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# NAVAL POSTGRADUATE SCHOOL

Monterey, California



A SUMMARY OF THE  
FOUNDATION RESEARCH PROGRAM

March 1982

Report for the Period

1 October 1980 to 30 September 1981

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Prepared for:  
Chief of Naval Research  
Arlington, Virginia 22217

Chief of Naval Development  
Washington, D. C. 20360

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NAVAL POSTGRADUATE SCHOOL  
Monterey, California

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The work reported herein was supported by the Chief of Naval Research, Arlington, Virginia 22217 and the Chief of Naval Development, Washington, D. C. 20360.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Forty-five projects of Independent Research/Independent Exploratory Development were funded by the NPS Foundation Research Program. This research was in the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics and Chemistry, Electrical Engineering, Meteorology, Aeronautics, Oceanography and Mechanical Engineering. A tabulation in Appendix I identifies area of research and the investigator(s). The category of independent research or independent exploratory research is also identified for each research task.		

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## OVERVIEW OF THE NPS FOUNDATION RESEARCH PROGRAM

FY 1981

The principal thrust of the research and exploratory development program at the Naval Postgraduate School (NPS) stems from its mission:

To conduct and direct advanced education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service; and in support of the foregoing to foster and encourage a program of research in order to sustain academic excellence.

A portion of the research performed at NPS is conducted through grants from the Chief of Naval Research and the Chief of Naval Development. Together these funds provide the basis for the NPS Foundation Research Program.

The major objectives of the Foundation Research Program are four-fold and include:

- \* sponsoring research efforts of junior faculty enabling them to establish a strong research program in their chosen field,
- \* allowing experienced faculty to change the course of their research programs,
- \* increasing the general research capability of the Naval Postgraduate School through capital equipment procurement, and
- \* providing the opportunity for the fulfillment of meritorious research projects that have no sponsor.

The four objectives are pursued with the ultimate goal of simulating the highest quality research program at NPS in support of the educational program received by students.

The Foundation Research Program is administered internally by a Research Council comprised of selected faculty members and headed by the Dean of Research. The function of the Research Council is to properly implement the goals and objectives of the program with a view toward approving meritorious proposals submitted by the NPS faculty.

This report describes the accomplishments of the Foundation Research Program for FY 1981. The summaries of the research efforts are organized by academic departments operating at NPS. Some research efforts have been funded by the Chief of Naval Research (6.1) which are oriented toward initiating and conducting scientific and applied research of a long-range nature in areas of special interest to the Navy. Other efforts have been funded by the Chief of Naval Development (6.2) and are used for conducting exploratory development deriving from scientific program areas or in other areas specifically requested by the Navy.

**DEPARTMENT  
OF  
COMPUTER SCIENCE**

Title: Concurrency Control in Distributed Database Systems

Investigator: D. Z. Badal, Assistant Professor of Computer Science

Sponsor: NPS Foundation Research Program

Objective: To analyze concurrency control mechanisms for distributed database systems.

Summary: This research divides concurrency control (CC) mechanisms into three classes. One class consists of blocking CC mechanisms and two classes contain non-blocking CC mechanisms. We define CC overhead and derive it for each class of CC mechanisms. Since CC overhead is dependent on CC mechanism only, it can be used as a metric for comparison of CC mechanisms and as a measure of CC load on DBMS resources. The research also described two new distributed CC mechanisms which are compared in terms of CC overhead with industry standard distributed 2 phase locking.

Publications: D. Z. Badal, "Concurrency Control Overhead or Closer Look at Blocking vs. Nonblocking Concurrency Control Mechanisms", Proceeding of the 5th Berkeley Conference on Distributed Data Management and Computer Networks, San Francisco, February 1981, pp. 85-105.

D. Z. Badal, "Concurrency Control Overhead or Closer Look at Blocking vs. Nonblocking Concurrency Control Mechanisms", NPS Technical Report, NPS52-81-005, June 1981.

Title: Advanced Methods for Software Development

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

Sponsor: NPS Foundation Research Program

Objective: Continued development of the theory and a practical methodology for advance software development.

Summary: Progress has been made on this project in four areas: theory, metrics, languages, and tools.

(1) Theory. This project has continued an investigation of the general properties of systems. Several formal models of systems have been developed and compared.

(2) Metrics. One of the most important properties of a system is its complexity. This project has developed a method of determining the major structural components of programming languages and other systems. This forms a basis for measuring the complexity of these systems. This project has also addressed the problem of the validation of complexity measures.

(3) Languages. This project has made progress in two aspects of very-high-level languages. First, it has shown that the operators of a relational calculus can be used for the high level manipulation of both data structures and program structures. Second, it has investigated the nature of objects and values in very-high-level functional and applicative programming languages. This has resulted in a clarification of the role each of these play, and guidelines for future language design.

(4) Tools. This project has investigated tools to enhance the development and maintenance of software. A tool that is proving very valuable is a syntax-directed editor. Since a separate syntax directed editor is required for each programming language, this project has developed and implemented a method for implementing these automatically.

Publications: B. J. MacLennan, "Values and Objects in Programming Languages", NPS Technical Report, NPS52-81-006, April 1981, also submitted for publication.

B. J. MacLennan, "Introduction to Relational Programming", NPS Technical Report, NPS52-81-008, June 1981.

Title: The Automatic Design of Algorithms

Investigator: Douglas R. Smith, Assistant Professor of Computer Science

Sponsor: NPS Foundation Research Program

Objective: The automatic design of computer algorithms from a user-supplied formal specification of a problem.

Summary: A new approach to automatic algorithm design has been developed. This research has involved several supporting sub-activities:

- 1) development of a formalism, called a problem reduction system for representing problems,
- 2) development of the abstract control structures and associated correctness schemes for the different algorithmic methods for solving problem reduction systems,
- 3) development of the theory of a new class of deductive mechanisms called precondition generators.

The algorithm design method has been used to derive 10 common divide and conquer algorithms by hand from their specifications.

Publication: D. R. Smith, "A Design for an Automatic Programming System", Proceedings of the Seventh International Joint Conference on Artificial Intelligence, August 1981.

Conference Presentation: D. R. Smith, "Problem Reduction Systems", Mathematics Department Seminar, NPS, January 1981.

Theses: J. S. Lape, and C. W. Miller, "Condition Recognition for a Program Synthesizer", Master's Thesis, June 1981.

**DEPARTMENT  
OF  
MATHEMATICS**

Title: Using Full Sequences for Spread Spectrum Applications

Investigator: H. M. Fredricksen, Associate Professor of Mathematics

Sponsor: NPS Foundation Research Program

Objective: To develop algorithms to generate sequences to be used in spread spectrum applications and to determine the efficacy of those sequences for the proposed use.

Summary: The binary full length non-linear shift register sequences were considered as possible good sequences to be employed in a spread spectrum system. It was necessary to determine good and efficient algorithms to generate the sequences and then to determine for the sequences generated how well they could be used as sequences in the spreading applications. Several algorithms were detailed and some of the sequences generated were further analyzed as spreading sequences. Research continues in this area on an unfunded basis.

Publication: H. M. Fredricksen, "A Survey of Full Length Non-Linear Shift Register Cycle Algorithms", SIAM Review, April 82 (forthcoming).

Conference Presentation: H. M. Fredricksen, "Using Full Sequences for Spread Spectrum Applications", International Information Theory meeting, Santa Monica, California, February 9 - 12, 1981.

Title: Numerical Solution of Fixed-Point Equations

Investigator: Michael D. Humphries, Adjunct Professor of Mathematics

Sponsor: NPS Foundation Research Program

Objective: To study the behavior of certain numerical methods, to develop them into useful algorithms, to apply them to other kinds of fixed-point problems, and to obtain a theoretical analysis of their properties.

Summary: Theoretical and experimental analyses were carried out to determine which algorithms were most appropriate. The choice of various parameters depends on the characteristics of the particular equation. New, more efficient algorithms were introduced as a result of this study.

Publication: Michael D. Humphries, "Numerical Solution of Fixed-Point Equations, NPS Technical Report, (forthcoming).



Title: Convergence of Non-Linear Optimization Algorithms Under Weakened Hypotheses

Investigator: I. B. Russak, Associate Professor of Mathematics.

Sponsor: NPS Foundation Research Program

Objective: To establish a weakened set of hypotheses under which it can be guaranteed that certain types of non-linear optimization algorithms will converge. Also to determine what the convergence rates are.

Summary: Consider the general constrained optimization problem

$$\begin{aligned} &\text{minimize } f(X) \\ &\text{subject to} \\ &g_{\alpha}(X) \leq 0 \quad \alpha=1, \dots, m' \quad g_{\alpha}(X)=0 \quad \alpha=m'+1, \dots, m \end{aligned}$$

where  $X$  is an  $N$ -dimensional vector. Real world applications of this problem occur very frequently in military applications, e.g. optimizing with respect to time to intercept, the parameters of a missile inteceptor system subject to constraints on its motion. Often however the restrictive conditions assumed in many convergence proofs of numerical algorithms for solving problems of this type are not true. It may therefore be incorrect to apply such algorithms in those cases. A weakened set of hypotheses which more accurately represents the real world situation is being developed and convergence rates under these modified conditions are being investigated.

Publication: I. B. Russak, "Convergence of Non-Linear Optimization on Algorithms Under Weakened Hypothesis," NPS Technical Report, (forthcoming).

**DEPARTMENT  
OF  
ADMINISTRATIVE SCIENCES**

Title: The Development of Case Research Methods in the Organizational Sciences

Investigator: Roger D. Evered, Associate Professor of Organizational Sciences, Department of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: To explore ways for extracting generalizable knowledge and theories from in-depth case studies of particular situations. It is postulated that systematic procedures can be found as an alternative to the usual reductivistic way of testing for commonalities, which necessarily destroys the complexity of the real event. This is part of an ongoing study to overcome the limitations of positivism in the social sciences.

Summary: A search has been made for studies that have examined the epistemology of the case method. Case epistemology has been contrasted with the nomothetic science method. Several possible case-based epistemologies are identified together with their advantages relative to normal nomothetic sciences.

Publications: R. D. Evered, "Case: The Surface Effect Ship Program," Intercollegiate Case Clearing House, with teaching note, 1981.

Theses Directed: D. Karnesky, "Case Writing for Military Organizations," Master's Thesis, March 1981.

**Title:** Analysis of Corrective Maintenance Active Repair Time Data

**Investigator:** M. B. Kline, Professor of Administrative Sciences

**Sponsor:** NPS Foundation Research Program

**Objective:** To continue analysis of active corrective maintenance repair time data from previous research to include non-electronic systems as well as more recent electronic systems which use advanced digital techniques such as digital diagnostics and built-in-test with respect to the suitability of the lognormal or exponential distributions as an estimator of repair times.

**Summary:** Data on mechanical systems and components such as helicopters, nuclear energy generation equipment (pumps, cooling components, extractors) and more recent electronic systems has been collected and is currently being analyzed using various statistical data analysis methods. The previous research established that the lognormal distribution was a more suitable description for repair times than the exponential distribution for electronic items.

**Publications:** M. B. Kline and R. Almog, "Suitability of the Lognormal Distribution to Corrective Maintenance Repair Times," Proceedings, Second International Conference on Reliability and Maintainability, Perros-Guirec, France, September 1980, pp 338-344.

**Conference Presentations:** M. B. Kline and R. Almog, "Suitability of the Lognormal Distribution to Corrective Maintenance Repair Times," NATO/AGARD Conference, Ankara Turkey, April 1979.

M. B. Kline and R. Almog, "Suitability of the Lognormal Distribution to Corrective Maintenance Repair Times," Second Annual Conference on Reliability and Maintainability, France, September 1980.

**Thesis Directed:** E. Camozu, "Analysis of Repair Time Data of Some Electronic and Mechanical Equipments," Master's Thesis, (forthcoming).

**Title:** Cost Accounting and Analysis in the Governmental Sector

**Investigator:** Shu S. Liao, Associate Professor of Administrative Sciences

**Sponsor:** NPS Foundation Research Program

**Objectives:** To develop the framework for a cost accounting system for governmental organizations by integrating program budgeting, output measurement, and cost accounting techniques.

**Summary:** Using municipal government organization as a model, this study developed methods of integrating policy setting, service, delivery, and performance evaluation in an accounting system. The primary purpose of such an accounting system is to generate useful information for governmental managers and policy makers. The accounting system also facilitates the preparation of an operating statement called for by the Financial Accounting Standards Board.

**Publications:** Shu S. Liao, "Integrating Policysetting, Service Delivery, and Performance Evaluation in an Accounting System: A General Framework," under review for publication in Public Administration Review.

Shu S. Liao, "Nonbusiness Financial Reporting: An Operating Statement Approach," under review for publication in Journal of Accounting, Auditing and Finance.

**Conference Presentation:** Shu S. Liao, "A Cost Accounting System for General Governmental Operations," Collected Abstracts of the American Accounting Association's Annual Meeting, August 6-8, 1981.

Title: Career Transition Agenda: Identifying What is Accomplished in Adapting to a New Job

Investigator: Meryl R. Louis, Assistant Professor of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: This study is part of a continuing research program and overall aims of which are to expand our understandings of career transitions. The current phase of the research was designed to identify fundamental tasks which newcomers accomplish in completing career transitions.

Summary: To date the research program has resulted in the formulation of: 1) a model of the cognitive processes by which individuals cope with transition experiences; 2) a conceptual framework distinguishing among features of transition experiences; 3) a typology of career transition situations; 4) an agenda of fundamental career transition tasks. In addition, a comparative analysis of alternative organizational practices for facilitating career transitions was conducted. And cultural aspects of organizational life relevant to newcomers have been described, as have more general aspects of culture in organizations.

Publications: M. R. Louis, "Managing Career Transitions: A Missing Link in Career Development", Organizational Dynamics, Spring 1982.

M. R. Louis, "A Cultural Perspective on Organizations: The Need for and Consequences of Viewing Organizations as Culture-Bearing Milieus", Human Systems Management, Volume 2, pp 246-258, 1981.

M. R. Louis, "Organizations as Culture-Bearing Milieus", In Louis R. Pondy et al (Eds.) Organizational Symbolism, Scott-Foresman (forthcoming).

M. R. Louis, "MBA's in the Press", Wharton Magazine, pgs 12-18, Fall 1981.

M. R. Louis, "Alternative Perspectives in the Organizational Sciences: 'Inquiry from the Inside' and 'Inquiry from the Outside'", Academy of Management Review, 1981, 6, #3, 385-395.

Conference  
Presentations:

M. R. Louis, "The Emperor Has No Clothes: The Effect of Newcomers on Work Group Culture", presented at the Western Academy of Management Meetings, April 1981, Monterey.

M. R. Louis, "Conversations on Organizational Culture", A symposium conducted at the Western Academy of Management Meetings, April 1981, Monterey.

M. R. Louis, "Managing Career Transitions: A Missing Link in Career Development", presented at the ORSA/TIMS Meetings, Colorado Springs, November 1980.

Thesis Directed:

Steven Froehlich, "The Sponsor Program: Facilitating Anticipatory Socialization for Personnel Being Transferred in the United States Coast Guard", Master's Thesis, December 1980.

Title: Enlistment Supply Models

Investigator: George Thomas, Professor of Management and Psychology,  
Department of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: To develop a supply model for high quality sailors.  
Then, to utilize the model to demonstrate a methodology  
for comparing alternative compensation policies for  
obtaining a required number of high quality sailors.

Summary: This research resulted in a development of a supply  
model for high quality sailors, i.e., mental group  
categories I and II, high school graduates. The  
explanatory variables were relative military pay,  
unemployment, number of recruiters, and the size of  
the eligible pool. Research on the demand for high  
quality sailors yielded data both on past accessions  
of high quality sailors and current utilization of  
high quality sailors by navy occupations. The  
supply model was used to demonstrate a methodology  
for comparing alternative compensation policies for  
accessioning a required number of high quality  
sailors.

Publications: G. Thomas and W. Van Doran, "The Supply of High  
Quality Sailors," NPS Technical Report, (forthcoming).

Thesis Directed: W. Van Doran, "The Demand and Supply of High Quality  
Sailors," Master's Thesis, December 1981.



Title: Sequential Testing for Selection: Tryout on Real Data

Investigator: R. A. Weitzman, Associate Professor of Psychology

Sponsor: NPS Foundation Research Program

Objective: A previous study showed that sequential testing worked on Monte Carlo data--the observed matched the theoretical Type I and Type II selection errors. The current study extended the method to real data.

Summary: The current study simulated sequential testing on real data consisting of the responses (correct or incorrect) of 960 Navy enlisted men to 70 items on the Electronic Technician Selection Test. The method successfully used these responses to predict with specified Type I and Type II selection errors performance on the final examination in the Basic Electricity and Electronics Class A School.

Publications: R. A. Weitzman, "Sequential Testing for Selection," (submitted for publication to Applied Psychological Measurement).

R. A. Weitzman, "Sequential Testing for Selection," NPS Technical Report, NPS54-80-Q13, December 1980.

Title: An Investigation into the Existence of a General Theory of Intra Firm Behavior

Investigators: David Whipple, Associate Professor of Economics and Systems Analysis, Department of Administrative Sciences and Kathy Kocher, Adjunct Professor of Economics, Research Investigator, Department of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: To begin the formalization of the differences and similarities in discipline-specific approaches to intra organizational efficiency-based problem solving in order to facilitate the development of more effective solution strategies.

Summary: Over the past few years there has been evidenced increasing concern over the applicability of traditional economic, management, and systems analysis theories to problems faced by specific individual firms, or production entities. This has led, in part, to the development of disciplines such as organizational behavior which have attempted to devise solution strategies based on the application of highly subjective techniques to the specific problem environment. While this may well alleviate or mitigate some of the specific problems encountered by that specific firm, it unfortunately does not (or at least, has not yet) lend itself to the formalization of a general theory of such intra firm behavior which would then be useful to analysts and policy-makers involved in decision making which may have significant (e.g., industry-wide) ramifications. This in turn has led to a general inability to predict and control such behavior and therefore, to the adoption of ineffective, or worse, counter productive, "macro" policies, and to the observation that, even if situations involve relatively homogeneous, or small numbers of, firms, policies flowing from rigorous and correct research and analysis do not often lead to the projected results after implementation. The general plan of attack here was to analyze representative pieces of three types of existing literature: traditional economics/theory of the firm, management/organizational behavior, and an institution-specific subset, to compare and contrast the major implications flowing from the first two in terms of the desire to motivate more

efficient behavior within typical organizations, and to develop testable hypotheses based on this juxtaposition.

**DEPARTMENT**  
**OF**  
**OPERATIONS RESEARCH**

**Title:** Operational Availability Analysis of Weapon Systems with Finite Spares Support

**Investigator:** F. Russell Richards, Associate Professor of Operations Research

**Sponsor:** NPS Foundation Research Program

**Objective:** To develop an algorithm for the determination of spares allocation to support weapon systems by maximizing the operational availability of weapon systems subject to a budget constraint.

**Summary:** Mathematical results were obtained for the component availability at any time given any number of spares for support of the component. Various operational deployment scenarios were investigated and expressions derived for system availability as a function of configuration and deployment scenario. A spares allocation algorithm was developed. A computer simulation model was developed to explore the sensitivity of system availability to the various model parameters and to allow comparison of effectiveness of the allocation procedure developed here with other allocation policies.

**Publications:** F. R. Richards, "Operational Availability Analysis of Weapon Systems with Finite Spares Support," NPS Technical Report (forthcoming).

**Conference Presentations:** F. R. Richards, "Operational Availability Analysis," Military Operations Research Society (MORS), 46th Symposium, U.S. Naval War College, Newport, Rhode Island, 2-4 December 1980.

**Thesis Directed:** Pat O'Reilly, "An Evaluation of Alternative Spares Stockage Policies," Thesis in progress.

Title: Representation of Additional Operational Factors in Combat Models

Investigator: James G. Taylor, Professor of Operations Research

Sponsor: NPS Foundation Research Program

Objective: To investigate how operational factors such as terrain effects, weapon-system capabilities, logistics constraints, etc., may be quantitatively included in force-on-force combat models and to analytically investigate how these included factors influence engagement outcome in such simulated combat. In support of this overall objective, the current state of the art for quantitative methodology for determining numerical values for Lanchester attrition-rate coefficients and for representing various tactically relevant operational factors in them was to be extended. Additionally, the consequences of representing the attrition process as either a deterministic or a stochastic process was to be investigated with respect to engagement outcome and the structure of the optimal combat strategies.

Summary: This research investigated the basic paradigms out of which complex operational Lanchester-type models have been developed through the process of model enrichment. It focused on (1) representing operational factors such as the line-of-sight process, target acquisition, weapon-system capabilities, logistics constraints, etc., in Lanchester attrition-rate coefficients, and (2) assessing the consequences of such functional representations with respect to engagement outcomes. A simple transparent derivation of the expected time for a single typical firer to kill a target was given under more general conditions than previously considered in the literature. The representation of the line-of-sight and the target-acquisition processes in Lanchester attrition-rate coefficients was investigated. The mathematical behavior of the models thusly formulated was also investigated: the qualitative behavior (including battle-outcome prediction) of solutions to these nonlinear Lanchester-type models that consider parallel acquisition of targets was determined. Other work investigated how the occurrence of force annihilation in such simulated combat depends on model parameters through the functional

dependence of the so-called modified parity-condition parameter on its argument for a particular important class of Lanchester-type equations for modern warfare. Force-annihilation-prediction conditions were also developed for Lanchester-type equations of modern warfare in which an important type of logistics constraint (limited ammunition) has been incorporated into the attrition-rate coefficients. Finally, the consequences of representing such a Lanchester-type attrition process as either a deterministic process or a stochastic one was investigated with respect to engagement outcome and optimal combat strategies. In particular, the structure of the optimal time-sequential fire-distribution policy obtained for a deterministic Lanchester-type attrition model was compared with that for a stochastic one.

Publications:

J. G. Taylor, "Analysis of the Functional Dependence of the Modified Parity-Condition Parameter on Its Argument for an Important Class of Lanchester-Type Equations for Modern Warfare," International Journal of Systems Science, (forthcoming).

J. G. Taylor, "A Simple Derivation of an Expression for the Lanchester Attrition-Rate Coefficient for 'Aimed-Fire' Combat," submitted to Journal of the Franklin Institute.

J. G. Taylor, "Annihilation Prediction for Lanchester-Type Models of Modern Warfare with Logistics Constraints," submitted to Mathematical Modelling.

J. G. Taylor and R. L. Powers, "Comparison of Optimal Time-Sequential Fire-Distribution Policies Determined from Deterministic and Stochastic Lanchester-Type Combat Models," submitted to Computers and Operations Research.

J. G. Taylor, "Qualitative Behavior of Solutions to Some Nonlinear Lanchester-Type Models that Consider Parallel Acquisition of Targets," submitted to International Journal of Systems Science.

Conference Presentation:

J. G. Taylor, "Survey of Stochastic Lanchester-Type Models," ORSA/TIMS Joint National Meeting, Houston, Texas, 13 October 1981.

Theses Directed:

G. K. Jenkins, "Decomposition of Attrition Processes in Hierarchical Models," Master's Thesis, June 1981.

S. D. Park, "An Operational Lanchester-Type Model of Small-Unit Amphibious Operations," Master's Thesis, September 1981.



**DEPARTMENT  
OF  
NATIONAL SECURITY AFFAIRS**

Title: United States Policy Toward Conflict in Africa

Investigator: Michael Clough, Adjunct Professor of  
National Security Affairs

Sponsor: NPS Foundation Research Program

Objective: To examine the role of the United States in the  
resolution of revolutionary conflicts in Africa.

Summary: To date, this research has involved tracing the  
evolution of political conflicts in Rhodesia and  
Namibia. It has used a loose bargaining model to  
identify major shifts in the nature of these con-  
flicts and to isolate the specific effect of United  
States policy in relation to these shifts. Initial  
studies have begun to expand the scope of this  
research to cover the Angolan Civil War and the  
Algerian revolution.

Publications: M. Clough, "From Rhodesia to Zimbabwe," in M. Clough  
(ed.) Political Change in Southern Africa, Institute  
of International Studies, University of California,  
Berkeley, (forthcoming).

M. Clough, "From Southwest Africa to Namibia," in M.  
Clough (ed.) Political Change in Southern Africa,  
Institute of International Studies, University of  
California, Berkeley, (forthcoming).

M. Clough, "Why Carrots Alone Won't Work," African  
Index, June 30, 1981.

M. Clough, "Namibia 1981?" African Index, December  
17, 1980.

Title: Cry Wolf Effects

Investigator: Katherine L. Herbig, Adjunct Professor of National Security Affairs

Sponsor: NPS Foundation Research Program

Objective: To investigate the phenomena labeled "cry wolf effects," i.e., repeated exposure to alarms which prove false, and the psychological impact such a pattern has on military readiness and response.

Summary: A survey of the literature on warning and strategic surprise revealed a variety of situations labeled "cry wolf effect." These were compared and analyzed; historical instances were discussed in the light of four psychological concepts relevant to the problem: availability, expectancy, desensitization, and decision-making process.

Publication: Katherine L. Herbig, "The Cry Wolf Effects," NPS Technical Report (forthcoming).

Conference Presentation: Katherine L. Herbig, "The Cry Wolf Effect on Military Surprise," International Studies Association Conference, Philadelphia, Pennsylvania, March 1981.

**Title:** Analysis of Mexican Growth Alternatives

**Investigators:** Robert Looney, Associate Professor of National Security Affairs, principal investigator and Peter C. Frederiksen, Associate Professor, Defense Resources Management Education Center

**Sponsor:** NPS Foundation Research Program

**Objective:** The major objective is to develop an optimal control-type macro-economic model of the Mexican economy from which a series of forecasts of the Mexican economy will be made under different assumptions concerning oil revenues.

**Summary:** The macro-economic model of twenty-six structural equations has been developed. These are determined by two stage least squares estimations for annual data covering the period 1951-1980. All in all there are thirty-eight endogenous and exogenous variables from which the model is constructed.

Preliminary optimal control analysis has been made of the expenditure of oil revenues by the Mexican Government over the period 1976-1979. A welfare loss function was selected that optimized growth with inflation setting a limit on the rate of expansion of the economy. Preliminary results indicate that the economy has not been able to effectively absorb the oil revenues and that a considerable amount of waste has resulted from the government's past patterns of expenditures in the sense that much of the oil receipts have in effect been used to finance imports.

Forecasts are now under way to determine the optimal rate of oil depletion under various assumptions as to international oil prices. Preliminary results indicate that it will be possible within a constraint on inflation for the government to gradually expand the rate of oil production from about 2.75 million barrels per day in 1980 to about 5.8 million barrels per day in 1990 without incurring excessive rates of inflation. In general it is assumed that at least half of this production will be exported to the United States.

A series of policy implications is being drawn for U. S. policy makers.

Publication:

R. Looney, Development Alternatives for Mexico  
(Praeger Publishers: New York, New York, forthcoming).

Title: South Korean Nationalism: Roots, Impact, and Prospects

Investigator: E. A. Olsen, Adjunct Professor, National Security Affairs

Sponsor: NPS Foundation Research Program

Objective: To determine the role of South Korean nationalism in shaping the Park Chung-hee and Chun Du-hwan governments and how it is being modified today.

Summary: A survey of the relevant literature was made, supplemented by interviews with several Korean academic authorities and American academic and governmental specialists on Korea. Several distinct patterns in the growth of South Korean nationalism became evident: a formative stage, a separatist stage, a nation-building stage, and a utilitarian stage. Over these stages South Korean nationalism evolved from a "cause" to a "result."

Publications: E. A. Olsen, "The Political Implications of Resource Scarcity on the Korean Peninsula," Korean Observer (December 1981), pp. 395-405.  
It also will be published in a book co-edited by the investigator and Professor Y.S. Yim, due in early 1982.  
  
E. A. Olsen, "South Korean Nationalism," Pacific Community (forthcoming).

Conference Presentation: E. A. Olsen, "The Political Implications of Resource Scarcity on the Korean Peninsula," American Political Science Association Annual Meeting, New York, September 1981.

Title: Soviet Decisionmaking for the National Security

Investigator: J. Valenta, Associate Professor and Coordinator of Soviet and East European Studies, NSA  
W. Potter, Assistant Director, CSIS, UCLA

Sponsor: NPS Foundation Research Program

Summary: The joint work to complete a manuscript based on the conference sponsored by the NPS/UCLA has been completed. The chapters have been updated and edited. The editors wrote the introduction and conclusion. The major findings of the book support the hypothesis about the complex nature of Soviet decisionmaking for national security often circumspected by the specific political culture and sometimes by the bureaucratic and organizational interests of the people involved.

Publications: J. Valenta and W. Potter, eds., Soviet National Security Decisionmaking (London: Allen and Unwin Publishers), (forthcoming).

J. Valenta, "From Prague to Kabul: The Soviet Style of Invasion," International Security, Fall 1980, pp. 114-141.

Conference Presentations: J. Valenta and S. Butler, "Soviet Interests in Southwest Asia," Strategic Institute, U.S. Army War College, October 15-16, 1981.

Thesis Directed: M. Hesson, "Demographic, Economic and Ethnic Factors and the Soviet Armed Forces," Master's Thesis, September 1981.

Title: French and Soviet Perspectives on Theater Nuclear Policy and Arms Control

Investigator: David S. Yost, Assistant Professor of National Security Affairs

Sponsor: NPS Foundation Research Program

Objective: Advance understanding of NATO interests and perceptions regarding probable theater nuclear arms control negotiations.

Summary: The first phase of this project (Summer 1980) focused primarily on France (in the context of NATO Europe in general), while the second phase (Winter 1981) focused on the Soviet Union and the probable content and course of imminent theater nuclear arms control negotiations. The research clarified West European and Soviet interests and perceptions regarding SALT II and SALT III issues, and reached conclusions as to U.S. policy alternatives.

Publications: D.S. Yost, "Beyond SALT II: European Security and the Prospects for SALT III," in Orbis, 24 (Fall, 1980), 625-655.

D.S. Yost, "SALT and European Security," in D.S. Yost, ed., NATO's Strategic Options: Arms Control and Defense (New York: Pergamon Press, 1981).

D.S. Yost, Der SALT-Prozess und die sicherheitspolitische Lage Westeuropas (Sankt Augustin/Bonn, Federal Republic of Germany: Konrad-Adenauer-Foundation, 1980).

D.S. Yost, European Security and the SALT Process, Washington Paper no. 85 (Beverly Hills and London: Sage Publications, 1981), series sponsored by Georgetown University's Center for Strategic and International Studies.



Conference  
Presentations:

D.S. Yost, "SALT, Strategic Doctrine, and Strategic Forces in the Light of Soviet Force Programs," 20th anniversary conference of the Inter-University Seminar on Armed Forces and Society, University of Chicago, October 23-25, 1980.

D.S. Yost, "National Outlooks on Security Issues in Western Europe," Naval Air Systems conference on National Security and Foreign Affairs in the 1980s, Annapolis, Maryland, December 7-10, 1980.

Theses Directed:

T.C. Glad, "Theater Nuclear Force Modernization as an Issue in West German Politics, 1977-1980," Master's Thesis, December 1980.

M. Helgeson, "Domestic Determinants of American Strategic Nuclear Doctrine, 1965-1980," Master's Thesis, December 1980.

G. Caughey, "Naval Implications of the Strategic Arms Limitation Talks," Master's Thesis, December 1980.

M. Carr, "The Campaign for Nuclear Disarmament in Britain 1958-1964 and 1979-1981: Apparent Impacts on Britain's Contribution to NATO," Master's Thesis, June 1981.

**DEPARTMENT**  
**OF**  
**PHYSICS AND CHEMISTRY**

Title: Classical Trajectory Studies of Low Energy Ion Impact Mechanisms on Clean and Reacted Single Crystal Surfaces

Investigators: Don E. Harrison, Jr., Professor of Physics, and Roger P. Webb, Post Doctoral Associate, with K. E. Foley, B.J. Garrison and N. Winograd, Pennsylvania State University

Sponsor: National Science Foundation and NPS Foundation Research Program (collaborators have separate support).

Objectives: Continue study of the effects produced when ions bombard clean and chemically reacted single crystal metal surfaces to understand mechanisms and coordinate with experimental investigations.

Summary: Classical trajectory simulations have developed to the point that it is feasible to model the cascade produced by an ion impact event. The ability to follow each individual atom in the cascade leads naturally to pictorial interpretations of a single sputtering event. Statistical analysis of data produces numbers which can be directly compared to the experimental data. The model computations are done using single crystal targets oriented to expose the low index surfaces. Research effort this year has established that many atom ejection effects normally attributed to the ion mass are actually caused by the ion's size. The influence of the atom-atom potential also has been studied. It appears possible to obtain useful atom-atom potential functions by comparing simulation results to experimental data. Small mass ratio, heavy target atoms, lead to a larger fraction of high energy ejected atoms.

Publications: N. Winograd, K. E. Foley, B. J. Garrison and D. E. Harrison, Jr., "Evidence for a Recombination Mechanism of Cluster Emission from Ion Bombarded Metal Surfaces," Physics Letters 73A(3) (1979) 253-55.

D. E. Harrison, Jr., "Atom Ejection Studies by Classical Trajectory Simulation," AIP Conference Proceedings No. 61, Aspects of the Kinetics and Dynamics of Surface Reactions (La Jolla Institute- 1979) ed. U. Landman, American Institute of Physics, New York, 1980, pp 307-18.

D. E. Harrison, Jr., B. J. Garrison and N. Winograd "Atom Ejection Mechanisms and Models," Secondary Ion Mass Spectrometry: SIMS II, ed. A. Benninghoven, et. al., Springer-Verlag New York (1979) pp 12-14.

B. J. Garrison, N. Winograd and D. E. Harrison, Jr., "Classical Trajectory Calculations of the Energy Distribution of Ejected Atoms from Ion Bombarded Single Crystals," Surface Science 87, (1979) 101-111.

D. E. Harrison, Jr., "Full Lattice Simulations of Atom Ejection Mechanisms," Proceedings: Symposium on Sputtering, Perchtoldsdorf/Vienna, Austria, April 2830, 1980, ed. P. Varga, et. al., pp 36- 61. (unpublished).

Title. Spectroscopic Data Center Compilation of Atomic Energy Levels

Investigator: Raymond L. Kelly, Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: To produce a useful, comprehensive, and semi-critical compilation of atomic energy levels, based on publications listing spectrum lines. The compilation is to be available to a large community of users, and is to be updated regularly on a continuing basis.

Summary: The initial phase of the compilation has been completed for the first 24 elements, Hydrogen through Chromium, for all stages of ionization. Such information makes possible classification of unidentified lines from plasma sources and in solar spectra, as well as the prediction of other lines (valuable in laser physics).

Publication: Raymond L. Kelly, "The Atomic Energy Levels of Iron," NPS Technical Report, NPS61-81-026, June 1981.

Title: Experimental Investigation of Electromagnetic Interference Zones during Ducting Conditions

Investigator: G. E. Schacher, Professor of Physics

Sponsor: NPS Foundation Research Program and Naval Ocean Systems Center

Objective: Investigate the interference pattern produced by multimode propagation in an atmospheric electromagnetic duct.

Summary: During September, 1980 signal strength measurements were performed over a 150 nmi range on Monterey Bay for a two week period. An aircraft carried a UHF transmitter and the receiver was located on Pt. Pinos. The aircraft had a complete suite of meteorological sensors so that the properties of the atmosphere were determined. Non-monatonic variations of signal strength with range were detected. The coupling of electromagnetic energy into the duct when the transmitter was outside its boundaries was found to be larger than predicted. Analysis of the data is proceeding.

Title: Plasma Surface Interaction

Investigator: F. Schwirzke, Associate Professor  
of Physics and Chemistry

Sponsor: NPS Foundation Research Program

Objective: To investigate unipolar arc damage of  
several materials, including stainless  
steel and TiC

Summary: Plasma-surface effects are of importance  
during the operation of high power plasma  
facilities like beam weapons, some high  
power lasers, high power x-ray generators,  
high power switches and controlled  
thermonuclear fusion devices, when material  
surfaces are exposed to particle and photon  
fluxes from a hot plasma. Such exposure  
causes surface damage via physical and  
chemical sputtering, evaporation and uni-  
polar arcing. The last one, arcing  
represents one of the most damaging  
plasma-surface interaction processes. Arc  
craters produced by plasma surface contact  
were detected with the scanning electron  
microscope on a stainless steel surface  
which was exposed to the plasma produced by  
a Q-switched Laser pulse. The laser pro-  
duced plasma with an electron temperature  
of about 100 eV expands rapidly from the  
focal spot on the target surface in normal  
and in radial direction. Although no  
external voltage is applied, about 20,000  
unipolar arc craters are observable on the  
stainless steel surface which was exposed  
to the radially expanding plasma for the  
short time of a few hundred nanoseconds.  
The size of the arc craters become smaller  
with increasing distance from the focal  
spot. This evidence shows that a laser  
produced plasma can be used to study  
plasma-surface effects. A new unipolar arc  
model has been developed.

- Publications: F. Schwirzke and R. J. Taylor, "Surface Damage by Sheath Effects and Unipolar Arcs," Journal of Nuclear Materials, 94 & 95 (1980) 780.
- F. Schwirzke, R. F. Bunshah and R. J. Taylor, "Observation of Unipolar Arc Damage on Stainless Steel," Thin Solid Films, 83 (1981) 117.
- Conference Presentations: F. Schwirzke, "Unipolar Arcing," Invited Paper, 1981 IEEE International Conference on Plasma Science, Santa Fe, NM, May 18-20, 1981.
- F. Schwirzke, J. H. Barker III, M. T. Keville, R. W. Lautrup, R. J. Rush, and R. J. Taylor, "Unipolar Arc Studies on Selected Materials," 1981 IEEE International Conference on Plasma Science, Santa Fe, NM, May 18-20, 1981.
- F. Ryan and F. Schwirzke, "The Role of Grain Boundaries in Cold Cathode Arc Initiation," 1981 IEEE International Conference on Plasma Science, Santa Fe, NM, May 18-20, 1981.
- F. Schwirzke, R. F. Bunshah and R. J. Taylor, "Observation of Unipolar Arc Damage on Stainless Steel and TiC Coatings on Stainless Steel," International Conference on Metallurgical Coatings, San Francisco, CA, April 6-10, 1981.
- F. Schwirzke, "Unipolar Arcs," NATO Advanced Study Institute on Electrical Breakdown and Discharges in Gases, Les Arcs, France, June 28-July 10, 1981.
- Theses Directed: J. H. Barker III and R. J. Rush, "An Investigation of Plasma-Surface Interactions on Selected Conductors and Insulators," Master's Thesis, December 1980.
- F. T. Ryan and S. T. Shedd, "A Study of the Unipolar Arcing Damage Mechanism on Selected Conductors and Semiconductors," Master's Thesis, June 1981.
- M. H. Beelby and H. G. Ulrich, "A Study of the Breakdown Mechanism of AISI 304 Stainless Steel, AISI 2024 Aluminum and Various Titanium Coatings," Master's Thesis, December 1981.



Title: Measurement of Underwater Acoustic Noise  
Due to Surf Phenomena

Investigators: O. B. Wilson, Professor of Physics, and H. A.  
Dahl, Assistant Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: To determine by means of a steerable  
receiving array the horizontal anisotropy  
of ambient noise in Monterey Bay under a  
variety of sea conditions and ranges from  
shore.

Summary: This was a continuation of the ambient  
noise directionality measurements in Mon-  
terey Bay begun in a previous year. As in  
the earlier work the measurements were made  
using Difar sonobuoys were modified to  
extend their lifetimes to periods of sever-  
al days. The modified buoys, however, did  
not prove to be entirely reliable, often  
failing within a period of a few hours.  
Computer programs were written to facili-  
tate the measurement and graphic recording  
of sonobuoy sensitivities prior to deploy-  
ment in the water. Computer programs that  
process real time noise data and plot the  
results as normal, surf conditions in the  
spring and summer, showed significant anis-  
otropy in the ambient noise, being as much  
as 10 dB more pronounced in the shoreward  
direction, for ranges out to 15 km from the  
beach in the frequency band of 20 Hz to 700  
Hz.

Title: Underwater Acoustic Noise Due To Surf Phenomena

Investigators: O. B. Wilson, Professor of Physics, and Harvey A. Dahl, Assistant Professor of Physics, Department of Physics and Chemistry, Stephen N. Wolf, Naval Research Laboratory

Sponsor: NPS Foundation Program and Naval Sea Systems Command

Objective: To determine whether surf generated noise is a significant component of the shallow water ambient noise. This is a continuation of work started in FY 1980.

Summary: Horizontal directionality of ambient noise was measured at ranges up to 15 km from the eastern shore of Monterey Bay, California. Water depths at the sites ranged from 8 to 175 m. A steerable cardioid receiving pattern was formed using signals telemetered from dipole and omnidirectional hydrophones suspended from tethered buoys. With no nearby shipping, whenever the maximum of the cardioid pattern was directed toward the beach, noise levels in the range 20 to as much as 700 Hz were greater than those obtained when the maximum was directed seaward. This difference or anisotropy (seaward vs. shoreward), which depended on range from the beach and on frequency, was 10 dB at 300 Hz at the 9 km site during very heavy surf. Surf beat was clearly audible when the cardioid maximum was steered shoreward at ranges as great as 2 km. During heavy surf, the ambient noise levels increased significantly in the same frequency range at which the anisotropy is evident. Also, the spectrum levels at these same frequencies decreased with increasing range from shore. The anisotropy diminished both in magnitude and in frequency range with lower wave height but was still observable during very light surf. The evidence is very strong that when wind and surf are high, breaking surf can contribute significantly to ambient noise in fairly deep continental shelf waters.

Publications: A manuscript for a Technical Report is in preparation. These results will also be submitted to the Journal of the Acoustical Society of America for publication as a paper.

Conference Presentations: The results will be reported at the December 1981 meeting of the Acoustical Society of America. Results of work in 1980 were presented at a similar meeting in Nov 1980.

Thesis Directed: J. Gagliardi, "Measurements of Horizontal Directionality of Ambient Noise in Monterey Bay", J. Gagliardi, Master's Thesis, Dec 1981.

**DEPARTMENT**  
**OF**  
**ELECTRICAL ENGINEERING**

Title: Millimeter Wave Transmission Media

Investigator: Jeffrey B. Knorr, Associate Professor of Electrical Engineering

Sponsor: NPS Foundation Research Program

Objective: To determine the characteristics of transmission media for millimeter wave integrated circuits including propagation, discontinuities and circuits.

Summary: An analysis of wave propagation on fin-lines has been completed and the reactance of a shorting septum in fin-line has been determined. Numerical and experimental studies of other fin-line discontinuities and circuits are in progress.

Publications: J. B. Knorr & P. M. Shayda, "Millimeter Wave Fin-Line Characteristics," IEEE Trans. on Microwave Theory and Techniques, Vol. MTT-28, pp 737-743, July 1980.

J. B. Knorr, "Equivalent Reactance of a Shorting Septum in a Fin-Line: Theory and Experiment," IEEE Trans. on Microwave Theory and Techniques, Vol. MTT-29, pp 1196-1202, November 1981.

Theses Directed: P. M. Shayda, "Spectral Domain Analysis of Fin-Line," Master's Thesis, December 1979.

G. Miller, "An Experimental Investigation of Some Fin-Line Discontinuities," Master's Thesis, December 1980.

S. Vlachos, "Equivalent Circuit Models for Some Fin-Line Discontinuities," Master's Thesis, June 1981.

**Title:** Radar Target Identification via Time-Domain Scattering Signatures

**Investigators:** Michael Morgan, Assistant Professor of Electrical Engineering and Michael Hamid, Adjunct Professor of Electrical Engineering

**Sponsor:** NPS Foundation Research Program

**Objective:** The long-range goal of this investigation is to establish the feasibility of developing advanced radar systems which are capable of target discrimination and classification via transient time-domain scattering returns. To achieve this objective, a comprehensive research program has been established in transient scattering, both from the aspects of analysis-computation and experimental modeling measurements.

**Summary:** Using the transient scattering laboratory, which was designed and constructed during the first year of this effort, the resonance region imaging of axisymmetric metallic targets was successfully demonstrated. By way of digital signal processing techniques it was possible to synthesize the ramp scattering responses of the targets which are, in turn, directly related to the projected images of the targets. The output of the processed measurement of target scattering is a facsimile image of the target. This technique provides an in-depth image and even allows viewing the back side of the target.

**Conference Presentation:** M. A. Morgan, "Data Acquisition & Processing in Transient Scattering Measurements," 1981 IEEE/AP-S Symposium, Los Angeles, CA, June 1981.

**Thesis Directed:** C. Hammond, "The Development of a Bistatic Electromagnetic Scattering Laboratory," Master's Thesis, December 1980.

M. Morag, "Radar Target Imaging by Time-Domain Inverse Scattering," Master's Thesis, March 1981.

L. Sorrentino, "Radar Target Imagery via Transient Response Processing," Master's Thesis, June 1981.

Title: Digital Signal Processing

Investigator: S. R. Parker, Professor of Electrical Engineering, and  
Y. C. Lim, Research Associate

Sponsor: NPS Foundation Research Program

Objective: The development of efficient algorithms and numerical  
techniques for digital filters, signal processing, and  
system modeling.

Summary: New results have been achieved for the efficient  
design of finite impulse response digital filters with  
discrete coefficients based upon a L.M.S. criteria,  
and finite wordlength FIR filter design using integer  
programming over a discrete coefficient space.

Publications: Y. C. Lim and S. R. Parker, "A Discrete Coefficient  
FIR Digital Filter Design Based Upon L.M.S. Criteria,"  
IEEE Trans. on Circuits and Systems, (forthcoming).

Y. C. Lim and S. R. Parker, "Finite Wordlength FIR  
Filter using Integer Programming Over a Discrete Coef-  
ficient Space," IEEE Trans. on Acoustics Speech and  
Signal Processing, (forthcoming).

Conference  
Presentations: Y. C. Lim and S. R. Parker, "Digital Lattice Filter  
Design using a Frequency Domain Modeling Approach,"  
1982 IEEE International Conference on Acoustics,  
Speech and Signal Processing, (forthcoming).

Y. C. Lim, T. Constantinides, and S. R. Parker,  
"Passband Gain Centering in Discrete Coefficient Value  
FIR Filter Design," 1982 IEEE International Conference  
on Acoustics Speech and Signal Processing, (forthcoming).

Y. C. Lim and S. R. Parker, "Discrete Coefficient FIR  
Digital Filter Design using a L.M.S. Criteria," 1982  
IEEE International Symposium on Circuits and Systems,  
(forthcoming).

Thesis Directed: I. K. Chang, "The Application of Adaptive Techniques  
for the Design of Digital Filters with Discrete Coef-  
ficients," Master's Thesis, (forthcoming).

DEPARTMENT  
OF  
METEOROLOGY



Title: A Synoptic Study of Summer Monsoon Depressions

Investigators: C. P. Chang, Associate Professor of Meteorology, and K. R. Saha, Senior Research Associate

Sponsor: NPS Foundation Research Program

Objective: To study the structure and development processes of the summer monsoon depressions in the vicinity of the Bay of Bengal.

Summary: The diagnostic analysis of two depressions with quite different origins show many basic similarities in structure and development. They both have a baroclinic structure with well-defined warm and cold sectors, the latter being situated to the east of the former in a region where the thermal wind is easterly throughout the troposphere. The axis of the depression tilts eastward with height. In a developing depression, the geopotential and the temperature fields differ in phase such that warm advection from the north occurs to the west of the depression center and cold advection from the south to the east. There is also strong convergence to the west and divergence to the east of the depression center in the lower troposphere, and vice versa in the upper troposphere. Thus a divergent secondary circulation exists in the zonal vertical plane with warm air rising to the west and cold air sinking to the east. Computed perturbation vertical velocity, which is in good agreement with the distribution of satellite-observed clouds, and relative divergence (divergence at 200 mb-divergence at 850 mb) show that there is marked increase in upward motion and relative divergence in the southwest sector during the period of development. A decrease in vertical zonal wind shear ( $U_{200}-U_{850}$ ) in the depression area is also noted, apparently a result of the effects of the finite amplitude baroclinic depression. Intensity and movement of the depressions are found to be strongly influenced by thermal advection from mid-latitude disturbances moving across central Asia and China. Warm advection from these disturbances to the west of the depression center favors development and accelerates westward movement of the depression whereas cold advection inhibits development and retards the movement.

Publications: K. R. Saha, and C. P. Chang, "On the Structure and Development of Monsoon Depressions," Submitted to the Monthly Weather Review.

Title: The Role of the Ocean in Extratropical Cyclone Evolution

Investigator: Russell L. Elsberry, Professor of Meteorology

Sponsor: NPS Foundation Research Program

Objective: The purpose of this research is to improve our understanding of the role of the air-sea fluxes in the extratropical cyclone evolution. A study of the cyclone and its environment will be carried out in a numerical model by systematically introducing the air-sea fluxes.

Summary: The approach in these experiments is to systematically add or subtract physical processes in the numerical model. The resulting effect on the development, maintenance and movement of the extratropical cyclones over the ocean is being studied from the history files of the computer runs. The wavelength of the cyclones in the diabatic model runs is only half that found in the adiabatic model results. Diagnostic interpretations using the Pettersen Development equation have been made with the atmospheric model results. Future experiments will involve the use of a finer-resolution atmospheric model to study cyclogenesis in polar air streams over the ocean and over land.

Conference Presentations: S. A. Sandgathe and R. L. Elsberry, "An Unsolved Problem--What Factors Produce Ocean Cyclogenesis," Proceedings Symposium on Current Problems of Weather Prediction, Publication 253, Zentral Anstalt fur Meteorologie und Geodynamik, Vienna, Austria, 34-37.

Theses Directed: S. A. Sandgathe, "A Numerical Study of the Role of Air-Sea Fluxes in Extratropical Cyclogenesis," Ph.D. Dissertation, September 1981.

Title: Diagnostics of Oceanic Extratropical Cyclones

Investigator: C. H. Wash, Assistant Professor of Meteorology

Sponsor: NPS Foundation Research Program

Objective: To transfer and develop a variety of limited area diagnostic programs for the study of both observed and numerically-simulated extratropical cyclone studies and to apply these techniques to the study of oceanic cyclogenesis.

Summary: During FY 81 the limited area quasi-Lagrangian budget programs were converted to NPS IBM 3033 system. Mass and angular momentum programs are complete with associated interpolation and utility programs while development in circulation and kinetic energy routines was initiated. Data from the First Global GARP Experiment of an intense oceanic cyclone were obtained and a mass budget study for the February 11-19, 1979 'President's Day Storm' completed.

Publication: C. Wash with L. Uccellini and P. Kocin, "An Analysis of Jet Streak Interaction in the President's Day Storm," February 17-18, 1979. Submitted to Monthly Weather Review.

Theses Directed: Don Roman, "Application of Quasi-Lagrangian Diagnostics and FGGE Data in a Study of East-Coast Cyclogenesis", Master's Thesis, September 1981.

**DEPARTMENT  
OF  
AERONAUTICS**

Title: Aerodynamic Stabilization of Gaseous Discharges

Investigator: Oscar Biblarz, Associate Professor of Aeronautics

Sponsor: NPS Foundation Research Program

Objectives: The main objective is to define practical aerodynamic means for stabilizing discharges of interest for electrical lasers, plasma-chemical devices, etc. Particular objectives is to compare discharge geometries as a function of flow velocity and of turbulence. This is a part of a continuing program.

Summary: The cross flow geometry shows interesting phenomena when compared to the parallel flow. A multiplicity of precursors to breakdown can be witnessed together with glow regions that change as a function of current. A downstream cathode has been used to observe current convection.

Publications: J. L. Barto, "Study of Gas Dynamic Effects on Non-Equilibrium, High-Pressure, Electric Discharges," NPS Report NPS 67-80-005, August 1980.

Conference Presentations: J. L. Barto and O. Biblarz, "Gasdynamic Interactions in Non-Uniform High Pressure Discharge," 33rd Gaseous Electronics Conference, Norman, Oklahoma, October 7-10, 1980.

O. Biblarz, "Some Aspects of Aerodynamic Stabilization of Gaseous Discharges," 1981 IEEE International Conference on Plasma Science, Santa Fe, New Mexico, May 18-20, 1981.

Thesis Directed: J. W. Wainionpaa, "Electric Discharge Interaction in Parallel and Cross-Flow Electric Fields," Master's Thesis, September 1981.

**Title:** Study of Basic Mechanisms that Lead to Arcing

**Investigator:** Oscar Biblarz, Associate Professor of Aeronautics

**Sponsor:** NPS Foundation Research Program

**Objective:** The main objective is to study the basic mechanisms that lead to arcing in laser discharges and to develop a discharge model which will aid in the prediction of discharge conditions. This is a new direction for a continuing project.

**Summary:** Arcing or glow collapse severely limits high energy laser performance even in the ionizer/sustainer discharge. This arcing may be caused by a variety of conditions. Using a two-dimensional model for the anode, we have established that Joule heating is not significant for common flush times in pulsed molecular lasers. We are presently looking at a model for unipolar arcing.

**Publications:** O. Biblarz, R. E. Ball, and S. T. Van Brocklin, "Electrode Boundary Layers in Dense, Diffuse Plasma," NPS Report No. NPS67-80-011, March 1980. AFWAL-TR-80-2088, October 1980.

S. T. Van Brocklin and O. Biblarz, "The Plasma Boundary Layer Over a Positive Electrode," IEEE Transactions of Plasma Science--Decision pending.

**Conference Presentation:** S. T. Van Brocklin and O. Biblarz, "Plasma Boundary Layer Over a Positive Electrode," 34th Annual Gaseous Electronics Conference, Boston, MA, October 20-23, 1981.

**Thesis Directed:** S. T. Van Brocklin, "A Computer Analysis of the Plasma-Boundary Layer Behavior Over a Positive Electrode," Aeronautical Engineer Thesis, June 1981.

**Title:** Multi-Stage Compressor Study

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

**Sponsor:** NPS Foundation Research Program

**Objective:** To reblade and instrument a 1.5 stage 3-stage axial compressor and carry out baseline measurements of the performance of newly designed "symmetrical" blading. The purpose is to enable a study which is aimed to reduce the sensitivity of current compressor designs to tip gap variations.

**Summary:** The compressor is 36 inches O.D. with a cylindrical flow path 7.2 inches high. The compressor was re-bladed first with IGV's, single stage and EGV's. Techniques for grinding and individually setting blades to uniform .001" tip gap were developed. The blades were of cast epoxy. Failure of some blading occurred from contact with a survey probe requiring new blades to be cast and installed. Preliminary measurements of the flow field and complete stage performance at 1200 RPM were completed and the conclusions from this phase of the program were documented. Composite construction to stiffen and strengthen the rotor blades will be used in blade designs required for the tip clearance study and different approaches are currently under study.

**Publications:**

- I. Moyle, "Progress Report - Multistage Axial Compressor Program on Tip Clearance Effects," NPS Contractor Report, NPS67-81-01CR, August 1981.
- I. Moyle, "Multistage Compressor - Survey of Literature on Tip Clearance and Blade Tip Flow Effects in Axial Turbomachines," NPS Technical Note, TPL TN 81-01, September 1981.
- I. Moyle, "Multistage Compressor - Blade Aeromechanical Design," NPS Technical Note, TPL TN 81-02, September 1981.
- I. Moyle, "Multistage Compressor - Fabrication of Molds and Casting of Epoxy Blades," NPS Technical Note, TPL TN 81-03, September 1981.

Title: Numerical Modeling of the Flow in Transonic Axial Compressors

Investigators: R. P. Shreeve, Director, Turbopropulsion Laboratory, and S. Eidelman, Research Associate, Department of Aeronautics

Sponsor: NPS Foundation Research Program

Objective: To develop a computer code which solves efficiently and accurately the transonic flow between the blades of a turbocompressor.

Summary: As the first step in the code development, a program which solves the basic Riemann problem was written. The effectiveness of the program was checked. The program will be used in the coming months by the Turbopropulsion Laboratory as a tool for wave engine analysis. Using the Riemann problem solver, a two-dimensional code was developed, which solved the problem of the shock wave propagating through a tube. Next the code was extended to solve the problem of the transonic flow in a tube containing one or two rectangular obstacles. This test problem showed that in order to complete the initially proposed research we will need to include three additional modifications; namely, (a) a multigrid solution; (b) solution in body fitted coordinates, and (c) application of the radiation boundary conditions for the subsonic in and out flow. The modification (a) has already been made, and work on modification (b) is currently in progress. Analytical work on calculation of the critical energy for direct initiation of detonation was finished and results of the work were reported in a paper entitled "A Method of Calculation of the Critical Energy for Direct Initiation of Unconfined Detonation." The paper was submitted for publication to Combustion Science and Technology.

Publications: S. Eidelman, "Model of Direct Initiation of Unconfined Detonations," NPS Contractor Report, NPS67-81-02CR, March 1981.



Title: Very High Reaction Turbines

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

Sponsor: NPS Foundation Research Program

Objective: To investigate analytically and experimentally the potential of two proposed very high reaction turbines of original design.

Summary: An unusually simple geometry of gas turbine rotor has been proposed to ONR and other agencies. Calculations of the potential performance of the geometry and tests of a small prototype are planned in order to provide an assessment of the potential. A second suggestion to obtain high energy conversion efficiencies using staged detonative combustion within a series of rotors of particular design is also being examined.

**DEPARTMENT  
OF  
OCEANOGRAPHY**

**Title:** Real-Time Ocean Profiling and Modeling in Monterey Bay

**Investigator:** C. N. K. Mooers, Professor and Chairman, Department of Oceanography

**Sponsor:** NPS Foundation Research Program

**Objectives:** Develop a predictive capability for surface mixed layer and seasonal thermocline phenomena based upon a one-dimensional model and real-time, vertical profiles of temperature, salinity, horizontal velocity, and sound speed, together with coastal wind data.

**Summary:** This project makes use of an autonomous profiling current meter system called the Cyclesonde. One Cyclesonde is on indefinite loan from NAVOCEANO; another was procured by NPS, and it was received at NPS in the summer of 1981. Both Cyclesondes have been put through shakedown exercises, either at the end of Monterey Bay or in Carmel Canyon. The Monterey Bay station has been run in the telemetry mode, with RF signals received and decoded at Spanagel Hall. This project has allowed procurement of the telemetry system and spare parts, and it has supported marine technician time for field testing and computer programmer time for software development. All phases of the system have been exercised, including data processing through to data archives on the IBM 3033. Currently, the instruments are undergoing refurbishment and modification with the manufacturer.

Title: Studies of Oceanographic Conditions Near the  
Marginal Sea-Ice Zone

Investigators: Robert G. Paquette, Professor, Department of  
Oceanography  
David C. Smith IV, Adjunct Professor, Department  
of Oceanography

Sponsor: NPS Foundation Research Program

Objectives: Produce a numerical model of water circulation in  
the Chukchi Sea in general and near the sea-ice  
margin in particular.

Summary: A previous "Gulf Stream Ring Model" has been con-  
verted to run on the NPS 3033 Computer. The  
model is now being adapted to simulate the Chukchi  
Sea.

Title: Acoustic Variability Experiment

Investigators: E. B. Thornton, Professor, Department of Oceanography.  
T. P. Stanton, Adjunct Professor, Department of Oceanography.

Sponsor: NPS Foundation Research Program

Objective: Investigation of the phase and amplitude modulation of sound propagating through the upper layers of the ocean.

Summary: Acoustic amplitude and phase fluctuations were measured across a 400 meter path. The sound source and hydrophones were mounted on the shelf adjacent to the Carmel Canyon at a depth of 35 meters. The depth of the canyon at this location is approximately 180 meters. The experiment was designed to measure only the direct path of sound and not receive either the surface or bottom reflected sound. The acoustic source signal was a composite pulse consisting of a 0.5 millisecond 20 kHz pulse followed by 5 milliseconds of pseudo-random noise. The pseudo-random noise has acoustic energy in the band from 4 to 20 kHz.

The ocean temperature structure was measured both at the source and the receivers using horizontal and vertical thermistor arrays in order to determine the structure and correlation functions for the temperature microstructure. A two current meter array measured the current shear; thermistors are also mounted on the current meter packages to give long time series of the temperature. Papers are being prepared describing these results.

Publication: E. B. Thornton, "Temperature Induced Phase and Amplitude Fluctuations of 20 kHz Pulses in the Upper Ocean," (forthcoming).

Thesis Directed: M. Wakeman, "Acoustic Amplitude Fluctuations of 20 kHz Pulses in the Upper Ocean," Master's Thesis, December 1981.

**DEPARTMENT  
OF  
MECHANICAL ENGINEERING**

Title: Elevated Temperature Fatigue of Alloys Used in Propulsion Systems

Investigator: K. D. Challenger, Assistant Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: This was the first year for this presently on-going program at NPS. The objective of the research is to discover the damage mechanism that exists when combined creep (sustained loads) and fatigue (cyclic loads) are imposed on the materials used in propulsion systems in various types of environments at elevated temperature. The knowledge of the damage mechanisms will then be used to develop design correlations that could be used to extrapolate laboratory test data to actual service conditions.

Summary: In the past we have used 2½ Cr - 1Mo steel to examine the effect of an oxidizing environment on the fatigue crack growth rate for continuously cycled specimens and specimens subjected to a loading wave form that included a constant strain hold period (creep damage). We found, to everyone's surprise, that compressive hold periods accelerated the fatigue crack growth rate as much as tensile hold periods. This indicates that the principal effect of the hold periods is to allow more oxidation to occur at the crack tip. We also examined the dislocation-precipitate substructure of these samples. The hold periods promoted a cellular dislocation structure indicating that some creep damage had occurred; this tells us that, even though the environmental effects were large, creep damage was also occurring. Thus for different testing conditions or different environments creep damage may overshadow the environmental effect and it must be considered important.

Also in the past year, we have designed and assembled a test facility for testing the elevated temperature properties of metals in controlled environments.

Publications: K. D. Challenger, A. K. Miller and R. L. Langdon, "Elevated Temperature Fatigue with Hold Time in a Low Alloy Steel: A Predictive Correlation,"

Publications:  
(continued)

accepted for publication in the Journal of Material  
for Energy Systems, August 1981.

K. D. Challenger and P. G. Vining, "The Effects of  
Hold Time in the Fatigue Crack Growth Rate of 2½  
Cr - 1Mo Steel," (forthcoming).

Theses Directed:

P. G. Vining, "Mechanisms of Elevated Temperature  
Fatigue Damage in 2½ Cr - 1Mo Steel," Mech. Engr.  
Thesis, June 1981.

W. Hastie, "Design and Construction of an  
Environmentally Controlled Elevated Temperature  
Fatigue Facility," Master's Thesis, September 1981.



Title: Experimental Investigation of the Fluid Mechanics  
of Buoyant Liquid Plumes

Investigator: W. G. Culbreth, Assistant Professor of Mechanical  
Engineering

Sponsor: NPS Research Foundation Program

Objective: To analyze the velocity distribution of turbulent,  
buoyant liquid plumes through the use of a Laser  
Doppler Velocimeter and to test the validity of  
various mathematical models used to predict turbu-  
lent entrainment in plumes and plume configuration.

Summary: A program of investigation has been developed and  
a commercial Laser Doppler Velocimeter has been or-  
dered. A high speed microcomputer system has also  
been ordered to acquire turbulent velocity data from  
the velocimeter.

Title: Differential Scanning Calorimetry Study of  
Rapidly Solidified Shape Memory Alloys

Investigator: Jeff Perkins, Associate Professor of  
Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: To experimentally determine the effect of micro-  
structural defects, particularly grain boundaries  
and dislocations, on the kinetics of martensitic  
transformations.

Summary: The effect of cold work and annealing have been  
investigated in terms of their effects on the  
temperature range of martensitic transformation  
in several Cu-Zn-Al alloys.

Publication: J. Perkins, et al., "Grain Boundary Structures  
in Rapidly Solidified Cu-Zn-Al Alloys," Scripta  
Met. 15, pp 771-76, 1981.

Title: Optimum Design of Torsional Shafts Using Composite Materials

Investigator: Garret N. Vanderplaats, Associate Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: To develop the analytic capability and FORTRAN program for the analysis of shafts made of multi-layered composite materials and couple this to a numerical optimization program to provide a general automated design capability.

Summary: The analytic capability has been developed to evaluate the response of hollow cylindrical shafts including synchronous whirl caused by mass imbalance. Failure modes which are evaluated include static and fatigue strength, maximum deflection, column buckling, axial and torsional cylinder buckling and critical speed. The constitutive equations have been formulated and programmed for shafts made of multi-layered fiber composites and metal-composite combinations. Shafts have been designed for strength, deflection, dynamic and buckling limits. This has been programmed in FORTRAN and coupled to the optimization program COPES/CONMIN. The capability has been demonstrated with the design of isotropic and composite shafts.

Theses Directed: Virgilio S. Merced, "Drive Shaft Design Using Numerical Optimization," Master's Thesis, June, 1980.

Amhet Onal, "Design of Composite Driveshafts Using Numerical Optimization," Master's Thesis, December, 1981.

# APPENDIX I

<u>Summary Title</u>	<u>Investigator</u>	<u>Type Funding</u>
COMPUTER SCIENCE		
Concurrency Control in Distributed Database Systems	D. Z. Badal	6.1
Advanced Methods for Software Development	B. J. MacLennan	6.1
The Automatic Design of Algorithms	D. R. Smith	6.1
MATHEMATICS		
Using Full Sequences for Spread Spectrum Applications	H. M. Fredricksen	6.1
Numerical Solution of Fixed-Point Equations	M. D. Humphries	6.1
Convergence of Non-Linear Optimization Algorithms Under Weakened Hypotheses	I. B. Russak	6.1
ADMINISTRATIVE SCIENCES		
The Development of Case Research Methods in the Organizational Sciences	R. D. Evered	6.1
Analysis of Corrective Maintenance Active Repair Time Data	M. B. Kline	6.2
Cost Accounting and Analysis in the Governmental Sector	S. S. Liao	6.1
Career Transition Agenda: Identifying What is Accomplished in Adapting to a New Job	M. R. Louis	6.1
Enlistment Supply Models	G. Thomas	6.1

<u>Summary Title</u>	<u>Investigator</u>	<u>Type Funding</u>
Sequential Testing for Selection: Tryout on Real Data	R. A. Weitzman	6.1
An Investigation into the Existence of a General Theory of Intra Firm Behavior	D. Whipple K. Kocher	6.1
OPERATIONS RESEARCH		
Operational Availability Analysis of Weapon Systems with Finite Spare Support	F. R. Richards	6.1
Representation of Additional Operational Factors in Combat Models	J. G. Taylor	6.1
NATIONAL SECURITY AFFAIRS		
United States Policy Toward Conflict in Africa	M. Clough	6.2
Cry Wolf Effects	K. L. Herbig	6.1
Analysis of Mexican Growth Alternatives	R. Looney P. C. Frederiksen	6.1
South Korean Nationalism: Roots, Impact, and Prospects	E. A. Olsen	6.1
Soviet Decisionmaking for the National Security	J. Valenta	6.2
French and Soviet Perspectives on Theater Nuclear Policy and Arms Control	D. S. Yost	6.1
PHYSICS AND CHEMISTRY		
Classical Trajectory Studies of Low Energy Ion Impact Mechanisms on Clean and Reacted Single Crystal Surfaces	D. E. Harrison R. P. Webb	6.1

<u>Summary Title</u>	<u>Investigator</u>	<u>Type Funding</u>
Spectroscopic Data Center Compilation of Atomic Energy Levels	R. L. Kelly	6.1
Experimental Investigation of Electromagnetic Interference Zones during Ducting Conditions	G. E. Schacher	6.2
Plasma Surface Interaction	F. Schwirzke	6.1
Measurement of Underwater Acoustic Noise Due to Surf Phenomena	O. B. Wilson H. A. Dahl	6.1
Underwater Acoustic Noise Due to Surf Phenomena	O. B. Wilson H. A. Dahl	6.1
ELECTRICAL ENGINEERING		
Millimeter Wave Transmission Media	J. B. Knorr	6.2
Radar Target Identification via Time-Domain Scattering Signatures	M. Morgan M. Hamid	6.2
Digital Signal Processing	S. R. Parker Y. C. Lim	6.1
METEOROLOGY		
A Synoptic Study of Summer Monsoon Depressions	C. P. Chang K. R. Saha	6.1
The Role of the Ocean In Extratropical Cyclone Evolution	R. L. Elsberry	6.1
Diagnostics of Oceanic Extratropical Cyclones	C. H. Wash	6.1
AERONAUTICS		
Aerodynamic Stabilization of Gaseous Discharges	O. Biblarz	6.1

<u>Summary Title</u>	<u>Investigator</u>	<u>Type Funding</u>
Study of Basic Mechanisms that Lead to Arcing	O. Biblarz	6.1
Multi-Stage Compressor Study	R. P. Shreeve	6.2
Numerical Modeling of the Flow in Transonic Axial Compressors	R. P. Shreeve S. Eidelman	6.1
Very High Reaction Turbines	R. P. Shreeve	6.2
OCEANOGRAPHY		
Real-Time Ocean Profiling and Modeling in Monterey Bay	C. N. K. Mooers	6.1
Studies of Oceanographic Conditions Near the Marginal Sea-Ice Zone	R. G. Paquette	6.1
Acoustic Variability Experiment	E. B. Thornton T. P. Stanton	6.1
MECHANICAL ENGINEERING		
Elevated Temperature Fatigue of Alloys Used in Propulsion Systems	K. D. Challenger	6.1
Experimental Investigation of the Fluid Mechanics of Buoyant Liquid Plumes	W. G. Culbreth	6.1
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