPONSOR: NAVAL RESEARCH LABORATORY

Naval Research Laboratory (NRL) is funding an investigation of the nonlinear interaction and scattering of crossed ultrasonic beams by turbulent flow in water. Successful scattering measurements have been made using continuous wave techniques to describe the turbulent flow field. Now pulsed sound waves will be used and digital signal averaging techniques will be used to extract information about the flow field. Currently a portable 8-ft long x 2-ft wide aluminum structure has been designed and built for supporting transducers. Precision radio frequency amplifiers have been built and tested. They will drive the transducers emitting very "clean and stable" pulses of acoustic energy — vital to the success of the project. The plumbing system consisting of a 20 H.P. jet pump and plumbing supplies is ready for assembly. A model version of the experiment has been built and is located in Michelson Lab A-8 for student evaluation. Measurements that are of publication quality should be made by mid June.

This project has been moved from NRL Washington, to the Naval Academy Hydrolab facility for convenience and for practicality.

Ultrasonic Particle Detection in Fluid Systems

RESEARCHER: ASSOCIATE PROFESSOR DAVID A. NORDLING
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

This is an on-going project that is intended to investigate the use of ultrasonics for the detection of particles (10-100 microns) in fluid systems. The fluid systems considered are hydraulic oil, lubricating oil, and water. The objectives are to give early warning of wear or imminent breakdown in hydraulic or lubricating systems, as well as pollution abatement. The method of investigation involves an on-line transducer emitting ultrasonic, high frequency pulses.

The results of the experiments are positive at present; however, the data as collected so far have not been shown to lead to size and distribution of size quantitatively. It is anticipated through the proper experimental design that this information and more can be obtained.

Laser Damage Effects

RESEARCHER: PROFESSOR CHARLES W. RECTOR
SPONSOR: NAVAL RESEARCH LABORATORY

The researcher incorporated a keyed bibliography on the general topic of laser effects into a computer data base in such a fashion as to be able to access it via keywords, titles, authors, etc. He served as a consultant on special projects in the field to the project manager.

Stressed-Induced Magnetization

RESEARCHER: PROFESSOR CARL S. SCHNEIDER
SPONSOR: ADMIRALTY UNDERWATER WEAPONS ESTABLISHMENT (AUWE), PORTLAND, DORSET, ENGLAND

The Academic Year 1982-1983 was spent at AUWE as Visiting Research Fellow pursuing research on magnetoelastic modelling and studying application of the non-uniaxial stress effect theory to rare earths.

Study of Defects in III-V Semiconductors

RESEARCHER: PROFESSOR ROBERT N. SHELBY
SPONSOR: NAVAL RESEARCH LABORATORY

Studies of native and radiation-induced defects in III-V semiconductors with R. Magno were continued at the Naval Research Laboratory. Measurements on the conduction properties of MBE GaAs and MBE GaAs—GaAlAs modulation doped and heterojunction devices were begun.

There was also a continuation of work on radiation-induced upsets of Josephson function devices.

Nonlinear Optics

RESEARCHER: ASSOCIATE PROFESSOR LAWRENCE L. TANKERSLEY
SPONSOR: NAVAL RESEARCH LABORATORY

Work continued at Naval Research Laboratory (NRL) on the development of a tunable vacuum ultraviolet (VUV) light source for spectroscopic studies. The sources were driven by radiation from rare-gas halide lasers. This pump radiation was harmonically converted to the VUV by nonlinear interactions in a noble gas. During the fall the researcher achieved the first conversion of a NeF laser to the third harmonic. This result was reported at the Lake Tahoe Topical Meeting on Eximer Lasers. An eximer-pumped dye laser was constructed for use on frequency mixing experiments to develop a broadly tunable VUV source. Several other pieces of apparatus, including a phase matching chamber, an absorption cell, and an ionization detector were fabricated. The new equipment is used to study the role of the xeon dimer in limiting the conversion efficiencies of non-linear processes in the VUV. This research effort is expected to continue for several years.

The Determination of Individual Colors and Magnitudes of Eclipsing Binary Systems

RESEARCHER: MIDSHIPMAN 1/C ROBERT M. CAMPBELL
ADVISER: PROFESSOR GRAHAM D. GUTSCHE
SPONSOR: TRIDENT SCHOLAR PROGRAM

Binary Star systems (two stars gravitationally bound to each other) have long held a position of importance to astronomers, since their pronounced interactions reveal much about the component stars' nature and functioning. This study determined the color and magnitude of individual stars of such systems, which will in turn give information concerning the stars' surface temperature, luminosity, and position on its evolutionary path. Observations were made with the U. S. Naval Academy sixteen-inch telescope, outfitted with a photoelectric photometer and filter system. The preliminary data so obtained was then reduced to correct for interstellar absorption, instrumental idiosyncracies, etc. so as to conform to a standard system of colors. Analysis was then made to correlate the type of binary system observed with its position on the evolutionary track.

Propeller Cavitation Noise Study

RESEARCHER: MIDSHIPMAN 1/C DANIEL N. DIXON
ADVISER: VISITING RESEARCH PROFESSOR ROBERT L. JENNETTE
SPONSOR: TRIDENT SCHOLAR PROGRAM

To gain an understanding of ambient noise in the oceans today, the characteristics of merchant vessel acoustic spectra must be determined. The major source of acoustic intensity emanating from a merchant vessel is the propeller noise. Data was gathered from a stationary cavitating vessel to determine exactly how much of the far-field spectra was propeller dominated. Digital signal processing techniques along with the coherence function were applied to the gathered data to eliminate problems such as propagation delay and shallow water effects. The coherence function displayed unexpected results concerning the dominant source of merchant vessel source levels.

Optical Excitation of Trapping States in Fe Doped INP

RESEARCHER: MIDSHIPMAN 1/C JOHN B. GIESSNER
ADVISER: PROFESSOR ROBERT N. SHELBY
SPONSOR: TRIDENT SCHOLAR PROGRAM

The knowledge that defect states affect the performance and speed of semiconductors is well known. Defect and trapping states are categorized according to their sex (hole or electron trap), energy in the gap, and capture cross-sections. The Deep Level Transient Spectroscopy (DLTS) technique that is useful for electrical pulsing becomes increasingly profitable using optical pulsing. The optical pulsing was accomplished using a simple, but efficient, infrared light emitting diode (LED). The LED had the fortunate property that with the decreasing temperature, the average energy output of the LED stayed about equal to the bandgap for the III-V semiconductor InP. Because of these fortuitous findings, the researcher concentrated on Fe-doped InP using LED excitation. These particular samples are being studied by Naval Research Laboratory (NRL) in connection with lasing that results from Fe transitions. Models for both the p + n junction and Fe transition were set up to help explain experimental results obtained. A coupled state that could be related to Fe + 3 to Fe + 2 hole emission was found to have an energy of .24ev on the n side of the metal-p + rectifying junction (a result proposed in the capacitance-junction model). Another energy related to the Fe + 2 to Fe + 3 electron emission was found in agreement with the model (e_n = .807ev). Trap states related to defects inherent in the growth of InP were also found. Many of the states seen by authors recently could be explained by the energy data in these experiments.

A Course in Modern Physics Presented on the Terak Microcomputer

RESEARCHER: PROFESSORS BILLIE J. GRAHAM AND GRAHAM D. GUTSCHE
SPONSOR: INSTRUCTIONAL DEVELOPMENT PROGRAM

An entire course in Modern Physics is being developed so that it can pretty much stand alone on the Terak Microcomputer. The course is divided into six segments, and the instructional media being prepared include:

a. Forty to fifty half-hour classroom type video tapes covering the concepts studied in Modern Physics. The Terak screen can be used to show the tapes, and the computer will control the tapes as they are being used.
b. Twelve computer-generated and managed problem sets (two for each segment).
c. Ten computer generated graphics presentations of some of the concepts of modern physics which can be enhanced by computer graphics and student interactions.
d. A traditional text in Modern Physics will also be used in the course.

Once the course is fully developed, it is planned that one instructor can manage four to six sections of SP301, Modern Physics, including personal extra instruction if it is required.

Independent Research

Soliton Dynamics By A Convergent Iteration Scheme

RESEARCHER: ASSISTANT PROFESSOR ACHIM W. WEIDEMANN

A (1 + 1)-dimensional model with two different sine-gordon fields coupled by a perturbing term was considered. Besides the usual sine-Gordon solitons, which also occur in the absence of coupling, the existence of a 'diagonal' solution using the implicit function theorem for Banach spaces after projecting out the 'translation mode' (Lyapunov-Schmidt method) was established. The implicit function theorem leads to an iteration scheme for the construction of this solution. For a typical interaction, the lowest order perturbation and energy shift was analytically calculated. The techniques developed here are made of a broad class of soliton problems beyond the model considered.

Quantum Fields in a 'Lorentz Basis'

RESEARCHER: ASSISTANT PROFESSOR ACHIM W. WEIDEMANN

A basis in the representation space of the irreducible unitary representations of the homogeneous Lorentz group ("Lorentz basis") and its relations to the commonly used representation of the inhomogeneous Lorentz group are explained. Quantum fields of any spin are expanded in terms of the (spinor) coefficients relating these two bases; their transformation properties under Lorentz transformations, T, C, and P are given. The correct spin-statics relations are found from (anti-) commutators of the field components. The relation between co- and contravariant field components yields a Dirac equation for any spin.

Research Course Projects

Computer Voice Analysis

RESEARCHER: MIDSHIPMAN 1 C MICHAEL D. BOEHET
ADVISER: PROFESSOR SAMUEL A. ELDER

The purpose of the project was to develop a computer system for analysis of the human voice. The specific objectives were to find and study characteristics that allow both word recognition and speaker identification. It was planned to use the Acoustics Laboratory PDP8-I computer and an SC-01 speech synthesizer, as well as the Naval Academy Time Sharing facility.

Digital analysis was performed on the eleven basic vowel sounds to find a means of achieving continuous phoneme recognition. Both time and frequency representation were explored. A successful realtime technique was developed, based on a logarithmic display of each phoneme in frequency space.

A Multi-Channel Astronomical Photometer

RESEARCHER: MIDSHIPMAN 1 C. KYLE D. CARR
ADVISER: PROFESSOR GRAHAM D. GUTSCHE

It is advantageous to be able to do photometric studies of a star in several spectral bands simultaneously rather than sequentially so as to eliminate any changes in the atmosphere and other seeing conditions from affecting the results. To accomplish this, a detector has been designed to fit into the focal plane of the U. S. Naval Academy Meinel astronomical spectrograph to provide three-channel operation. By choice of the spectral region to be observed, the detector can then provide standard U-B-V, B-V-R, or V-R-I magnitude measurements. The detectors are Si photodiodes, coupled to aluminized, parabolic light pipes. A prototype instrument has been constructed and some preliminary measurements have been made, suggesting a few modifications that should be made before proceeding further.

Design of an On-Board Computer System for the Tris Experiment

RESEARCHER: MIDSHIPMAN 1 C. AARON L. GRAY, III
ADVISER: ASSISTANT PROFESSOR FRANCIS D. CORBETT

This project was performed in support of the U. S. Naval Academy National Research Laboratory space-shuttle experiment TRIS (Trapped Ions in Space). Its objective was to explore design possibilities for an on-board microprocessor controller for the experiment.

The TRIS payload will contain a motor-driven, rotating, five-sided cylinder on which stacks of plastic track detector will be mounted in order to record the impact of energetic heavy ions. A microprocessor is needed to control the rotation of this cylinder, so that different stacks can be exposed during different portions of the spacecraft's orbit.

A 16-bit single-board microcomputer (TI990/101M) was chosen for this design project because it is compact and relatively easy to interface and because considerable expertise in its use exists at the Naval Academy. During the course of the project several machine-language programs were written to enable the computer to sense the current position of the cylinder and control its rotation to the desired position via a parallel I/O port and relay drivers. A simple shaft encoder and driver circuit were built and tested. The project was only a partial success because although the programs apparently performed as intended, hardware interfacing problems prevented the motor driver from working reliably.

Future efforts on this project should include the development of improved interface circuitry, as well as the development of a high-level language capability that would permit software design to proceed more rapidly

Structural Analysis of the Tris Payload

RESEARCHER: MIDSHIPMAN 2/C CHARLES W. MARTINE, JR.
ADVISER: ASSISTANT PROFESSOR FRANCIS D. CORBETT

This project was performed in support of the U. S. Naval Academy National Research Laboratory space-shuttle experiment, TRIS (Trapped Ions in Space). Its objective was to perform a computer-assisted structural analysis of a portion of the payload, using the GIFTS (Graphics-oriented Interactive Finite-element Time Sharing) system on Naval Academy Time Sharing.

Following the discovery of software errors in an earlier effort using GIFTS version 5.06, the Computing Center implemented GIFTS version 5.07, an improved version of the system. This version was pronounced up-and-running early in the semester. Attempting to model the TRIS cannister lid, a circular plate with a thin plastic window supported by a grid structure, soon revealed numerous flaws in the system. In fact, it was discovered that this TRIS analysis was the first test run of the new system. By the end of the semester, the lid had been successfully modelled, but the system modules necessary for the structural analysis were not yet running properly. A less sophisticated hand analysis of the cannister lid was then performed, so that construction plans could proceed.

The Computing Center is attempting to solve the problems associated with GIFTS 5.07, and as soon as the modules are running properly, the analysis will continue. It is hoped that the analysis can be completed by the end of the summer.

Magnitudes and Colors of Galaxies at High Redshift

RESEARCHER: MIDSHIPMAN 1/C PAUL SHANKLAND
ADVISER: ASSISTANT PROFESSOR C. ELISE ALBERT

The goal of this project was to develop a computer code to predict the magnitudes and colors that well-studied nearby galaxies of known morphological type would exhibit at increasing redshift. Such information is necessary to investigate both galaxy evolution and various cosmological models. The project consisted of three phases:

First, a detailed background study was made of the measurement of magnitudes and colors and the distribution and evolution of stars in the spheroidal and disk components of our own galaxy. The second, and primary, phase was the development and testing of a computer code to calculate the "K-correction", the magnitude difference between a redshifted and a non-redshifted flux distribution when observed through a fixed spectral interval. For a given flux distribution, the "K-correction" is computed in each of four bandpasses (ultraviolet, blue, visible, red) for a galaxy "placed" at redshifts increasing in increments of 0.1 from 0.0 to 3.0. The final phase of this project then involves the application of the program to nearby galaxies. New high-resolution for ultraviolet flux distributions from the International Ultraviolet Explorer satellite were obtained for several galaxies and digitized to produce initial data files, and a literature search was conducted to select the most useful wavelength sensitivity function for each bandpass. The k-corrections have been computed successfully for test data and the researcher plans to extend this study to numerous galaxies of varying type during the summer of 1983.

Reconditioning of a 400-keV Van De Graaff Accelerator

RESEARCHER: MIDSHIPMAN 2/C DAVID W. STEVENS
ADVISER: ASSISTANT PROFESSOR FRANCIS D. CORBETT

The goal of this project was to recondition a 400-keV Van de Graaff accelerator obtained through excess property channels and intended for eventual use in several courses and in midshipman faculty research. Prior to the beginning of this project, most of the damaged components of the accelerator had been repaired or replaced, and awaited testing, some fine finish work, and assembly. Efforts in this project concentrated on the vacuum and high-voltage systems of the accelerator.

The vacuum system, which consisted of an oil diffusion pump, rotary mechanical pump, and several valves and gauges, was assembled, leak tested, and eventually made to operate properly, producing an ultimate vacuum in the range 4×10^{-6} Torr.

The high voltage system consisted of a 20-kV DC supply, an insulating, moving belt which carries charge to the high voltage terminal of the accelerator, an insulated column which supports the terminal, and an evacuated accelerating tube through which the

beam particles pass. The entire system is enclosed in a pressure vessel containing N_2 and CO_2 gas at 100 psi to minimize sparking. As part of this project, the 20-kV supply was rebuilt, the column and terminal were cleaned and polished to reduce corona discharge, and the system was assembled. The voltage on the terminal is determined by measuring the current passing through a calibrated resistor string, and the values of these resistors were measured using a special fixture that was designed and built for the purpose. Once the system was completed, terminal voltages in excess of 575 kV were obtained.

This project concluded with the successful operation of the vacuum and high-voltage systems. Additional work is needed on the ion-beam-forming systems before the accelerator is fully operational.

AD-A140 059 SUMMARY OF RESEARCH ACADEMIC DEPARTMENTS 1982-1983(U) 3/3
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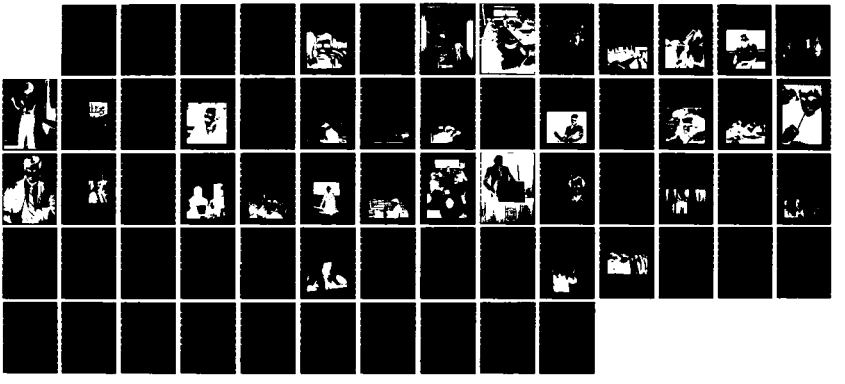

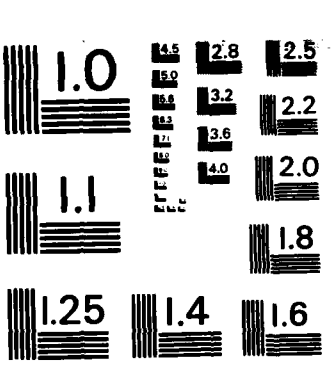

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Publications

ALBERT, C. Elise, Assistant Professor, co-author, "**Some Properties of the Centers of cD Galaxies**," *Publications of the Astronomical Society of the Pacific*, 94 (December 1982), 887-890.

Large-scale images of the cores of supergiant galaxies, obtained with the Yerkes Observatory 1 meter f/19 telescope, have been compared with those of associated giant galaxies in terms of apparent central surface brightness and the frequency of close companions. These observations are of interest for constraining models for the origin and evolution of cD galaxies.

ALBERT, C. Elise, Assistant Professor, co-author, "**On the Distribution of Interstellar Gas in the Galactic Halo**," *The Astrophysical Journal*, 263 (December 15, 1982), 690-695.

New and existing observations of 21-cm emission lines toward 10 distant, high-latitude OB stars are combined with existing observations of interstellar L_α absorption lines, in order to determine the ratio, N_{21}/N_α, of the two different column densities of HI. This ratio, which is related to the fraction of the cool, neutral gas in the halo that lies beyond each star, decreases smoothly to about unity with increasing distance from the galactic plane. The column density of neutral gas beyond about 1 kiloparsec can be as much as one-third of the total above the plane, but only relatively small amounts of such gas lie more than 2 kilparsecs from the plane. The distances to, and the possible birthplaces of, these population I stars in the halo are discussed.

BRILL, Donald W., Professor, co-author, "**Acoustic Spectroscopy**," *Journal of Acoustical Society of America*, (September 1982), 1067-1069.

An acoustic target may be characterized by the frequency spectrum of its eigenvibrations as to size, shape, and composition. Resonance effects corresponding to acoustic excitation of the eigenvibrations, which are contained in the backscattered echoes from the target, can be used for target identification purposes. We here study the dependence of the resonance spectra of fluid targets in vacuo (or in a tenuous ambient fluid) on target shape, in order to illustrate this approach, presenting the eigenfrequency spectra in the form of "level schemes" as in atomic spectroscopy, and hereby introducing the concept of "acoustic spectroscopy."

CORRELL, Francis D., Assistant Professor, co-author, "**The ^{4}He($\vec{d}$, αp)n Reaction at 12 and 17 MeV**," *Nuclear Physics*, A397 (1983), 205-224.

The cross section and analyzing powers A_y, A_{yy}, and A_{xx} for the reaction ^{4}He($\vec{d}$, αp)n are studied with kinematically complete measurements at incident energies of 12 and 17 MeV. Spectral features due to final-state interactions and quasifree scattering are measured. A three-body model of the Faddeev type gives a satisfactory fit to the cross-section and A_y data, but it fails to fit adequately the tensor analyzing-power data. The tensor analyzing powers in the breakup process should be sensitive to the input two-body force, and that sensitivity seems to be somewhat greater near the three-body 1^+ resonance.

CORRELL, Francis D., Assistant Professor, co-author, "**Special Features of the Alpha-Induced Deuteron Breakup**," IEEE Transactions on Nuclear Science, NS-30(1983), 1146-1148.

The alpha-induced deuteron breakup reactions have been of interest since the nucleon-induced deuteron breakup problem was addressed with tractable and predictive models based on the Faddeev formalism and with appropriate nucleon-nucleon forces. This paper discusses a few special features of the alpha-induced deuteron breakup reactions. Specifically, pointed out are the importance of the n-p tensor force in the predictions of the three-body model that fit the tensor analyzing powers better and the concomitant deterioration of the fit to the vector analyzing power caused by the inclusion of the tensor force. It is suggested that there exists evidence for the ^{1}SO n-p interaction, which isospin forbidden, in both the cross section and spin observables data. Finally, certain characteristics of the p-α quasifree-scattering and n-α final-state-interaction processes are discussed.

CORRELL, Francis D., Assistant Professor, co-author, "**Elastic Scattering of Polarized Tritons from A = 26-28 Nuclei at 17 MeV**," *Physical Review*, C26 (1982), 369-378.

Differential cross sections and analyzing powers for elastic scattering of 17-MeV polarized tritons from ^{26}Mg, ^{27}Al, and ^{28}Si were measured in the angular range 20° to 160°. Significant target dependence of the analyzing power was observed, and reaction mechanisms other than shape-elastic scattering appear to contribute at large scattering angles. An optical-model analysis of these data was carried out to determine potential parameters that fit both observables simultaneously. The central potentials are reasonably well defined by the data, but strong absorption limits the ability to determine reliably the parameters of the spin-orbit potential; at the present low triton energy, the scattering appears to be sensitive predominantly to the spin-orbit strength in the outer surface region of the nucleus.

CORRELL, Francis D., Assistant Professor, co-author, "**The Interaction of Polarized Tritons with ^{32}S**," *Nuclear Physics*, A388 (1982), 542-562.

Cross sections and analyzing powers have been measured for the elastic and inelastic scattering of tritons from ^{32}S, along with the ^{32}S(t, α)^{31}p reaction data, using the 17 MeV polarized triton beam available at the Los Alamos National Laboratory. An optical model analysis of the elastic scattering data has yielded a spin-orbit potential with an unconventional geometry. The inelastic analyzing powers have shown a requirement for including the deformation of the spin-orbit potential in the coupling potential form factor. The (t, α) reaction data have been analyzed using the zero-range DWBA. Certain features of this reaction data which could not be described by the DWBA are well predicted when the analysis is extended to include explicitly the inelastic couplings and two-step processes through a CCBA calculation.

ELDER, Samuel A., Professor, co-author, "**Mechanisms of Flow-Excited Cavity Tones at Low Mach Number**," *Journal of the Acoustical Society of America*, 72 (August 1982), 532-540.

Cavity tone spectra have been investigated as a function of wind speed in a low noise wind tunnel, at Mach numbers below 0.2. The cavity, a cylindrical closed pipe with a rectangular slot for a mouth opening, was flush mounted in the side of a flat plate, 30-in. downstream of the leading edge. Both laminar and (tripped) turbulent boundary layer fluctuations, acoustic background noise, sheartone feedback coupling, and cavity resonant feedback coupling are quantitatively sorted out on the basis of theoretical models. A theory of laminar pipetones, complementing an earlier model of turbulent pipetones, is used as a basis for explaining sheartone pipetone interaction. An empirical correction curve is introduced to take into account the slowing of wave speed in thick shear layers.

ELDER, Samuel A., Professor, and Bruce JOHNSON, Professor (Naval Systems Engineering), "**Towed-Model Apparatus for Investigating Underwater Cavity Tones**" *Journal of the Acoustical Society of America*, 72 (April 1983), S56.

The problem of steady tones generated by flow over a rectangular cavity in a flat plate with a sharp leading edge has been studied previously in air, utilizing a *low-noise wind tunnel. Three tone mechanisms* already identified are cavity resonance feedback, edge-force feedback, and cavity turbulence response, the resonance effect being predominant in air. To isolate edge-force effects, new studies are being done underwater where cavity resonance is less pronounced. The towed model system was chosen over the continuous water tunnel, on account of large background noise associated with the latter. Fiberglass model is fabricated into thin fairwater structure designed for good towing stability. Though possessing slight convex curvature, the vertical fairwater approximates a flat plate with 9° angle of attack. Cavity instrumentation includes fixed hydrophone for sound detection and motor-driven hot film probe for velocity profile surveys. Preliminary results are compared with similarity predictions from air data.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Computer Modelling of Simple Point Defects in Rare-earth Doped Alkaline Earth Fluorides**," *Journal of Physics C: Solid State Physics*, 15 (1982), 3441-3453.

The results of a package of FORTRAN computer programs for modelling defects in ionic crystals and for fitting experimental data are described. The fundamental concept of the defect simulation is similar to HADES except that the minimization procedure is different since the package is designed to run on small computers. As an example of the use of this package, the relative stabilities of NN and NNN complexes for various rare earths, lanthanum and yttrium are considered. First, the data-filling routine was used to analyze relaxation data for NN and NNN complexes in rare-earth-doped strontium fluoride. The experimental results for strontium fluoride were then used in conjunction with the defect-simulation program to determine potentials for all of the rare earths, yttrium and lanthanum. Those rare-earth potentials were then used in the simulation of calcium fluoride and show that the NNN complex should not be observable except for possibly the smallest rare earths. This implies that the B site of Wright and co-workers or the RII relaxation requires another explanation. Also, the potentials were used in the simulation of barium fluoride, showing that the NN complex should be observable only for the largest rare earths or lanthanum. Next, the enthalpy for NN−NN reorientation via the interstitialcy mechanism was calculated for rare earths in calcium and strontium fluoride. In general, the calculated reorientation enthalpies are larger than the experimental values. However, the variation of the enthalpy with the size of the rare earth is in reasonable agreement with experiment. Finally, the variation of the calculated enthalpy with pressure is found to be in excellent agreement with experiment.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Dielectric Spectroscopy in Rare Earth Doped Lead Fluoride**," *Solid State Chemistry*, 1982, Eds. R. Metselaar, H.J.M. Heijligers and J. Schoonman, Amsterdam: Elsevier Scientific Publishing Co., 1983.

Audio frequency complex impedance measurements have been performed over the temperature range 5.5-380K for lead fluoride doped with nine different rare earths, yttrium and lanthanum. A single relaxation is found for rare earths larger than gadolinium. That relaxation is tentatively assigned to jumps of a nearest neighbor interstitial fluorine charge compensator between equivalent sites. However, the activation enthalpy depends strongly upon the nature of the rare earth in contrast to the alkaline earth fluorides.

For rare earths smaller than gadolinium, the dielectric spectrum is quite complex with up to eight relaxations being observed. The relaxations are attributed to both simple sites and clusters on the basis of the dependence of peak heights on the dopant concentration. The spectra showed marked differences from those observed in the alkaline earth fluorides.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Electrical Properties of the Fast Ion Conductor Lanthanum Dluoride**," *Journal of Physics C: Solid State Physics* 15 (1982), 7215-7228.

Audio-frequency complex impedance measurements have been performed on pure and alkaline earth doped lanthanum trifluoride at zero pressure over the temperature range 5.5-310K and at pressures up to 0.3 GPa in the vicinity of room temperature. Studies have been made both parallel and perpendicular to the optical axis. The real part of the dielectric constant is found to be given by a $\epsilon' = 12.6$ and $\epsilon_{\perp} = 14.4$ and both components increase slightly with temperature.

Also, for the calcium-doped material, four relaxations have been observed. The activation enthalpy for the principal relaxation is close to that for the motion of free vacancies and thus is attributable to the reorientation of a bound vacancy. In addition, the anisotropy ratio for the relaxation is found to be A A = 1.8, which is opposite to the anisotropy observed for DC conductivity. An explanation of the anisotropy ratio is discussed. The remaining relaxations are tentatively attributed to other jumps of bound vacancies.

Finally, the pressure-dependent conductivity has been measured in the association region, yielding an activation volume of about 2.4 $cm^3\ mol^{-1}$. The value parallel to the optical axis is slightly larger than that perpendicular to the optical axis. In addition, the thermal expansion coefficient of the activation volume is found to be negative. The value of 2.4 $cm^3\ mol^{-1}$ is interpreted to be the activation volume for the motion of vacancies.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**The Effect of Pressure on the Ionic Conductivity in PEO-$LiC10_4$**," *1982 Annual Report of the Conference on Electrical Insulation and Dielectric Phenomena*, New York: IEEE Publishing, pp. 134-139.

Audio frequency complex impedance measurements have been performed at zero pressure from 5.5-380K and at pressures up to 0.2 GPa at 320K for various samples of PEO-LiC10. Four different regions are observed in the imaginary part of the dielectric constants including electrode effects, DC conductivity, and relaxations. An activation volume is calculated from the effect of pressure on the DC conductivity. The activation volume is in good agreement with the predication of a dynamical diffusion model. Both the present results for lithium motion and previous work for sodium motion are consistent with an intrahelical jumping process.

MORGAN, Bruce H., Associate Professor, "**Polarization Effects with Pendulums**," *The Physics Teacher*, 20 (November 1982), 541-542.

This note describes a lecture demonstration apparatus which employs two pendulums attached to threads which cross orthogonally over the stage of an overhead projector where they are bonded together with a drop of glue. The other end of each string is attached to a light spring which is in turn attached to a fixed support. The purpose is to demonstrate effects observed with polarized light, including circular and elliptical polarization, as traced on the viewing screen by the moving dot-like projection of the drop of glue. Many citations describing earlier ways of performing similar demonstrations are given.

Presentations

ALBERT, C. Elise, Assistant Professor, "**Neutral Interstellar Gas in the Lower Galactic Halo**," American Astronomical Society, Boston, Massachusetts, 10 January 1983.

ALBERT, C. Elise, Assistant Professor, "**Neutral Interstellar Gv in the Galactic Halo**," Washington Neighborhood Astronomers' Meeting, College Park, Maryland, 15 March 1983.

BRILL, Donald W., Professor, co-author, "**Sonar Target-Identification by Mean of an Acoustic Spectroscopy Scheme**," Oceans' 82 Conference and Exhibition, Washington, D.C., 21 September 1982.

ELDER, Samuel A., Professor, and Bruce JOHNSON, Professor (Naval Systems Engineering), "**Towed-Model Apparatus for Investigating Underwater Cavity Tones**," Meeting of the Acoustical Society of America, Cincinnati, Ohio, 12 May 1983.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, co-authors, "**Electrical Relaxation in Rare Doped Cubic Lead Fluoride**," Fourth Europhysical Topical Conference on Lattice Defects in Ionic Crystals, Dublin, Ireland, 30 August-3 September 1982.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**The Effect of Pressure on the Ionic Conductivity in PEO-$LiC10_4$**," Conference on Electrical Insulation and Bielectric Phenomena, Buck Hill Falls, Pennsylvania, 17-21 October 1982.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Electrical Relaxation in PEO-complexed with Lithium and Sodium Perchlorate**," 1983 March Meeting of the American Physics Society, Los Angeles, 21-25 March 1983.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Effect of Pressure on Electrical Conductivity in Poly(ethylene exide) Complexed with Alkali Metal Salts**," 1983 March Meeting of the American Physical Society, Los Angeles, 21-25 March 1983.

FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, and Peter J. WELCHER, Assistant Professor, "**Computer Modelling of Activation Enthalpies in Strontium Fluoride**," 1983 March Meeting of the American Physical Society, Los Angeles, 21-25 March 1983.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "**Electrical Relaxation in PEO Complexed with Calcium and Barium Thiocyanate**," 1983 March Meeting of the American Physical Society, Los Angeles, 21-25 March 1983.

FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, et al, "**Radiation Induced Electrical Relaxation in Rare Earth Doped Calcium Fluoride**," Radiation Effects in Insulators-1983, Albuquerque, New Mexico, 30 May-3 June 1983.

GRAHAM, Billie J., Professor, "**Applications of Solar Energy to Continuous Belt Dehydration**," Distributed Solar Energy Collector Summary Conference, Albuquerque, New Mexico, 17 March 1983.

TANKERSLEY, Lawrence L., Associate Professor, co-author, "**Third-Harmonic Conversion of XeF Laser Radiation**," Winter '83 Topical Meeting on Eximer Lasers, Lake Tahoe, Nevada, 10 January 1983.

WEIDEMANN, Achim W., Assistant Professor, "**A Convergent Iteration Scheme for Soliton Dynamics**," Meeting of the Division of Particles and Fields, American Physical Society, University of Maryland, College Park, Maryland, 28 October 1982.

WINTERSGILL, Mary C., Assistant Professor, "**Ion Implantation in Polymers**," Radiation Effect in Insulators-1983, Albuquerque, New Mexico, 30 May-3 June 1983.

Division of Professional Development

DEPARTMENT OF

Leadership and Law

COMMANDER JULIUS B. DELL, USN
CHAIRMAN

Members of the Leadership and Law Department conduct applied research in support of institutional objectives. In the main, this research is directed toward midshipmen professional development. It also supports program development and validation in areas such as the integration of women and officer career development.

Independent Research

Algorithmic Thinking for the Undergraduate

RESEARCHER: ASSOCIATE PROFESSOR PATRICK R. HARRISON

This research uses PASCAL structures to build algorithms for structuring technical problems to produce more efficient learning. The initial research is aimed at the non-technical major. Complexity analysis is used to evaluate these algorithms. The assumption is made that the complexity of a problem includes both inherent complexity and complexity as a function of the algorithm the student uses to structure it. By reducing complexity in the later case, more efficient learning can be promoted. The research has implications for a variety of educational and engineering applications.

Improving Midshipman Academic Performance

RESEARCHER: ASSOCIATE PROFESSOR KAREL MONTOR, LIEUTENANT COMMANDERS , USN, CHARLES OLSEN, J. E. SMITH; LIEUTENANTS, USN, JACK DALRYMPLE, WALTER EASTON, THOMAS HUTCHINSON, MICHAEL O'DONNELL, ROBERT PRODOEHL, JOHN H. WATTERS; AND CAPTAIN EDMUND EATON, USMC.

Approximately 160 Fourth Classmen and 75 Third Classmen were selected to participate in a special program to monitor their academic progress and involve them in video and computer instruction along with officer counseling. Past expectations on these midshipmen would have been that all would have gone to the Academic Board. As a result of this program, only 15% of the plebes had to appear and 29% of the youngsters. Of those that did not have to appear before the Academic Board, 35 were told to increase their QPR above 2.00 by 8 weeks or face discharge. These 35 were given special counseling, and only five had to go before the Board.

Of the 114 midshipmen who appeared before the January 1983 Academic Board and were put in to the monitor program only 22 had to return to the Board in May 1983, for a percentage recall of 19%. Specific statistics are as follows: 1983 1 of 11 = 9%; 1984 3 of 51 = 6%; 1985 5 of 16 = 31%; and 1986 13 of 36 = 19%.

Publications

MONTOR, Karel, "**Measuring Whether Effective Communications Exists Within an Organization by Evaluation of the Indicators of Good and Bad Communications as they Affect Mission Accomplishment and Morale**," *The Communicator*, 7(Summer 1982), 3.

A flow-chart was presented to provide stand-alone procedures for unit and organizational commanders to determine whether effective communications exist in either their existing organization and/or in the command that they take over.

Presentations

MONTOR, Karel, Associate Professor, et al., "**A Myopia Avoidance Effort**," Fourth Annual Conference of the Engineering in Medicine and Biology Society, Philadelphia, 20 September 1982.

MONTOR, Karel, Associate Professor, "**Directions in Social Science Research and Education within the Defense Establishment**," 50th Military Operations Research Society Symposium, Annapolis, 10 March 1983.

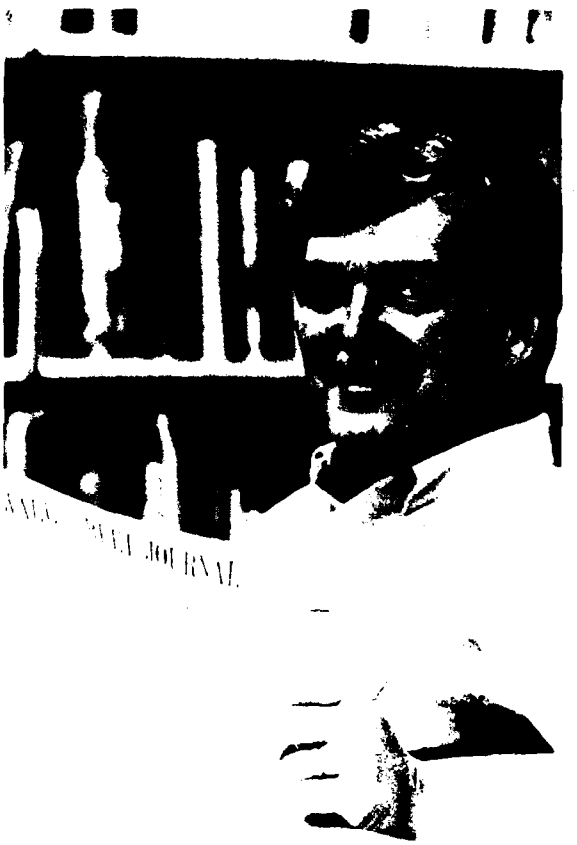
MONTOR, Karel, Associate Professor, "**Thoughts on Leadership and Success**," Annual Conference of the Chesapeake Regional Association of Student Counsels, Pasadena, Maryland, 19 April 1983.

DEPARTMENT OF

Economics

PROFESSOR ROGER D. LITTLE
CHAIRMAN

During the last year the Economics Department has pursued initiatives begun in the recent past to further defense-related research. We are investigating, with the help of the Academic Dean's office and the Naval Academy Alumni Association, the possibility of establishing an institute for defense economics. Among the purposes of the institute are fostering applied research in defense economics by visiting teaching and research faculty, hosting small workshops, and sponsoring larger conferences. A concrete step toward this last goal is a conference the Naval Academy will co-sponsor in the fall of 1983 with the office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) titled "The All-Volunteer Force After a Decade: Retrospect and Prospect." This year we were fortunate to attract C. Duncan MacRae, an internationally known economist, whose specialties include international trade and finance as well as urban economics.



Desirous of making the most of our proximity to Washington, D. C., two faculty members spent the last year on leave of absence from the Academy to serve in research/policy-making positions in the federal government. Associate Professor Arthur Gibb worked at the Agency for International Development while Assistant Professor Thomas Zak was at the Federal Trade Commission.

These activities of Department faculty members, together with eight publications, three sponsored research projects, and numerous presentations during the last year, are evidence of a high level of research activity which portends increased scholarly activity in the years ahead.

Sponsored Research

Conversion and Documentation of Annualized Cost of Leaving Model

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM R. BOWMAN
SPONSOR: NAVAL POSTGRADUATE SCHOOL AND DEFENSE MANPOWER DATA CENTER

The researchers worked with the Naval Postgraduate School on a project sponsored by DMDC. Researchers were to validate all input data for the "Annualized Cost of Leaving" Model and provide necessary information to update data for future use. Another task was an evaluation of the accuracy of this model, which has become the major retention model for the U. S. Navy.

Microeconomics Via "CAVE"

RESEARCHERS: ASSOCIATE PROFESSOR RAE JEAN B. GOODMAN AND CAPTAIN E. P. MCLYMAN, USMC
SPONSOR: OFFICE OF THE ACADEMIC DEAN

Five CAVE programs were developed on the following topics: 1. Supply, Demand and Market Equilibrium, 2. Elasticity, 3. Supply and Demand Models, 4. Production Costs, and 5. Production and Revenue.

Completion of the topics listed above brings the total number of CAVE programs to eleven. The eleven programs were used in the Basic Economics course by two instructors (4 sections) this past academic year. One instructor used CAVE as a substitute for lectures; the second to supplement classroom instruction and for quizzing. The programs also have been used during summer school sessions.

A study comparing users and non-users of the CAVE programs concludes there is enhanced learning for users of CAVE. The result of the study was presented at the 1983 Small College Computing Symposium in Northfield, Minnesota, in March 1983.

Socio-Economic Characteristics of Recruits and Potential Recruits: Evidence from the National Longitudinal Survey Youth Cohort 1979-1980

RESEARCHERS: PROFESSOR ROGER D. LITTLE AND ASSOCIATE PROFESSOR J. ERIC FREDLAND
SPONSOR: OFFICE OF NAVAL RESEARCH

The objective is to use the second wave of the National Longitudinal Survey 1979 Youth Cohort to examine the socioeconomic characteristics of military recruits and potential recruits in comparison to their peers who have not joined the service and have expressed little interest in doing so. The work involves:

1. Identifying those too young to serve who have expressed intentions to serve and comparing their socioeconomic characteristics with those who have expressed no such intentions.

2. Attempting to develop statistical indicators of the likelihood that an individual will serve, based on previous expressions of intention to serve.

3. Examining prior civilian labor market experiences and schooling experiences of those who joined the service in 1980 to ascertain motives for joining the military.

The research methodology involves a variety of multivariate statistical techniques. Work is in progress. It will be completed by about 1 July 1983.

The Economics of Robotics in Aircraft Maintenance and Repair

RESEARCHER: PROFESSOR CLAIR E. MORRIS
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, CARDEROCK

This project, funded for the summer of 1982, was directed toward developing a theoretical basis for studying the use of robotics in naval aircraft maintenance and repair. The study identified the scope of repair tasks that might possibly be performed by robots, and then developed the kind of economic tools that could be used to make rational judgments, based on sound analysis. The analytical economic tools that were suggested had to be appropriately suited to the nature of the problem. An eight-page report documented the type of analysis that could be used, the kind of data needed, and the bibliography of methodological sources. Ultimately, an on-going cost benefit study will provide some insights into the feasibility of adopting robotic technology for this vital service activity.

Independent Research

The Incumbency Reinforcement Theory of Advertising and Profitability

RESEARCHER: INSTRUCTOR GERALD BERG

The theory of the effect of advertising on the economy is often based on the consumer's use of alternative information sources and the ability of advertising to reinforce past experience to engender brand loyalty. The theory is developed in some detail and tested empirically.

Economic Barriers to Lateral Entry: Phase II

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM R. BOWMAN

The researcher worked as principal investigator from September 1982 through January 1983 on a contract to develop civilian opportunity wages for Navy enlisted personnel in an all-volunteer force era. Econometric models were developed for use in predicting retention rates for junior service personnel.

Industrial Transition of Displaced Workers

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM R. BOWMAN

The researcher worked under contract to evaluate a job search program developed by investigations in 1981 for Crucible Steel Company. A proposal and evaluation questionnaire were developed under contract to the Potomac Institute for Economic Research, December 1982 through January 1983.

Effect of the Tax Equity and Fiscal Responsibility Act of 1982 on Savings and Loan Associations Tax Position

RESEARCHER: ASSOCIATE PROFESSOR RAE JEAN B. GOODMAN

The Tax Equity and Fiscal Responsibility Act of 1982 contained changes in the bad debt deduction for financial institutions. This paper investigates the effects of the changes for savings and loan's tax and income position for 1983 and 1984, using projections of income, deposits, and mortgages provided by the Federal Home Loan Bank Board. An alternative policy—mortgage interest tax credit—suggested by the President's Commission on Housing—is also included in the research.

The method of investigating is primarily simulation of the effects relative to the current tax system. The fundamental assumption made is that 1983 and 1984 are "normal" years.

Application of Nonmarket Valuation to Forest Planning in the White Mountains National Forest

RESEARCHER: ASSOCIATE PROFESSOR F. REED JOHNSON

This research combines data on visitor travel to and within the White Mountains National Forest in New Hampshire with physical-facilities data, conflicting-use data, and natural features to estimate the value of outdoor recreation. These values will be integrated into the existing forest planning process to determine the optimal mix of market and nonmarket outputs for the forest.

Data has been collected and edited. The bulk of the research will be done during the summer and consists primarily of demand modelling and regression estimation.

Application of Nonmarket Valuation to Marine Fishing in the Chesapeake Bay

RESEARCHER: ASSOCIATE PROFESSOR F. REED JOHNSON

This research involves merging data from the 1979 National Marine Fisheries Service Survey of Chesapeake Bay sites with physical water-quality data from the Environmental Protection Agency's Chesapeake Bay Project. The data will be used to estimate the effects of water quality variations on the economic value of recreational fishing on the bay. These will be refined this summer in addition to testing a discrete choice model on this data.

Interest on Bank Reserves

RESEARCHER: ASSOCIATE PROFESSOR A. ROYALL WHITAKER

Although interest on bank reserves has often been proposed, no one has ever noticed that it would lead to monetary growth. This project, begun in January of 1981, is at the stage of interest by the Chairman of House Banking Subcommittee and Milton Friedman. This past year has been spent convincing others of the theoretical soundness of the proposal, and devising ancillary accounting techniques.

Research Course Projects

Microeconomics and Reenlistment Behavior

RESEARCHER: MIDSHIPMAN 1/C HARRY P. DORMAN
ADVISER: PROFESSOR ROGER D. LITTLE

This project entailed the study of microeconomic theory at the graduate level and the subsequent use of this theory in practical problems dealing with cost-benefit analysis and the retention of Navy enlisted personnel. Working under the supervision of Commander Lee Mairs, USN, Director of OP162, Economic Analysis Branch of the Total Forces Information Systems Management Division, the project initially required the study of microeconomics at the level taught by Commander Mairs recently at the Naval Postgraduate School. Using this as the basis for practical research under the supervision of Dr. Wendell Waites, Commander Cummings Piatt, USN, and Mr. Steve Cylke, the theory and operation of the Navy's state-of-the-art computer model on enlistment retention, Annualized Cost of Leaving (ACOL) was addressed. One of the practical applications of cost-benefit analysis investigated through use of this model was the determination of the cost effectiveness of certain reenlistment bonuses as well as the appropriate levels of these bonuses for different ratings. The opportunity to discuss and investigate these problems under the tutelage of the Navy practitioners in the field was both stimulating and productive.

Air Pollution: Health Results and the Effects of Regulation

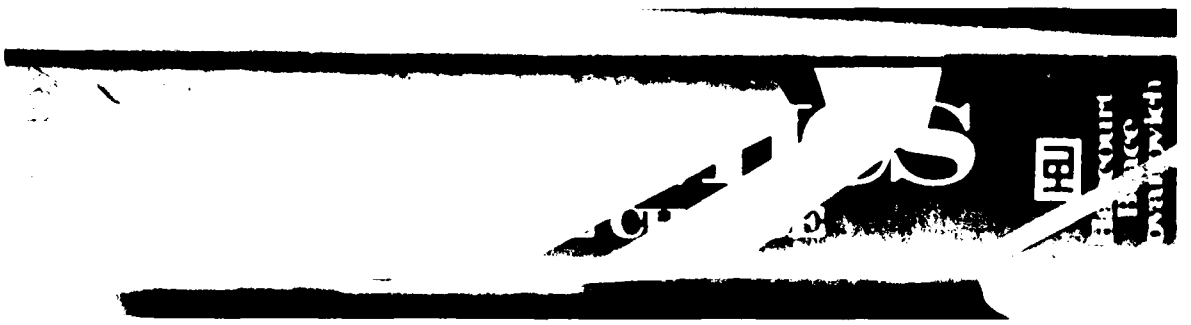
RESEARCHER: MIDSHIPMAN 1/C ARCHIBALD S. DUNN
ADVISER: ASSOCIATE PROFESSOR F. REED JOHNSON

There is an abundance of empirical evidence that indicates that a relationship between air pollution and health effects does in fact exist. The nature of the association, however, remains rather vague and is difficult to measure accurately in a direct manner. This difficulty in turn creates many problems for the formulation and administration of a proper air quality program.

Since there is no reliable dose-response formula to measure health reactions to specific concentrations of pollutants, it is hard to estimate who should be protected, and what level of ambient air-pollution-reduction provides an adequate safety margin. Thus policy must use current data on health reactions and a cost-effective approach in establishing some air quality standard.

The administration of an air quality program also has several difficulties. A decision must be made on how any reduction in pollution levels will be achieved, and who will pay for it. While Congress favors direct regulation with pollution-abatement equipment, other alternatives remain that may be more efficient.

To make some evaluation of a program's merits, it is necessary to estimate the value of the resulting benefits. This is particularly difficult for air quality benefits, because the value of decreased probability of illness is a somewhat nebulous concept to place monetary value upon. The method of risk analysis is a better tool for this estimation than either a willingness to pay or a human capital approach. Any method used will have some implicit restriction that does not capture the full benefits of a cleaner atmosphere.



An Analysis of Banking Deregulation

RESEARCHER: MIDSHIPMAN 1/C DWIGHT JENKINS
ADVISER: VISITING ASSISTANT PROFESSOR ROBERT PIROG

This study begins with a history of banking regulation. It includes problems arising from the absence of banks in colonial times, and from the First and Second Banks of the United States, the National Bank Acts of 1863 and 1864, and the Federal Reserve Act of 1913.

Next is a title-by-title explanation of the Depository Institutions Deregulation and Monetary Control Act of 1980, the most recent bank regulation act. Important provisions of this new law include the authorization of automatic transfer of funds, negotiable order of withdrawal (NOW) accounts, establishment of remote service units, and establishment of a universal level of reserve requirements for depository institutions.

The new law allowed banks to pay money-market rates to depositors nationwide, beginning in mid-December 1982. These new bank money-market accounts have proven to be extremely popular. By mid-April nearly $350 billion in deposits had gone into these new accounts. The money comes from a variety of sources: increased new savings, closing of old low interest accounts, and money-market mutual funds. One effect of this influx of money has been a rapid increase in the M-2 definition of the money supply. Another effect of the new accounts is the high cost of consumer credit. If banks must pay market interest rates, they also must charge them.

Taxpert: An Expert System

RESEARCHER: MIDSHIPMAN 1/C SCOTT MILLER
ADVISER: VISITING PROFESSOR C. DUNCAN MACRAE

This research studied the application of "expert systems" to taxation. It was hypothesized that one could develop and operate an expert system incorporating production rules and dealing with the Internal Revenue Code of 1954 (as amended through 1981) on the Naval Academy Time-Sharing System (NATS). Background research was conducted and a system, "BEAST," written in BASIC, was modified and brought up on NATS. From this initial work, it was determined that the BASIC language was not tailored as well for use with expert systems as certain other languages.

Two other languages were examined for possible use. After deciding in favor of "LISP," a new program was adapted and brought up on NATS, which incorporated as production rules various sections of the internal revenue code. Numerous modifications were made to the set of rules incorporated in the program as new ones were introduced. The program functioned properly and was able to analyze the data submitted. A continuation of this research could incorporate modifications of the existing rules and/or additional tax rules as necessitated by new tax laws or Internal Revenue Service decisions.

Military Manning Issues

RESEARCHER: MIDSHIPMAN 1/C DAVID T. PEARSON
ADVISER: PROFESSOR ROGER D. LITTLE

United States military manpower policy is crucial to national security, not only because the most important resource of any military organization is its people, but because conventional force strength is the key to deterring conflict in the nuclear age. Determining an appropriate policy requires not only that deterrence be considered, but the political, economic, and social factors as well. Perspectives on these issues are provided in *Manning the Modern Military*, *Paying the Modern Military*, and *Blacks in the Military*, all by Martin Binkin. To provide a balance, the recommendations of Robert McNamara, Charles Moskos, Henry Kissinger, and others are provided in the American Assembly's *Military Service in the United States*, and the Atlantic Council's *Toward a Consensus on Military Service*. In sum, the topic is timely, controversial, important, and demands analysis from many perspectives.

The ultimate criterion in evaluating alternate manning schemes is maximization of military effectiveness. With this goal in mind, the all volunteer force (AVF) and other manning policies are analyzed. It is concluded that the AVF is the best way to provide for the defense of the United States today. Trade-offs between secondary objectives will be present regardless of what policy is chosen. Two changes in the enlisted structure of the AVF would ease these trade-offs and improve the quality of the force. First, a modified military compensation system designed to bring wages more in line with skills and productivity should be adopted. Second, a two tiered pay system which distinguished between length of service and benefits received would provide the military with the quality, quantity, and experienced manpower it needs. Recognizing that these initiatives may fail to provide the voluntary active reserve forces necessary for adequate defense, it is clear that a strengthened reserve force and definitive provisions for a draft must be addressed simultaneously.

Expert Systems in Taxation

RESEARCHER: MIDSHIPMAN 1/C FRANK G. VERNET
ADVISER: VISITING PROFESSOR C. DUNCAN MACRAE

The topic of this independent research was the use of "expert systems" in economics. More specifically, it was the application of computer logic or deduction systems to the field of tax laws.

The initial step in the project was reconstructing and altering an already existing expert system written in BASIC language and incorporating tax laws from the 1982 Internal Revenue Service code book as a data base. It was possible to determine a person's tax liability using this expert system by answering "yes" or "no" to a series of computer generated questions. These questions were not "created" by the computer; they were actually antecedents to conclusions asked in question form by the computer. If all the antecedents to a conclusion were verified, the computer was then able to report it had "deduced" a certain conclusion. If all the antecedents were not verified, the computer reported it was unable to "deduce" a certain fact.

After the BASIC program was working satisfactorily, the researchers switched over to the same program written in LISP. This language is better suited to "expert systems," and is currently in use in other such systems. In this program it was possible to successfully incorporate NOT statements into the deduction process. For example, if the inquirer answered "No" to an antecedent question and consequently eliminated the conclusion the computer was looking to verify, it would store that fact and use it to verify another consequent. This had the effect of giving the computer the flexibility to jump from consequent (conclusion) to consequent. Additionally, it eliminated the need for asking the same question over again when trying to prove a new consequent. Using this new version, the same data base was incorporated in the expert system and was expanded to include new sections of the tax code.

This research project opened up and introduced a whole new field in computers and economics. This was something completely new to the researcher—very interesting and, at times, equally frustrating. Further work in this field would prove very beneficial as this is a new and untapped area of computer applicability and has tremendous potential for growth.

Depo-Provera: The Federal Drug Regulation Dilemma

RESEARCHER: MIDSHIPMAN 1 C CHARLES VOIGTSBERGER
ADVISER: PROFESSOR CLAIR E. MORRIS

There are many economists, and members of the drug industry, who contend that regulatory methods in the United States have impeded new drug marketing to the extent that the costs to society have far exceeded any intended benefits.

The Federal Drug Administration is under some political and social pressure to alter their evaluation process of new drugs. This is intended to speed up the introduction of new drugs into the market so that the people who may benefit from the new drugs will be able to use them, while at the same time it will insure a high degree of confidence that the efficacy and safety of their ingredients have not declined.

The purpose of this paper is to determine whether the costs of the regulatory process do exceed its benefits, the extent of the drug lag in the United States, and whether the drug evaluation process is changing to minimize this drug lag, and cost to society.

A brief history of drug regulation is presented in the paper, including the evolution into today's regulatory process. Studies of cost-benefit analysis of certain drugs are cited to test the contentions widely held. Also, comparisons are made between the United States and some European countries to show the magnitude of the drug lag. The current debate on the injectable contraceptive Depo-Provera is used as an example illustrating the current situation of regulation in the drug industry.

The conclusion is that the regulatory process of the drugs in the United States has impeded the introduction of new drugs and has raised costs well above the intended benefits. However, it is recognized that often political goals take precedence over those of economic efficiency. Another conclusion is that the regulatory process has not changed dramatically in its evaluation process of new drugs, and that there is a significant lag caused by this process. It is also concluded that there are methods of improving the regulatory process in the drug industry, but in order to do so there must first be a change in social attitudes toward this industry.

Publications

GOODMAN, Rae Jean B., Associate Professor, "**Analysis of the President's Commission on Housing's Mortgage Interest Tax Credit**," Invited Working Paper No. 46, Federal Home Loan Bank Board, February 1983.

This paper presents the results of an investigation of the effect on savings and loan associations for the 1975-1980 period of the mortgage interest tax credit proposed by the President's Commission on Housing. The tax proposal is a mortgage interest tax credit, available to final investors (holders) of mortgages or mortgage-backed securities, and computed as a percentage of the mortgage interest earned. Eligibility for the tax credit would be based on net new mortgage flows; the level of the tax credit would depend on the interest income from mortgage assets. The report of the President's Commission discussed both a fixed-rate tax credit and a graduated tax credit.

The conclusions of the study are: (1) A constant-rate tax credit of 2 percent for savings and loans investing 40 percent or more of all net new funds in mortgages would provide, in general, a break-even point with the current tax system. (2) A step-graduated tax credit ranging from 1.0 to 2.5 percent with a 40 percent or greater investment of net new funds in mortgages would provide a tax-neutral situation. (3) A graduated tax would supply additional incentives for mortgage investment relative to a constant-rate tax credit. (4) A tax credit covering a much greater range in portfolio investment in mortgages would provide incentives for new entrants into the market. (5) There should be some form of eligibility requirement linked to annual mortgage flows to prevent any windfall gain to one-time mortgage issuers (holders). (6) There are significant arguments to support a mortgage interest tax credit relative to the current tax system.

GOODMAN, Rae Jean B., Associate Professor, "**CAVE in Economic**," *Proceedings of the Sixteenth Annual Small College Computing Symposium*, 16 (March 1983), 125-135.

This paper presented the results of tests of the educational effectiveness of CAVE in Economics. The results of the four-week exams of seven sections of FE210, Basic Economics, were compared for users and non-users of CAVE. The statistical results were significant that CAVE aided in the understanding of principles of economics.

JOHNSON, F. Reed, Associate Professor, co-author, "**Economic Valuation of Potential Scenic Degradation at Bryce Canyon National Park**," in Robert D. Rowe and Lauraine G. Chestnut, Editors, *Managing Air Quality and Visual Resources in National Parks and Wilderness Areas*. Boulder, Colorado: Westview Press, 1982.

A recent conflict over proposed surface mining near Bryce Canyon National Park is precedent-setting in that it marks the first unsuitability petition filed under the provisions of the Surface Mining Control and Reclamation Act of 1977. The way in which issues are ultimately resolved in this case bears on future implementation of the act and the current review of associated regulations ordered by Interior Secretary James Watt.

This paper reviews the background to the Bryce controversy, describes data obtained by the Department of the Interior, and reports some recent analytical results derived from the data.

Given the absence of any cardinal measure of the loss in value to Yovimpa Point visitors, the total estimated value of Yovimpa Point to visitors places an upper bound of about $120,000 annually on the possible cost, adjusted appropriately for growth in demand and discounting over the life of the mine. Since about 70 percent of the visitors expected no loss in value, the upper bound may arguably be reduced to $36,000. In order to go beyond this, it would be necessary to calculate actual changes in the slopes and intercepts of the demand curve for Yovimpa Point.

JOHNSON, F. Reed, Associate Professor, co-author, "**Substitutability, Reversibility, and the Development-Conservation Quandary**," *Journal of Environmental Management*, 15 (July 1982), 79-91.

Choices among alternative uses of natural resources are particularly troublesome in instances which involve significant non-pecuniary, non-consumptive values. Considerable progress has been made in recent years in developing theoretical tools for evaluating irreversible uses of unique natural amenities. Unfortunately, the usefulness of this work is greatly restricted by the limited number of cases which appear to satisfy the special assumptions of this literature. Public policy more typically involves a range of more or less reversible development options involving a resource for which there exist more or less substitutable commodities.

This paper presents a model of natural resource allocation which admits consideration of a large class of public policy issues involving reversibility and substitutability. The development-conservation tradeoff is characterized as incorporating a wide range of options including, but not limited to, unrestricted development and pristine preservation.

JOHNSON, F. Reed, Associate Professor, co-Author, "**Multiple Destination Trip Bias in Recreation Benefit Estimation**," *Land Economics* 58 (August 1982), 364-372.

One widely accepted technique for estimating the willingness-to-pay for a recreation site in cost-benefit studies is the Clawson-Knetsch travel-cost method. The travel-cost method assumes, among other things, that all travel costs are incurred exclusively to obtain access to the single specific recreation site being valued and thus differences in travel cost may be treated as a proxy for price. This study (1) examines the consequences of multiple destination trips on travel-cost estimates of benefits, (2) suggests a means of correcting the bias that arises under such circumstances, and (3) obtains nearly identical value estimates from the travel-cost method and from a direct question on willingness-to-pay. The magnitude of multiple destination bias is illustrated, and possible solutions to this problem are considered using itinerary information for visitors to Bryce Canyon National Park.

MORRIS, Clair E., Professor, "**Depression**," *The World Book Encyclopedia*. Chicago: World Book, Inc., 1983, Vol. 5, pp. 125-128.

This short article defines the term "depression" that is associated with changes in the level of economic activity. The effects of depressions on individuals and society are described and a distinction is made between this type of business condition and a recession. Some of the worst depressions in the United States are identified and the causes are explained. Keynesian aggregate demand theories and monetarist theories are explored as possible cures and preventive measures for this kind of economic situation. A suggested bibliography of the latest research on depression is attached, along with a graph that shows economic contractions and expansions over time.

Presentations

BERG, Gerald, Instructor, "**The Incumbency Reinforcement Theory of Advertising and Profitability**," Seminar, University of Maryland, College Park, Maryland, 13 April 1983.

FREDLAND, J. Eric, Associate Professor, and Roger D. LITTLE, Professor, "**Socioeconomic Characteristics of the All Volunteer Force**," Office of Naval Research, Manpower R&D Committee, Washington, D.C., September 1982.

FREDLAND, J. Eric, Associate Professor, and Roger D. LITTLE, Professor, "**Socioeconomic Characteristics of the All Volunteer Force**," Tri-Service Laboratory Commanders Conference, U. S. Naval Academy, Annapolis, Maryland, 7-8 October 1982.

GOODMAN, Rae Jean B., Associate Professor, "**Savings and Loan Associations in the Mortgage-Backed Bond Market**," Eastern Economic Association Meeting, Boston, Massachusetts, 10 March 1983.

LITTLE, Roger D., Professor, "**Socioeconomic Status of World War II Veterans by Race: An Empirical Test of the Bridging Hypothesis**," Monterey, California, 2 March 1983.

MACRAE, C. Duncan, Visiting Professor, "**Life Cycle Saving and Owner Occupied Housing Demand**," Southern Economic Association, Atlanta, Georgia, November 1982.

MACRAE, C. Duncan, Visiting Professor, "**Foreign Exchange Gains and Losses**," American Accounting Association, Philadelphia, Pennsylvania, April 1983.

MACRAE, C. Duncan, Visiting Professor, "**Expert Knowledge Based Systems for Tax Policy Analysis**," New York University, New York, May 1983.

MACRAE, C. Duncan, Visiting Professor, "**Currency Trading: Taxation of Gains and Losses**," Georgetown University, Washington, D. C., June 1983.

WHITAKER, A. Royall, Associate Professor, "**Improving on Sheppard's Correction for Grouping Error in Second Moment Calculations**," Eastern Economic Association, Boston, Massachusetts, April 1983.

DEPARTMENT OF

Language Studies

PROFESSOR JOHN D. YARBRO
CHAIRMAN

Along with full teaching loads this year most members of this Department have kept active with research or special studies. Assistant Professor Brent completed his project on Rousseau and East-Asian thought. Assistant Professor Dahlgren, using documents in libraries in Spain and France, has made major progress on her study of Calderon's allegorical drama. She has presented four related papers and written two review articles. Associate Professor Halbig has reported in *Shipmate* on the 1982 Naval Academy Foreign Affairs Conference, translated two articles on amphibious warfare, and written two professional articles for the *Naval Intelligence Quarterly*. On other fronts he has presented two papers on computer aids to dictionary production and another on a pedagogical topic.

Associate Professor Daniel Lee carried forward his large-scale computerized collection of data on Chinese military leaders, with further research in China. Assistant Professor Rivera-La Scala published Volume I of her study of didactic poetry in fifteenth-century Spain and is now working on Volume II. Assistant Professor Tolstoy has completed revision of his book manuscript on the Russian Orthodox Church during the 1917 Revolution.

Among our three foreign officer-instructors, Commander Battke, Federal German Navy, made a study of the role of women in the U. S. Navy, and Lieutenant Commander Urvoy, French Navy, directed a research course in French on French foreign policy in Africa.

Overall, in view of the Department's roster of eight civilian professors and three exchange officers, research activities are in good balance with our primary effort in teaching.

Sponsored Research

The Allegorical Drama of Calderon De La Barca (1600-1681): A Semiotic Approach to the *Auto Sacramental*

RESEARCHER: ASSISTANT PROFESSOR SHARON G. DAHLGREN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This book-length study proposes to examine Calderon's allegorical drama as communicative systems, including the implementation of the techniques of semiotics, the study of signs, sign functions, and sign production. In approaching these plays as sign systems, especially as they are highly symbolic art forms in their presentation of abstractions as characters on the stage, the researcher should help explain the dramatic power they held, both in Spain and abroad. To this effect the researcher has studied the works of Umberto Eco and his theory of codes, and the models of Algirdas Greimas, for the analysis of the correspondences between differing cultural objects, such as painting and literature.

The researcher is particularly interested in questions of staging the *autos* in the seventeenth century and the visual effects designed to reinforce the verbal message of the written text. The analysis of the relationships between verbal and nonverbal signs has led to four papers she has presented at conferences this academic year. To explain the "world-stage" metaphor in *El gran teatro del mundo*, she has developed two different models, using Greimas as a base, that refer to the two different sets of characters in the work. Calderon establishes a recognizable gestural system of communication between characters as a visual means of testing each character to determine his or her condemnation or salvation. The analysis of the gestural content in nondramatic texts has become a topic of interest for medievalists in very diverse areas of inquiry, as learned at the Medieval Institute conference in May 1983. She has extended her investigation into dramatic and semi-dramatic works before Calderon and has found that the application of semiotics provides convincing results for the Early Renaissance as well.

Automated Biographic Analysis of the Chinese Military Leadership

RESEARCHER: ASSOCIATE PROFESSOR DANIEL T. Y. LEE
SPONSOR: DEFENSE INTELLIGENCE AGENCY

This is a continuing long-range project to study biographic characteristics and career patterns of significant military leaders in the People's Republic of China (PRC). Data entries in the computer base are categorized by strict syntactical rules, permitting summarizations of single or multiple biographies, according to desired characteristics, name, or location. Biographies may be linked to create chronological, geographical, and personal names compendia to meet specific and detailed research needs. Hierarchical clusterings, a technique to identify patterns in the overall structure of the PRC leadership, are now being developed. This facility should allow analysis of patterns in the evolving characteristics and backgrounds of the key decision-makers of the country.

Research in Taiwan and Hong Kong in the summer of 1982 has resulted in the addition of some 120 new biographies to the collection. This past year over three-fourths of the previous entries have been revised or augmented. The total number of leaders included now stands at 644. Associate Professor Rodney T. Tomlinson, of the Political Science Department, serves as research associate for this project.

Didactic Poetry in Fifteenth-Century Spain: Juan de Mena's "Coplas De Los Siete Pecados Mortales"

RESEARCHER: ASSISTANT PROFESSOR GLADYS RIVERA-LA SCALA
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The first phase of this study culminated in the publication of Volume I in December 1982, with the title, *Juan de Mena's COPLAS DE LOS SIETE PECADOS MORTALES and First Continuation.*

Volume II is now in preparation. It includes the first critical edition of the Second and Third Continuations of the COPLAS, left unfinished at Juan de Mena's death, and an intertextual analysis of the main poem and its three continuations. In order to edit the texts, the researcher has collected, studied, and collated primary source materials from British, French, Italian, and Spanish libraries and has established detailed, first-hand descriptions of the principal manuscripts. To determine secondary sources and influences in regard to themes, structure, style, and language, she has located and studied didactic works, both literary and nonliterary, medieval sermons, and other religious and moralistic writings of the period. After transcribing into modern script the manuscript that will serve as the base text of Volume II, she has collated variant readings from manuscripts and early printings consulted last summer in Spain and France and has assembled an extensive bibliography of analytical materials. The process of editing the texts is now almost complete. Chapters providing a cultural and literary orientation to the Second and Third Continuations are now being written. In addition to Volume II, to be published in book form, the project will result in two journal articles dealing with related findings.

Research Course Projects

Current French Foreign Policy Towards the Sub-Saharan French-Speaking Countries of Africa

RESEARCHER: MIDSHIPMAN 1 C KEVI K. PAPP
ADVISER: LIEUTENANT COMMANDER LOIC URVOY, FRENCH NAVY

The purpose of this project was to study and define possible changes in France's African policy following positions adopted by the new socialist government regarding North-South dialogues. The researcher first determined that nothing very concrete has been published on French policies towards its ex-colonies in Africa. The project thus began with documents obtained from the French Embassy containing official policy statements and guidance. Then French press comments were analyzed. Next came a substantial interview with a French Embassy Counselor who provided background information in depth and answers to some specific questions.

In summary, the Sub-Saharan French-speaking countries of Africa, even though independent today, are of definite national interest in France. This study offers an overview of post-World War II relations, examines the period just before the 1981 elections in France, and then focuses on the present government's policies. The immediate assumption is that no change is imminent, but after studying the ideas of Mr. Cot, ex-Secretary for Cooperation in the French cabinet, one notes signs of fundamental changes in the approach towards economic help to African countries. These changes will be gradual, but they introduce a new emphasis in French foreign policy for Africa. This emphasis concerns Human Rights, choice of projects for aid based on practical benefits for the people, and efficient use of funds.

Publications

HALBIG, Michael C., Associate Professor, "**Naval Academy Foreign Affairs Conference 1982**," *Shipmate*, 45 (July-August 1982), 8-9.

This is a summary of the 1982 Conference, including comments by visiting students and observers.

RIVERA-LA SCALA, Gladys, Assistant Professor. *Juan de Mena's COPLAS DE LOS SIETE PECADOS MORTALES and First Continuation*. Edition, Notes, and Study, Vol. I. Madrid: Ediciones José Porrúa Turanzas, 1982.

Volume I of this study of didactic poetry in fifteenth-century Spain is the first critical edition of this long medieval poem, a bestseller in its time. Written by Juan de Mena, a major poet, and Gomez Manrique, a prominent literary and political figure, it deals with the seven deadly sins.

The editor's book opens with a discussion of the poem and its place in the didactic tradition of Spain and Western Europe. She follows with an analysis of the base manuscript and explains its relationship to 24 other extant versions. The book concludes with an edited text of the poem, a section on variant readings, and glossaries of Spanish medieval terms and proper names. It thus provides a thorough study of one of Spain's most influential literary works of the pre-Renaissance period.

Presentations

BRENT, Steven T., Assistant Professor, "**Rousseau's *Emile* and the 'Xue Ji': Humanistic Universals**," Kentucky Foreign Language Conference, Lexington, Kentucky, April 1983.

DAHLGREN, Sharon G., Assistant Professor, "**La Provence d'hier et d'aujourd'hui**," Alliance Française d'Annapolis, September 1982.

DAHLGREN, Sharon G., Assistant Professor, "**Petrarchan Motifs in the Pastoral World of Jorge de Montemayor: A Study of the Eclogues in the *Cancionero* (1554 and 1562)**," Annual Meeting of the Modern Language Association of America, Los Angeles, California, December 1982.

DAHLGREN, Sharon G., Assistant Professor, "**'Estas son las senales de amor': Semiotic Systems and Mystic Experience in Santa Teresa de Jesus**," Annual Meeting of the Modern Language Association of America, Los Angeles, California, December 1982.

DAHLGREN, Sharon G., Assistant Professor, "**The Staging of *El gran teatro del mundo*: A Semiotic Approach to the *Auto Sacramental***," Annual Meeting of the Modern Language Association of America, Los Angeles, California, December 1982.

DAHLGREN, Sharon G., Assistant Professor, "**Courtly Lyric and Dramatic Technique in Gil Vicente and Jorge de Montemayor**," 18th International Congress of The Medieval Institute, Kalamazoo, Michigan, May 1983.

HALBIG, Michael C., Associate Professor, "**Reversing Word Fields: Models and Methods**," Annual Conference of American Translators' Association, Washington, D. C., October 1982.

HALBIG, Michael C., Associate Professor, "**On Mining a Word Field: The New Technologies**," Annual Conference of American Translators' Association, Washington, D. C., October 1982.

HALBIG, Michael C., Associate Professor, "**Spoken Homework on Cassettes: Teaching the Spoken Language**," Third Conference on Individualized Instruction in Foreign Language Teaching, Columbus, Ohio, May 1983.


His Excellency
BERNARD VERNIER-PALLIEZ
Ambassador of France

DEPARTMENT OF

Political Science

PROFESSOR G. POPE ATKINS
CHAIRMAN

Political Science Department faculty members and midshipmen students undertook extensive research and writing in all disciplinary fields during the 1982-1983 academic year. Ten faculty members and seventeen midshipmen pursued fifty-nine projects in the areas of political theory and methodology, U. S. politics, comparative and international politics, and foreign policy analysis, as well as several related to classroom teaching. Three broad topical areas received special attention: Latin America (fourteen projects), Soviet Union and Eastern Europe (twelve projects), and the North Atlantic Treaty Organization (eleven projects). Other specific topics addressed included U. S. warfare doctrine and defense issues, U. S. Congress, the United Nations, Chinese leadership, international law, the U. S. legal system, communications theory and international politics, military sociology, politics in South Africa and in the Middle East, and computer-aided teaching devices. Eleven publications included two books, seven articles, a teaching package, and a book review. In addition, three books and three articles were accepted for publication. As this summary indicates, the Political Science Department continues to maintain a research environment that encourages professional growth of the faculty, allows outstanding midshipmen to pursue special studies, and supports teaching excellence.

Sponsored Research

Midshipmen Characteristics of Those Who Stay Vs. Those Who Leave: An Analysis

RESEARCHER: PROFESSOR CHARLES L. COCHRAN
SPONSOR: NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER

Midshipmen entering the Naval Academy in the summer of 1978 took the American Council on Education's Student Information Form Questionnaire. This questionnaire, also given to entering college students throughout the nation, allows us to compare midshipmen characteristics (i.e., demographic, personality, and personal data) with those at other colleges.

In late summer 1982, follow-up surveys were mailed out to all who entered in 1978, whether they graduated from USNA or pursued an alternative career path. The follow-up questionnaire includes several items pertaining to their views of the academy (faculty, curriculum, student cohorts, etc.). Items from the follow-up survey are being analyzed in conjunction with the midshipman's responses on the Student Information Form he completed upon entrance to the Academy. In this way, social, demograpic, personality, and other correlations between stayers and leavers can be determined.

The Nato Theater Nuclear Force Modernization Debate and Soviet Response to Modernization Plans

RESEARCHER: ASSISTANT PROFESSOR GALE A. MATTOX
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

In the mid-1970s, the demise of U. S. nuclear superiority and advent of US/USSR strategic parity prompted European unease with the existing theater nuclear imbalance. In addition, the deployment of the SS-20, beginning in 1976, by the Soviet Union posed a qualitative as well as quantitative improvement in Soviet capabilities on the European continent. The nuclear imbalance on the continent, which had previously been accepted in light of U. S. strategic nuclear guarantees, was no longer acceptable to the NATO alliance. The NATO response was the 1979 dual-track decision to reestablish the nuclear balance through either arms control negotiations or a program of theater nuclear modernization. The Soviet response to the decision has been to offer a moratorium of theater nuclear force deployments during the Geneva arms control talks and attempt to dissuade the West Europeans from accepting the planned nuclear deployments.

Maneuver Warfare and The Marine Corps

RESEARCHER: CAPTAIN RICHARD S. MOORE, USMC
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study examines the principles of maneuver and applies them to specific U. S. Marine Corps air-ground and amphibious doctrine. The objective is to develop a new doctrinal approach for the Marine Corps that will enable the Corps to fight successfully on the modern battlefield. This study begins with an examination of maneuver warfare concepts as developed by Colonel John Boyd, USAF (Ret.), and places them in historical context, particularly as they have been applied in the 20th Century. Following this, detailed doctrinal principles will be developed and applied to current Marine Corps tactical and operational doctrine. Special emphasis will be given to the air-ground-logistics concepts of the Marine Corps and to the amphibious applications of maneuver warfare. The outline has been forwarded to several military and civilian analysts for comment, and research has been conducted, with a trip to 29 Palms, California, in July 1983 to observe Marine Corps combined arms training.

Political Culture of Poland

RESEARCHER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study examines the political culture of Poland, specifically shared opinions, attitudes, values, habits, and beliefs and orientations toward the political process. Political culture in Poland is transmitted from generation to generation and determines national identity. It is an essential variable which accounts for a society's political preferences, stability, and instability.

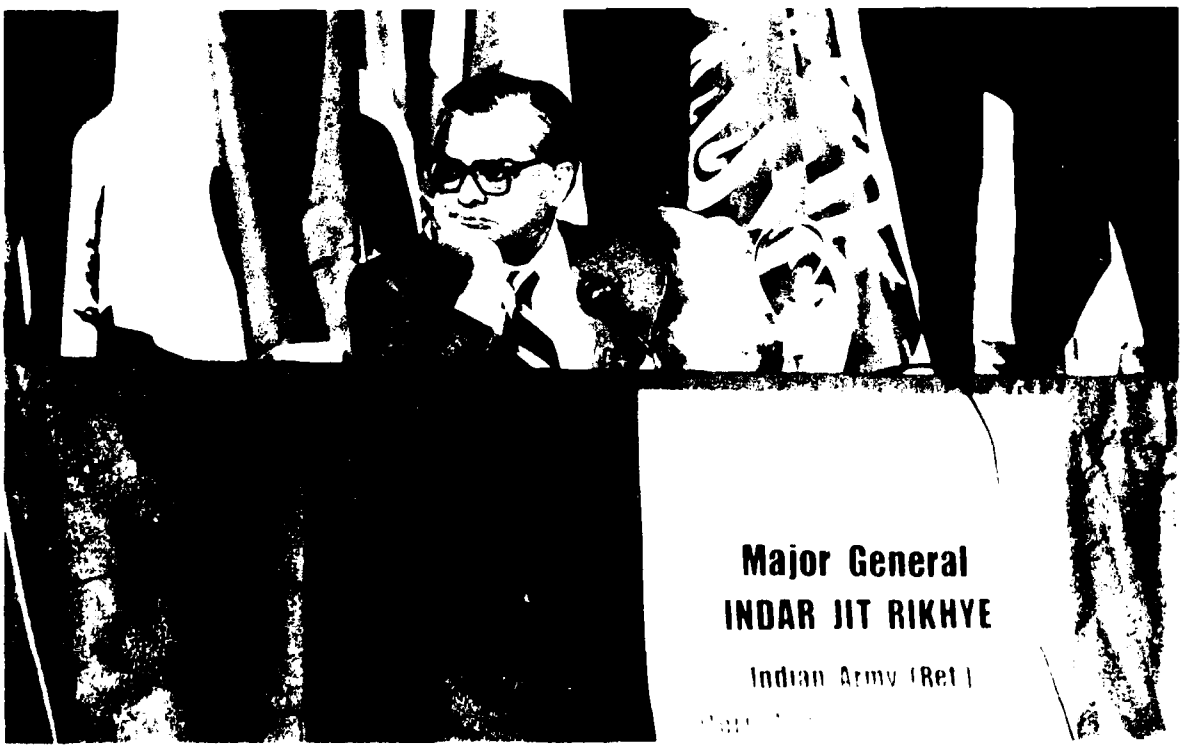
The methodology used in this study involves the examination of interplay between ideology and political behavior, and attitudes toward the state, trade unions, church, etc.

Biographic Analysis of Chinese Leadership

RESEARCHER: ASSOCIATE PROFESSOR RODNEY G. TOMLINSON
SPONSOR: DEFENSE INTELLIGENCE AGENCY

This study is an analysis of eighteen biographic characteristics of the leaders of the People's Republic of China. English-text summaries are prepared according to strict syntactical rules, with imbedded computer flags affixed to proper names and locations, permitting researchers to link biographical names with names and locations, in the biographical text.

Research includes automated linkages of "who knows whom," identifying rising stars in the Chinese hierarchy. Research is on a continuing basis and includes the development of a public appearance file that will be linked to the biography file. When complete, it will be possible to develop seniority lists and study patterns in behavior of Chinese leaders.



Independent Research

Diplomacy in the South Atlantic Crisis of 1982

RESEARCHER: PROFESSOR G. POPE ATKINS

On 2 April 1982, Argentina invaded and took military control of the inhabited portions of the United Kingdom's Falkland Islands colony in the South Atlantic. Argentina asserted it was enforcing its rightful sovereignty over the Islas Malvinas, the name it applied to the disputed territory. Costly naval, air, and land warfare ensued, effectively ending on 14 June with Argentina's defeat at the hands of British armed forces. The United States, the United Nations, the European Community, and the Inter-American System made considerable diplomatic efforts, first to avoid warfare, then to end it, and finally to repair postwar relations. Other actors, such as the Soviet Union, the Vatican, the Conference of Nonaligned Nations, and many more, were involved to some degree. However, this essay emphasizes the roles played by the disputants and the principal third parties. While the crisis seemed to begin as an isolated series of events in a remote corner of the globe, it ended with important consequences for international politics on several levels.

Who Joins the Armed Forces?

RESEARCHER: PROFESSOR JOHN A. FITZGERALD

The study is an examination of two civilian population groups: 18-20 year olds who express an interest in joining the military and their counterparts who do not. These two groups are compared in terms of their relative criminal and social deviancy characteristics. The objective is to refine screening procedures using national survey data from the Department of Labor and Ohio University.

Iran: Tradition and Turmoil

RESEARCHER: FOREIGN SERVICE OFFICER-4 JOHN W. LIMBERT

Iran is the only Middle Eastern state to have preserved its national identity through the upheavals of the Arab, Turkish, and Mongol invasions. Modern Iran is the heir to the richest culture in the Middle East—a culture that penetrates far beyond that state's political boundaries. Afghanistan, Turkey, the Eastern Arab states, the Indian sub-continent, Soviet Central Asia, and the Caucasus have all been parts of the Iranian cultural empire.

This book seeks elements of continuity in Iranian society from pre-Islamic times to the turmoil of the Islamic Republic. It discusses the persistence of religion as a dominant force in politics and society; the attraction of unorthodox doctrines such as Mazdakism, Baha'ism, and revolutionary Shi'ism; the tradition of strong, charismatic leadership under various names; and the constant problem of ruling peoples of diverse tribal, religious, and linguistic affiliation.

This work looks for the explanation of recent political changes in conditions peculiarly Iranian. It examines the society emerging from the revolution and some of its new institutions: the revolutionary guards, the assembly, the neighborhood committees, and the Friday prayer leaders. Focusing on the continuing tension between pragmatism and revolutionary ideology, it discusses the possible direction of events when Iran begins rebuilding its economy and establishes stable political institutions.

Soviet Policy Toward Western Europe, 1977-1983

RESEARCHER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

This work deals with trade and political-military relations between Western Europe and the Soviet Union, and examines the Soviets' aims; that is, their views on the INF talks, the peace offensive, and the attempts to "decouple" American and West European security.

World Politics in the General Assembly

RESEARCHER: ASSOCIATE PROFESSOR RODNEY G. TOMLINSON

This result updates the original work of Hayward Alker and Bruce Russett of Yale University. The Alker/Russett undertaking studied voting patterns, issues, and bloc formation for the period 1947-1964. This research replicates the previous research for the 1947-1964 period and then launches into the period 1965-1983 with intention to extend the Alker Russett research and explore new insights and factors molding world politics at the United Nations. Findings to date show that voting blocs/coalitions form around issues and less around philosophies, as had been the case in the earlier years of the United Nations. The researcher prepared a computer model that replicates the Alker Russett design. The model calculates voting "scores" for nations and issues and passes these scores to a factor analysis program. After factor analysis another set of programs links nation names and issue descriptions to the factors.

Write Your Congressman

RESEARCHER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

This book-length manuscript analyzes communications patterns between members of Congress and their constituents. While the axiom "Write Your Congressman" has been a long-standing aspect of the American system, it has taken on new meaning with the dramatic increase in two-way communications and the application of modern information technology. The research confronts all aspects of the communications nexus with special emphasis on the impact of communications and the implications of current trends for the future.

Research Project Courses

The Trans-Siberian Pipeline: Cause For A "Progressive Divorce" Within the Western Alliance

RESEARCHER: MIDSHIPMAN 1/C PAUL BECKER
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

In the post-detente era, the Western Alliance has undergone an alarming division between the United States and Western European nations. Foreign policy objectives within the Alliance have undergone revisions that have resulted in a fragmented approach to dealings with the Soviet bloc. This growing dichotomy within the Alliance was exemplified by the recent controversy surrounding the Trans-Siberian Pipeline. The Reagan Administration claimed its allies were inviting economic blackmail because of vulnerability to Soviet political pressures. More importantly, it would benefit Moscow with hard currency that would boost a sick Soviet economy and fuel their expanding military economy. However, the economic benefits gained through this joint Soviet venture were enough to convince European states to disregard U. S. opposition. The unsuccesstul economic sanctions imposed by the United States exacerbated the "progressive divorce" developing between the United States and Western Europe. The purpose of this research project was to examine this friction in terms of the specific issue of the Trans-Siberian pipeline.

Defense-Related Political Action Committees and Congressional Voting Patterns

RESEARCHERS: MIDSHIPMEN 1/C RICHARD HANS AND MICHAEL WORLEY
ADVISER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

Relying on campaign contribution data from the Federal Elections Commission and voting records of the Congress, this study analyzed six years of data to determine the degree to which campaign contributions are related to Congressional voting. Once it was definitely determined that the two factors were related, two competing hypotheses were tested. The first viewed campaign contributions as an incentive which precedes voting behavior and the second viewed contributions as a reward for past legislative support. Both factors seem to be at work, with the reward relationship a bit stronger. In looking at the relationships over time, it is clear that recent increases in PAC activity, especially in the defense realm, have increased the degree of linkage. The relationships were controlled to factor-out aspects such as seniority and party identification. Party was important in that Republicans supported national defense votes quite highly, whether or not they received defense PAC contributions.

Rumania and the Soviet Union

RESEARCHER: MIDSHIPMAN 1/C JAMES W. L. HUDSON
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

Soviet occupation of Rumania after World War II led to extensive Soviet military basing and exploration of Rumanian resources, continuing until the Soviet withdrawal in 1958. Rumanian leadership was permitted to administer policy during and after the occupation because of Rumania's subsequent displays of independence have strongly appealed to the Rumanian people. Rumania has a strong and prepared army and reserve military structure, and refuses to participate in Warsaw Pact maneuvers. Basic Rumanian policies have not changed since the early 1960s, when the Soviet attention was diverted from Rumania to the Sino-Soviet dispute. The most noteworthy problem Rumania experiences is economic--owing foreign banks great debts. This may lead Rumania to seek greater trade contracts with the Soviet Union and the Communist bloc, thereby appearing to bow to the Soviets. Rumania has received extensive economic aid from the United States, as well as most favored nation status, and as a result is improving her condition, but needs to make significant technological advances in order to stand on her own again. These moves toward independence from the Soviet Union will remain difficult for Rumania.

Terrorism in Latin America

RESEARCHER: MIDSHIPMAN 1/C SUSAN M. KOYE
ADVISER: PROFESSOR G. POPE ATKINS

The purpose of this research paper was to evaluate the terrorist threat in contemporary Latin America. Terrorist acts have stirred international concern as well as created political complications within affected countries. The objective of this research study is to evaluate terrorist strategies, motives, ideologies, and goals and to determine whether any trends will continue in Latin America. The social, political, and economic conditions prevalent during the past periods of terrorism will also be evaluated as an aid in predicting these trends. An introductory section reviews the literature on terrorism and summarizes the major theories about its causes and processes. Subsequently, the analysis focuses on terrorist groups in Venezuela, Uruguay, and Nicaragua. These particular countries were selected for individual case study because each country recently has had a strong challenge of guerrilla warfare. They represent different social settings within which important guerrilla groups operated and different political outcomes resulted.

Patterns of Soviet Diplomacy and Negotiating Behavior and Relevance to Strategic Arms Control

RESEARCHER: MIDSHIPMAN 1/C THOMAS B. MODLY
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

From a strategic perspective, the existence of nuclear arms has often been cited as the most destabilizing element in U.S.-Soviet relations. Though they have been successful as deterrent forces, the massive strategic nuclear arsenals of both nations have continued to expand international concern as to their necessity as instruments of peace. Both the United States and the Soviet Union have recognized and shared this concern and have attempted to alleviate this instability through negotiations for nuclear arms limitations. This fact justified a study of dominant Soviet patterns of diplomacy and negotiating behavior: in particular, an analysis of the specific cultural, historical, and organizational characteristics of the Soviet diplomatic service and diplomatic tendencies in strategic negotiations. This study has revealed the existence of distinct patterns of Soviet behavior which evolved as a result of cultural influences and past negotiating experiences. Russian xenophobia and historical emphasis on national self-preservation have emerged as the prevailing motivations for Soviet approaches to international affairs and diplomacy. The Soviet Union's diplomatic posture has also been shown to be highly dependent upon their perceptions of strength and weakness. The Soviet Union's negotiating tactics generally compromise on ideological principles whenever serious threats to their national security are perceived. This compromise, however, redirects Soviet emphasis to the projection of specific short-term objectives through an aggressive negotiating stance.

American Defense Priorities for the 1980s

RESEARCHER: MIDSHIPMAN 1/C GORDON MOLLER
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

The purpose of this paper was to assess the defense needs of the United States for the remainder of this decade and into the 1990s. A general overview of the present international situation, as it concerns defense, allowed an objective assessment of what the United States should do to maintain her own national security and protect her allies, while concurrently reducing international tensions. Then the threat from the Soviet Union was sketched and the relative capabilities of the United States and its allies examined. The following areas received extensive analysis: strategic rocket forces and bombers, theater nuclear forces, enhanced radiation weapons, conventional forces (size and structure), and arms control efforts. After examining present problems in each area, a set of policy recommendations for each was proposed to address the deficiencies. Several other areas were briefly discussed as well; principal of these were readiness, budgetary considerations, standardization among allies, and technological advancements that could affect security.

The International Political System on a Computer for use in Simulations of Political Situations

RESEARCHER: MIDSHIPMAN 1/C STEPHEN NORDELL
ADVISER: ASSOCIATE PROFESSOR RODNEY G. TOMLINSON

The project involves combining phenomena to create a computer model that operates continuously while simulation players interact with one another. By studying past models, knowledge of the functioning of the international political system was developed and then applied to this original model. It emphasizes the intersection of trade, war, diplomacy, deterrence, and coalition formation. This model and associated control programs will function on the Naval Academy computer and permit groups of students to develop situational simulations of international politics. The completed work was turned over to the faculty advisor for classroom applications.

Illegal Immigration Across the United States-Mexican Border: A Continuing Dilemma

RESEARCHER: MIDSHIPMAN 1/C MIKE ORTEGA
ADVISER: PROFESSOR G. POPE ATKINS

This paper is an analysis of the illegal immigration problem in United States-Mexican relations. It provides a background of various border programs that have been formulated in recent years, including the *Bracero* program and the Border Industrialization program. The causes and effects of illegal immigration across the U.S.-Mexican border are then analyzed. These causes include wage differentials between U. S. and Mexican workers and the population growth rate and unemployment in Mexico. Implications of the problem center around the fact that the United States has become the fourth-largest Spanish-speaking nation in the western hemisphere with Hispanics the second largest minority in the nation. The pressure to arrive at some solution of the illegal immigration problem is apparent. This pressure comes not only from U. S. administrators but Hispanic organizations as well. Depressed wages in the United States, displacement of U. S. workers, and drains on educational and social services push for some type of policy solution. The general interdependence that exists at the U. S.-Mexican border makes it even more difficult to arrive at some kind of policy solution.

The Hungarian Political System Today: Evolution and Analysis

RESEARCHER: MIDSHIPMAN 1/C KEVE PAPP
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

This paper is an analysis of the Hungarian political system today and the historical, political, and social events that influenced it. The paper consists of three major parts: 1. An historical introduction describes the events prior to 1956, when Janos Kadar became head of the Communist Party and his country; 2. an analysis of the major reforms that have occurred in Hungary since 1956. (the fact that reforms have taken place in Hungary, a Soviet bloc country, has great significance); and 3. a description of the Hungarian government, including its structure and social and cultural implications influences.

Although Hungary's freedom of action remains severely restricted by the Soviet Union, and it is faced with major social problems, reforms have been implemented with surprising smoothness.

Geopolitics and Conflict in the Southern Cone

RESEARCHER: MIDSHIPMAN 1/C AMADO PARRA
ADVISER: PROFESSOR G. POPE ATKINS

Geopolitics has become increasingly important in the Southern Cone nations of South America, where its application has affected both domestic and foreign policy. Applied geopolitics is particularly prevalent in Argentina, Brazil, and Chile (the ABC countries), whose current military governments have used geopolitics in an effort to solve national problems that have existed since colonial times. This geopolitical thinking focuses not only on programs for internal national development, but also on international relations and power politics. Application of geopolitics by the ABC countries has usually been at the expense of neighboring states, so that several conflicts have arisen in the Southern Cone over related issues.

This paper is an analysis of the application of geopolitics by Argentina, Brazil, and Chile, and of the relationship of their application to conflict in the Southern Cone. Beginning with the military coup d'etat in Brazil in 1964, the Southern Cone nations have successively adopted geopolitical thinking for the solution of regional international problems. The other nations have generally emulated the Brazilian model: this includes not only Chile (with the overthrow of Allende in 1973) and Argentina (with the overthrow of the Peron government in 1976), but also the smaller "buffer" states of Paraguay, Uruguay, and Bolivia. Relations among these nations have been increasingly based on geopolitical issues or concerns.

A Comparative Analysis of the Disposition of Drunk Driving Cases in the Maryland District Court, Annapolis

RESEARCHER: MIDSHIPMAN 1/C RICHARD A. SCHOTT
ADVISER: PROFESSOR JOHN A. FITZGERALD

The hypothesis of the study is that white, middle-aged, white-collar males are less severely punished for drunk driving violations. It is substantially supported by the data, except that it was the elderly, rather than the middle-aged, that fared best. A secondary conclusion is that significant variability in sentencing exists among the four judges studied. Data were recorded from attendance at Maryland District Court sessions over a two month period, and supplemented by interviews with court personnel.

Central Asian Demographics and Future Instability in the Soviet Union

RESEARCHER: MIDSHIPMAN 1/C PAUL W. SIEGRIST
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

This study examines Soviet population change in relation to ethnic and nationality issues and effects on Soviet manpower demands. The paper began as an investigation into the effects of the demographic changes that have been noted in the Soviet Central Asian Republics as a result of the 1959 and 1970 Soviet censuses. As a political science student who has studied with an emphasis on both the ideological and practical working aspects of the world's communist regimes and their effects on U. S. national security, a major change in the Soviet population's composition was of interest in light of the possible adaptations that the world's largest and most powerful communist state may have to make to adjust to the change.

The Ukrainians and Bolshevik Nationality Policy, 1915-1938

RESEARCHER: MIDSHIPMAN 1/C CHARLES J. SITARSKI
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

This study examines Soviet nationality policy toward Ukrainians. Nationality policy began to serve the Bolsheviks as a tool during the pre-Revolutionary period and continued to be used as such well after the establishment of the USSR. But the nationalities policy of the Bolsheviks at the start of the Revolution hardly resembled the Stalinist policy of the late 1930s. The nationalities policy of the Bolsheviks was a concept which was constantly subjected to new interpretations as the need for such changes arose. The policy was used and changed as necessary to perpetuate first the Revolution, then the Russian cause, and finally the interests of the Bolshevik Party. Nationality policy served three distinct purposes between 1915 and 1938 during three different time periods. The transition from one period to the next was an evolution, usually gradual, and marked only by subtle, seemingly minute changes in the interpretation of the nationality policy.

Electronic Surveillance: National Security or Governmental Espionage?

RESEARCHER: MIDSHIPMAN 1/C STEPHEN C. TRAINOR
ADVISER: PROFESSOR CHARLES L. COCHRAN

The purpose of this research is to investigate the role of international law in intelligence activities. The ultimate choice of the topic came as a result of information made available by General John Warner, USAF (Ret.), of the Defense Intelligence School. It is an investigation of the efforts to tighten secrecy in government and protect the rights of individual citizens under the Constitution. The paper examines legal and practical obstacles in the United States concerning official secrecy. Court cases are examined along with the statutes authorizing intelligence agencies to conduct their authorized activities.

Sino-Soviet Relations, A Chinese Perspective

RESEARCHER: MIDSHIPMAN 1/C KIM WILLIAMS
ADVISER: ASSISTANT PROFESSOR ARTHUR R. RACHWALD

One of the most crucial relationships in the world today is the one between China and the Soviet Union. Except for a brief period of close alliance during the 1950s, the relationship has been antagonistic, at times becoming violent. Several factors have contributed to the animosity of this relationship. The first is the legacy of the past. Historical myths of the "Mongol Hordes," and the "Northern Barbarians" underscore the relationship. Another source of tension is the nationalistic feelings exemplified by the volatile border disputes. Ideological differences are at the forefront of the conflict. Mao became convinced that the Soviet model was irrelevant to Chinese problems and embarked on an independent course. The resultant differences in domestic models and foreign policy goals, especially with regards to Eastern Europe, Japan, Africa, and the United States, drove another barrier between China and the Soviet Union. Alternative future relationships include escalation to nuclear war, continued hostility with isolated armed clashes, and reduced tensions. All-out war is unlikely as is total reconciliation.

Psychological and Cultural Bases of International Relations

RESEARCHER: MIDSHIPMAN 1 C STEVEN ZOTTI
ADVISER: COMMANDER EDWARD A. MCKENNEY, USN

Psychological and sociological aspects of communication can have an important impact on international relations. The formulation of national and international images cannot be understood solely from the traditional view of the international scene, and new approaches emphasizing socio-psychological aspects of human interaction must be blended in. Scholars such as Herbert Kelman, Karl Deutsch, and Ralph White have presented theories and approaches to decision making, negotiation and systems analysis theories that base their propositions on the socialization process which is the foundation for image formulation. The critical study of these theories has helped this student to achieve more understanding of the communications aspect of international relations.

Publications

ATKINS, G. Pope, Professor, "**The Reorientation of U. S. Policy toward Latin America**," in Jack W. Hopkins (ed.), *Latin America & Caribbean Contemporary Record. 1981*. New York: Holmes & Meier, 1983.

This essay deals with President Reagan's resolve to bring basic changes to U. S. policies toward Latin America. In contrast to his predecessor, President Reagan emphasized East-West conflict in the region. He deemphasized human rights as the basis for relations, resuscitated arms-transfers to policy purposes, and revised the approach to nuclear nonproliferation. The Reagan administration chose to concentrate on the Caribbean area. Consequently, with the exception of Mexico and, to a degree, Argentina, U. S. efforts initially focused on small countries. Relatively little attention was paid to the major nations, most notably Brazil, outside the Caribbean context.

President Reagan's first year of dealing with Latin American affairs seemed to be a matter of ideology in search of policy. His conservative government succeeded in reorienting the context of policy, but substantive changes were not as extensive as its rhetoric had anticipated and continued to declare. Complex situations, domestic politics, and foreign reactions not only constrained U.S. action but forced a broadening of the initial approach. In the Caribbean Basin, the administration evolved an "initiative" that included support for elections, societal reform, and economic cooperation for development. Unanticipated crises, especially Anglo-Argentine military conflict in the South Atlantic, fundamentally altered evolving relationships and forced a recalculation of U. S. policies.

COCHRAN, Charles L., Professor, "**U. S. Interests and the Law of the Sea Convention**," *Shipmate*, 45 (October 1982), 11-14.

U. S. policy interests are affected differently if we do not sign the Law of the Sea (LOS) Convention and too few other states ratify the Convention to bring it into force; if the U. S. does not ratify the convention and enough other states ratify it, it does become the binding law for a majority of other states. This paper examines the effect on U. S. interests regarding the legal status of the Territorial Sea, the Contiguous Zone, the Straits, the Exclusive Economic Zone, and the Continental Shelf, and lastly, the Area.

The paper concludes that the interests of the U. S. are best served if a treaty comes into force even without U. S. participation in every instance, except for the Deep-Seabed Mining issue.

FRANTZICH, Stephen E., Associate Professor, *Computers in Congress: The Politics of Information*. Beverly Hills, California: Sage Publications, 1982.

During the last decade, the U. S. Congress has moved from being a technological laggard to a leader in the use of information processing technology. The process of innovation within the Congress serves as an excellent setting for analyzing theories of innovation which have helped enlighten other realms. Innovation is not neutral in its impact. Introducing new methods of information processing has had an important impact on the way Congress makes its decisions, who holds power, and ultimately the kinds of public policies enacted.

FRANTZICH, Stephen E., Associate Professor, "**C-SPAN in the Classroom**," *NEWS For Teachers of Political Science*, 36 (Winter 1983), 2-3.

The availability of C-SPAN (the cable television, gavel to gavel, coverage of U. S. House of Representatives floor proceedings) offers the potential for revolutionizing the way we teach about Congress. Subjects and concepts difficult to explain in words can now be brought into the classroom live and serve as the basis for discussion and analysis. This article outlines both the promise and the pitfalls of such coverage, giving special emphasis to formats most applicable to classroom use.

FRANTZICH, Stephen E., Associate Professor, "**Communications and Congress**," in Gerald Benjamin, *The Communications Revolution and Politics*. New York: The Academy of Political Science, (1982), 88-101.

Congress, as a part of modern society, has not been immune to changes in communications technology. As the target, subject of, and producer of communications, Congress has had to learn how to use modern communications technology to its own individual and institutional advantage. This book chapter discusses the general place of Congress in the communications network, with special emphasis on the role of computers and live television coverage.

FRANTZICH, Stephen E., Associate Professor, *Presidential Popularity in America*. Washington, D. C.: American Political Science Association, 1982 (2nd ed.).

This is the second edition of a student-oriented package of readings and computer accessible raw data focusing on the causes and consequences of Presidential popularity in America. After reading a forty-page discussion of the substantive area, students are given the opportunity to do their own research using the data provided.

MOORE, Richard S., Captain, USMC, "**Ideas and Direction: Building Marine Corps Amphibious Doctrine**," *Marine Corps Gazette*, 66 (November 1982), 49-58.

This article examines the development of Marine Corps amphibious doctrine during the period 1920-1934 in order to draw conclusions concerning the doctrinal process. Beginning in 1920, when Major General John A. Lejeune became Commandant of the Marine Corps, Marines began to focus their attention on amphibious warfare. Particularly at the Marine Corps Schools at Quantico, Virginia, the Marine Corps slowly evolved a doctrine for landing operations. By 1925, large scale exercises had been carried out in which new doctrinal concepts were tested. Delayed by operational requirements in Latin America and China from 1926-1929, the development of amphibious doctrine surged forward with the appointment of Brigadier General J. C. Breckinridge as the head of the Marine Corps Schools. Demanding free thought and open exchange of ideas, the officers assigned to Quantico, students and instructors, examined the details of amphibious landings and, by 1934, had published a manual that remains essentially unchanged today. The Marine Corps' successful development of amphibious doctrine was, thus, the result of three basic elements: clear command direction, sound organization, and, perhaps most important, widespread intellectual flexibility and questioning.

MOORE, Richard S., Captain, USMC, "**Institutionalizing Audacity**," *Marine Corps Gazette*, 67 (May 1983) 61-64.

This article discusses the means by which initiative and boldness can become an institutional trait in the Marine Corps. To do so, three basic elements are necessary: 1. a revamped education system that encourages open thought and free debate rather than memorization of techniques; 2. promotion and assignment of those officers that demonstrate operational excellence instead of bureaucratic competence; and 3. building an environment among Marines that emphasizes mutual trust and responsibility. By making these three elements part of the institution as a whole, the Corps will continue to symbolize military excellence. Failure to do so will result in a Marine Corps that is little more than a uniformed bureaucracy.

RACHWALD, Arthur R., Assistant Professor, "**Poland's Quo Vadis?**," *Current History*, 81 (November 1982), 353-356, 389-392.

The August 1980 Gdansk Agreement between the Communist party and Solidarity in Poland was a written social contract, which legalized "new, independent, self-governing labor unions" in exchange for a declaration that Solidarity would not transform itself into a political party. In December 1981, however, Solidarity asked for free elections, and the pro-Communist forces imposed the martial law to prevent Soviet invasion. So far, the martial law has produced temporary and superficial stability in Poland, but it has done very little to solve political and economic problems. The martial law has eliminated Polish society as a partner to decision-making, and the internal instability in Poland must continue.

RACHWALD, Arthur R., Assistant Professor, *Poland Between the Superpowers*. Boulder, Colorado: Westview Press, 1983.

This book examines the foreign and domestic policies of Poland since World War II in light of the country's relations with the Soviet Union and the United States. The approach focuses on three salient goals of Polish foreign policy: security, guaranteed both by alliance with the Soviet Union and by support for the idea of European collective security; territorial integrity, evidenced by Poland's effort to obtain unconditional international recognition of its western border; and domestic political stability and economic prosperity. Frequently, these goals have been mutually exclusive and unequally pursued.

Presentations

ATKINS, G. Pope, Professor, "**U. S. National Security Interests in the Western Hemisphere**," Latin American Seminar, National Defense University, Fort Lesley J. McNair, Washington, D. C., 23 September 1982.

ATKINS, G. Pope, Professor, "**President Reagan's Latin American Policy**," South American Branch, Department of Commerce, Washington, D. C., 29 September 1982.

ATKINS, G. Pope, Professor, "**Conflict Resolution in the Western Hemisphere**," Meridian House International, Washington, D. C., 4 November 1982.

ATKINS, G. Pope, Professor, "**The Western Hemisphere in World Politics**," Inter-American Defense College, Fort Lesley J. McNair, Washington, D. C., 28 January 1983.

ATKINS, G. Pope, Professor, "**Aftermath of the Malvinas/Falklands War**," Middle Atlantic Council of Latin American Studies, Williamsburg, Virginia, 8 April 1983.

ATKINS, G. Pope, Professor, "**The Inter-American System and the Southern Cone**," Foreign Service Institute, Arlington, Virginia, 12 May 1983.

ATKINS, G. Pope, Professor, "**Argentine Diplomacy in the Malvinas Crisis**," Conference on Civil-Military Relations, Indiana University, Bloomington, Indiana, 28 May 1983.

ATKINS, G. Pope, Professor, "**Declining Role of the United States in Latin America**," American Enterprise Institute, Washington, D. C., 15 June 1983.

COCHRAN, Charles W., Professor, "**U. S. Ocean Policy Objectives and the LOS**," Maritime Administration, Washington, D. C., 2-3 March 1983.

FRANTZICH, Stephen E., Associate Professor, "**Congressional Policy Making in the Computer Age**," American Political Science Association Annual Convention, Denver, Colorado, 3 September 1982.

FRANTZICH, Stephen E., Associate Professor, "**The Political Implications of Computers in Congress**," U. S. Air Force Academy, 6 September 1982.

LIMBERT, John W., Foreign Service Officer, "**The Politics of Cables and Fables**," Middle East Studies Association, Philadelphia, Pennsylvania, 5 November 1982.

LIMBERT, John W., Foreign Service Officer, "**Reflections on the Iranian Revolution**," Brooklyn College, New York, 16 January 1983.

MATTOX, Gale A., Assistant Professor, "**Rethinking NATO Strategy**," International Studies Association, Mexico City, 6 April 1983.

MATTOX, Gale A., Assistant Professor, co-author, "**New Directions in West German Arms Export Policy**," ISA and National Capital Area Political Science Association Annual Meeting, Washington, D. C., 26 February 1983.

MATTOX, Gale A., Assistant Professor, "**U. S. National Security Policy**," (in German to Security Policy Group leaders), Ramparts Program, State Department (USIA), Washington, D. C., January 1983.

MATTOX, Gale A., Assistant Professor, "**National Security Issues for the 1980s**" and "**West European Perspectives on Nuclear Armament**," Mary Washington College, Fredericksburg, Virginia, 24 February 1983.

MATTOX, Gale A., Assistant Professor, "**The Green Movement in Germany**" and "**European vs. U. S. Foreign Policy Interests**," Lafayette College, Easton, Pennsylvania, 24-25 March 1983.

MATTOX, Gale A., Assistant Professor, "**West German Perspectives on Nuclear Armament and Arms Control**," American Academy for Political and Social Science. Address to Annual Meeting, Philadelphia, Pennsylvania, 22 April 1983.

PURKITT, Helen E., Associate Professor, co-author, "**A Content Analysis of U. S. Foreign Policy toward Southern Africa during the Carter and Reagan Administration**," International Studies Association Annual Conference, Mexico City, Mexico, 7 April 1983.

RACHWALD, Arthur R., Assistant Professor, "**Eurocommunism and the Polish Revolt of 1980**," National AAASS Meeting Washington, D. C., 14 October 1982.

RACHWALD, Arthur R., Assistant Professor, "**Current Situation in Poland**," School of Advanced International Studies, Washington, D. C., 8 November 1982.

TOMLINSON, Rodney G., Associate Professor, "**Bloc and Coalition Formation in the United Nations - 36th GA**," Department of State, Washington, D. C., 8 February 1983.

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This annual report summarizes the research work of the Naval Academy faculty and midshipmen for the period July 1982 through June 1983. Sponsored and independent research projects are listed by title, followed by the names of the investigators and an abstract. A list of publications and their abstracts are included as well as presentations at professional meetings, conferences, and seminars.

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