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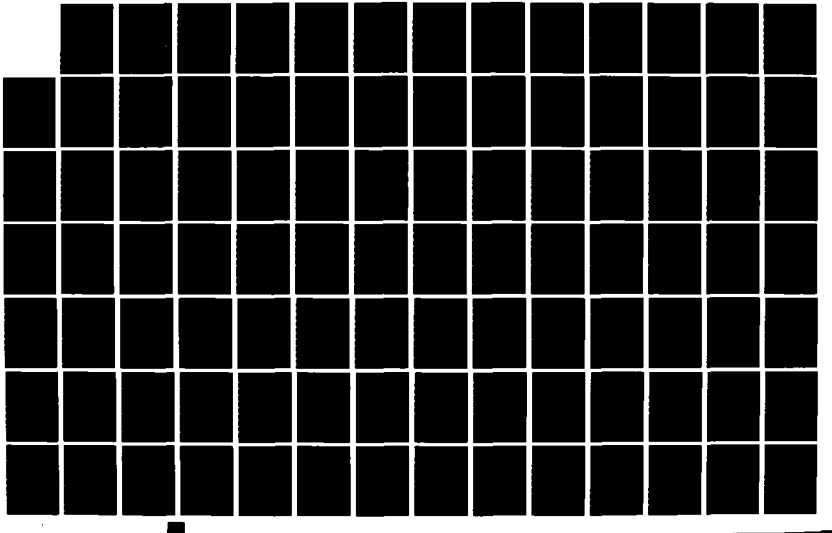

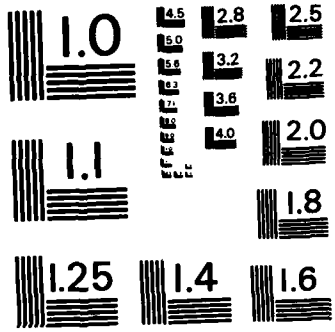

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ANNUAL REPORT

on the

NAVY-ASEE SUMMER FACULTY

RESEARCH PROGRAM

for

1983

with a

SUMMARY OF STATISTICS

and a

CUMULATIVE COMPILATION OF DATA ON LATER

RESEARCH FALLOUTS

from the

FIRST FIVE YEARS OF THE PROGRAM

1979 - 1983

Robert L. Sternberg

Office of Naval Research
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495 Summer Street
Boston, Massachusetts 02210

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I. INTRODUCTION AND EXECUTIVE SUMMARY

I. INTRODUCTION AND EXECUTIVE SUMMARY

About the 1983 Program

Continuing and expanding the Navy Summer Faculty Research Program (NSFRP) conducted for ONR by the American Society for Engineering Education (ASEE) previously in the summers of 1979, 1980, 1981 and 1982, the NSFRP program in 1983 brought 111 faculty members from United States colleges and universities to 10 Navy laboratories for 10 weeks cooperative summer research between the NSFRP participants and Navy scientists at the laboratories working in areas of mutual interest to both parties.

As in the earlier years the objectives of the NSFRP program in 1983 were:

- 1) To engage university faculty members in the research programs of the participating Naval laboratories;
- 2) To develop a basis for continuing research of interest to the Navy at the participating faculty members institutions;
- 3) To establish continuing relations among faculty members and their professional peers in the Navy laboratories; and
- 4) To enhance the research interests and capabilities of the science and engineering faculty members taking part in the Navy program.

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As previously the NSFRP program was conducted in 1983 by ASEE with John Lisack, Jr. and Jeffery (Jeff) Jarosz serving as Project Directors and F. X. (Tim) Bradley serving as a Consultant at ASEE.

As before participation was restricted to United States citizens holding teaching or research appointments in American institutions of higher education.

The 10 Navy laboratories that took part in the program during 1983 were:

Naval Research Laboratory, Washington, DC

Naval Medical Research Institute, Bethesda, Maryland

Naval Air Development Center, Warminster, Pennsylvania

Naval Coastal Systems Center, Panama City, Florida

Naval Ocean Systems Center, San Diego, California

Naval Personnel Research and Development Center, San Diego, California

Naval Ship Research and Development Center, Annapolis and Carderock, Maryland

Naval Surface Weapons Center, Silver Spring, Maryland
and Dahlgren, Virginia

Naval Underwater Systems Center, Newport, Rhode Island
and New London, Connecticut

Naval Weapons Center, China Lake, California

The 111 faculty member participants taking part in the 1983 program were selected by the Navy laboratories from 614 applicants and came from colleges and universities in all parts of the United States. Included in this representation were 46 of the contiguous states, the District of Columbia, Hawaii, Puerto Rico and the Virgin Islands.

Disciplines covered in the research conducted under the NSFRP program in 1983 again ranged from medical and personnel research to topics in physics, chemistry, computer science and the several branches of engineering and applied mathematics and statistics. The selection of topics varied at each Navy laboratory to suit the specific areas of research within the individual laboratories charter assignments while at the same time being chosen so as to be of interest to the faculty member participants.

Virtually all -- in fact, 93 percent -- of the NSFRP participants in 1983 held the Ph.D. or an equivalent doctoral degree in his or her field of expertise and approximately one third were assistant professors, one-third were associate professors and one-fourth were full professors, with the remainder holding other types of academic appointments. Some 24 percent were women or members of minority groups including representatives of almost all categories of the latter, including, in particular, 13 women, and eight Black Americans. The physical sciences collectively constituted the dominant field of the participants this year at 36 percent followed by engineering at 24 percent and mathematics and the mathematical sciences at 14 percent with the remaining 26 percent in the life sciences and related areas. The ages of the participants again showed quite a spread but the average remained unchanged from the proceeding year at 43.

The 1983 NSFRP participants were paid stipends of 6000 dollars for their 10 weeks tenure at their Navy laboratories plus suitable allowances for travel. The total cost to the Navy of the 1983 program was about 767,000 dollars. Somewhat less than half of these funds were provided by ONR while the balance came from the individual Navy laboratories on an agreed prorated basis; more particularly each Navy laboratory was assigned from 4 to 8 NSFRP participants funded by ONR and was allowed to take at its option an additional number to be paid for out of its own funds, the actual number of such additional appointments in the event ranging from zero at the Navy Coastal Systems Center to 22 extra at the Naval Research Laboratory.

Many favorable and even glowing comments and expressions of enthusiasm for the program were received by ASEE and the writer regarding the experiences of the participants and their host Navy laboratories in 1983 and previous years and -- aside from a few minor difficulties experienced at one or two of the Navy laboratories in timely establishment of clearances for

a few of the NSFRP participants and a fairly commonly expressed desire by the participants for more remunerative stipends -- ASEE and the writer found no significant problems with administration of the program or with its reception by the individual participants and Navy laboratories involved.

At the end of the summer each NSFRP participant prepared a report on his summer's research at his host Navy laboratory. Abstracts of 107 of these reports are presented later in this document and a number of these have been -- and it is anticipated that many more of these will eventually be -- further developed into professional research papers appearing in the archival scientific literature. Abstracts for the remaining reports on the 1983 program were delayed for various reasons and were not available in time to be included here.

Finally, before the NSFRP participants departed to return to their home colleges and universities, an appropriate certificate was presented to each of them by the Navy and ASEE in recognition of their participation in the 1983 program.

Growth of the Program in its First Five Years

Starting in 1979 with a total of 16 NSFRP participants and three Navy laboratories the program grew to 26 participants and seven Navy laboratories in 1980 with funding during these first two years provided entirely by ONR. In 1981 with the decision made to permit additional participants to be supported by Navy laboratory funds, the NSFRP program grew that year to 59 people and 10 Navy laboratories and expanded again in 1982 to 97 participants at the same 10 Navy laboratories. In 1983 without further growth in the number of Navy laboratories cooperating in the program, the number of faculty member participants grew to 111.

The percentage growth of the program over the period 1979 through 1983 in participants was almost 700 percent and in Navy laboratories taking part in the program a little more than 300 percent.

Total funding during the same five year period went from about 99,700 dollars in 1979 to 767,000 in 1983 as noted with more than half of the total annual funding ultimately coming from the Navy laboratories rather than ONR.

These growth figures are illustrated further in Figures 1 and 2 below. Included in Figure 2 also is a graph showing the growth from 1979 to 1983 in the NSFRP stipends paid each participating faculty member for his or her 10 weeks tenure in the program. As shown therein the participants stipends grew from an original sum of 4000 dollars in 1979 to 6000 dollars in 1983.

Fallouts from the First Five Years of the Program

A number of interesting "research fallouts" as we term them of Navy significance have occurred as a result of the 1979, 1980, 1981, 1982 and 1983 NSFRP programs. Among these it is noteworthy that from the first five years of the program involving a total of 16 NSFRP participants in 1979, 26 in 1980, 59 in 1981, 97 in 1982 and 111 in 1983 -- or 309 all told -- a total of

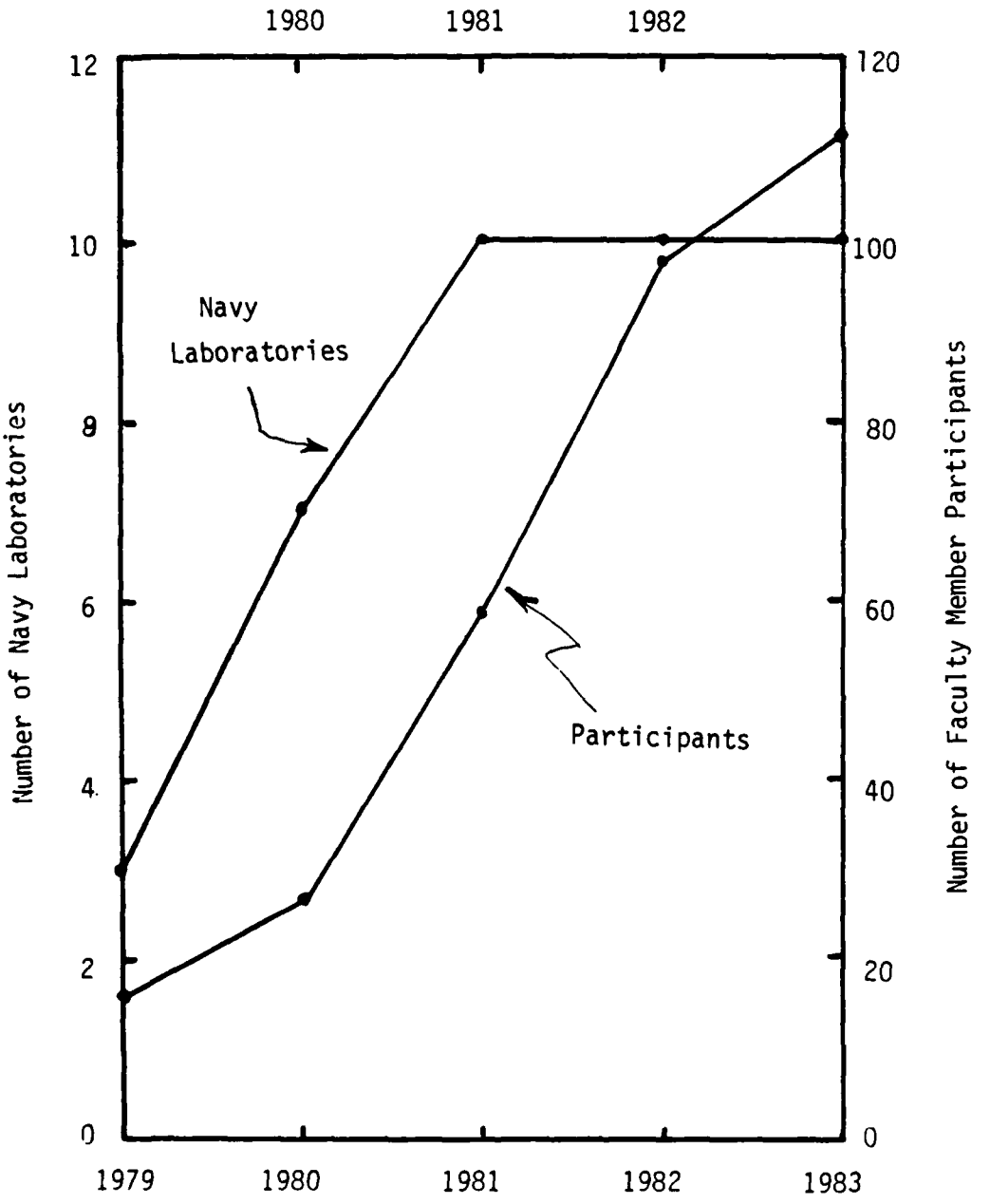

Figure 1

Growth of the Program in its First Five Years
Navy Laboratories and Number of Faculty
Member Participants

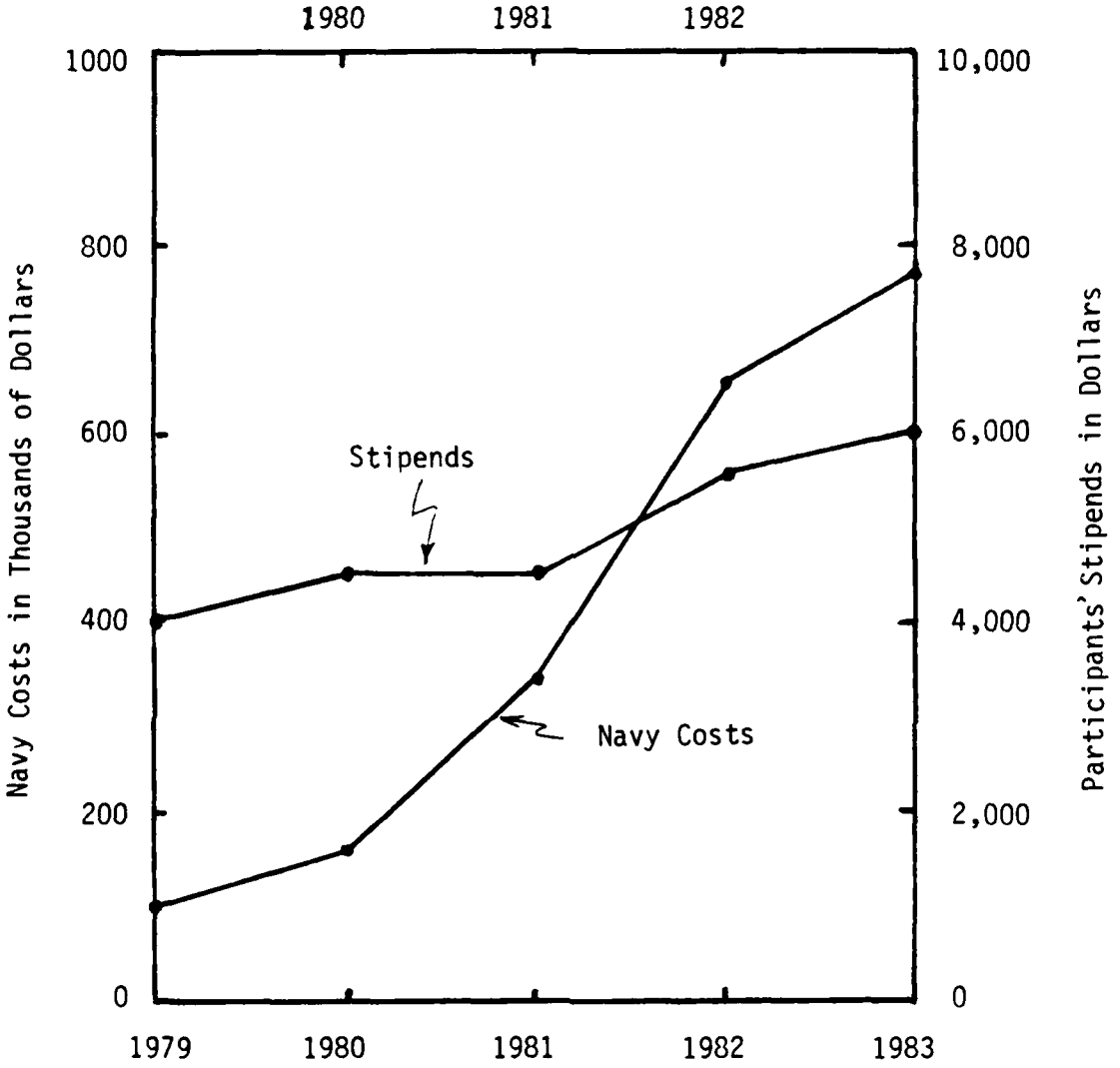

Figure 2

Growth of the Program in its First Five Years
Navy Costs and Participants' Stipends

- o 40 research contracts adding up to $1,065,000 dollars have been awarded to 34 former NSFRP participants for follow on research;

- o At least 12 former participants have been further employed by their host Navy laboratory as consultants or on inter-government personnel act or exempt part-time civil service appointments and two such participants have become full-time civil servants at their host laboratories.

and

- o At least 100 papers on, or continuing research started under, the NSFRP programs have been presented as invited or contributed papers at scientific and engineering meetings of Navy interest and/or have been published in refereed journals or in the conference proceedings of such meetings and at least two former NSFRP fellows have based their masters or doctoral theses on work started under the program.

Clearly these accomplishments go a long way towards demonstrating the success of the NSFRP programs in meeting the Navy's objectives set forth earlier.

Organization of the Report

Additional items of interest, factual data, more information on costs and more detailed statistics regarding various aspects of the 1983 NSFRP program are provided in Section II and further information regarding personnel, statistical and cost data is summarized for the first five years of the program in Section III.

The abstracts of the individual NSFRP participants' reports for 1983 on their 10 weeks summer research are presented in Sections IV through XIII, one section being devoted to each of the participating Navy laboratories, and full reports on many of the individual projects can be provided by the writer or ASEE, if desired.

The cummulative compilation of data on the later or subsequent "research fallouts" of Navy interest which have resulted from the 1979, 1980, 1981, 1982 and 1983 NSFRP programs is presented in some detail in Section XIV.

Finally, a brief outline of plans for future NSFRP programs and plans for continued tracking of future NSFRP program research fallouts are set forth in Section XV.

Acknowledgements

The writer is indebted to many persons at ONR for many helpful suggestions and other assistance with administration of the NSFRP programs and wishes to express his appreciation for their efforts. He is also indebted to, and wishes to thank, F. X. (Tim) Bradley, John Lisack, Jr. and

Jeffrey (Jeff) Jarosz of ASEE for carrying out all the many and varied duties involved in the administration and day-to-day management of the NSFRP programs for ONR and ASEE. Thanks also are due the Program Coordinators at the 10 Navy laboratories and the Navy scientists and the many NSFRP participants that took part in the several NSFRP programs; their names appear later on in this report and their collective help, advice and assistance during the years the writer has managed the NSFRP program is herewith acknowledged with pleasure.

II. ADMINISTRATION, STATISTICAL DATA AND COSTS FOR THE FIRST FIVE YEARS OF THE PROGRAM

Administration and Program Execution

Throughout the first five years of the NSFRP program ASEE administered the program for ONR. At ASEE F. X. (Tim) Bradley and Jeff Jarosz acted as Project Directors during the years 1979 through 1981. John Lisack, Jr. replaced Tim Bradley at ASEE after the retirement of the latter in 1982 and again served as Project Director in 1983. At ONR the program was led by Nick Perrone as Scientific Officer during the years 1979 and 1980 after which the writer took over those duties at ONR.

The administration of the NSFRP program by ASEE has each year followed the same general pattern as that described in Section II for the 1983 program and need not be repeated here except to note the effects of growth of the program and a change or two in the names of the Program Coordinators at the participating Navy laboratories.

Personnel During the First Five Years

As noted in the Introduction and Executive Summary the NSFRP program grew from 16 participants and three Navy laboratories at the start in 1979 to 111 participants at 10 Navy laboratories in 1983. During this period the Program Coordinators administering the program at the Navy laboratories taking part in the program were the same as those listed in Section II for the 1983 program except that during the years 1979 through 1981 David A. Patterson acted as Program Coordinator at NRL and during the years 1979 through 1983 J. A. Kiesow and V. D. Schinski each served part of the time in that capacity at NMRI. Except for these changes the Program Coordinators thus have been the same throughout the entire period of their Navy laboratories' participation in the NSFRP program.

The names of the faculty member participants during the first five years of the NSFRP program are listed in Table IV. Those who have returned for a second and, in the one case a third, year in the program in this list are marked with an asterisk in the case of second time appointments and with a double asterisk in the case of the single third time appointment.

III. ADMINISTRATION, STATISTICAL DATA AND COSTS FOR THE FIRST FIVE YEARS OF THE PROGRAM

originally allocated 401,000 dollars and the Navy laboratories put up approximately 412,000 dollars for the program for 1983, the actual costs were in the final analysis substantially less.

Table III

APPROXIMATE PRORATED DISTRIBUTION OF 1983 NSFRP PROGRAM COSTS AT THE NAVY LABORATORIES IN THOUSANDS OF DOLLARS

Navy Laboratory	Cost to ONR	Cost to Laboratory	Total Costs
NRL	55.3	152.0	207.3
NMRI	41.5	13.8	55.3
NADC	34.6	76.0	110.6
NCSC	27.6	0	27.6
NOSC	34.6	48.4	83.0
NPRDC	27.6	41.5	69.1
NSRDC	41.5	20.7	62.2
NSWC	34.6	6.9	41.5
NUSC	34.6	27.6	62.2
NWC	34.6	13.8	48.4
Totals	366.5	400.7	767.2

The proportionately higher funding of 401,000 dollars provided originally by ONR for the basic 53 participants as compared to the 412,000 dollars provided by the Navy laboratories for the extra 58 participants noted in the preceeding paragraph reflects the basic overhead costs for advertising and organizing the program while the fixed basic charge of 7190 dollars to the Navy laboratories per extra participant for the 58 extra people was based on the participants' stipend of 6000 dollars plus an incremental overhead and travel allowance for each participant estimated to average 1190 dollars per extra person with some slight adjustments to these figures in a few special cases.

As noted above and indicated by the figures tabulated, the actual average cost per participant as determined after completion of the program for 1983 was only about 6910 dollars which figure -- when the costs are distributed evenly between ONR and the Navy laboratories -- yield the prorated data set forth in Table III.

As noted earlier in the Introduction and Executive Summary about 93 percent of the participants in the 1983 NSFRP program held the Ph.D. or another doctoral degree and the three professional ranks were almost evenly represented in the program. More particularly, 32 percent of the participants were Assistant Professors, 31 percent were Associate Professors and 28 percent were Full Professors, the remaining nine percent being in special categories. Also as noted, virtually every area of the continental United States plus Washington, DC and several of the overseas states and territories of the nation were represented in the 1983 NSFRP program.

Participation by Women and Minorities

Similarly as in the two previous summers there was substantial participation in the 1983 NSFRP program by women and minority group members. In fact out of 111 participants 27 were either women or from minority groups or both. More particularly, 14 were representatives of Black, Oriental or Asian groups and 13 were non-minority women. A total of eight of the 1983 participants were Black Americans. On a percentage basis, 24 percent of all of the participants were women or minority group representatives, 7.2 per cent were Black Americans, 5.4 percent were of Oriental or Asian background and 12 percent were women.

Although the Black American participation was less than hoped for, it should be noted that more Black Americans were offered appointments than were able to accept them in the final event.

Costs and Distribution of Support

The full cost to the Navy for the 1983 NSFRP program was approximately 767,000 dollars as noted previously. As originally planned ONR provided about 401,000 dollars for 53 participants and the Navy laboratories made available about 412,000 dollars for the 58 extra participants yielding a total of approximately 813,000 dollars for the complete program of which -- owing to various savings that occurred -- only about 767,000 dollars was actually spent. Since not all of the Navy laboratories desired to have more participants than could be paid for by ONR, the Navy laboratory contribution came, of course, only from those Navy laboratories which actually took the extra participants.

The approximate distribution of the Navy's costs for the 1983 NSFRP program between ONR and the 10 participating Navy laboratories corresponding to the distribution of participants shown in Table I is set forth in Table III below. The contribution made available by each Navy laboratory that elected to take extra participants was based on a nominal figure of 7190 dollars times the number of such extra participants. In the final event, the average cost per participant after deducting the various savings realized during the actual administration of the program was approximately 6910 dollars and this latter figure is the basis of the approximate prorated costs presented in Table III. Thus although ONR

Participants	Rank	Academic Department	College/University	Navy Lab
Stein, J.J.	Assoc Prof	Elec Eng	Penn State	NADC
Sweat, A.J.	Asst Prof	Elec Tech	Memphis State	NPRDC
Tappert, F.D.	Prof	Ocean Eng	U Miami	NUSC
Tillman, C.	Assoc Prof	Chemistry	Southern U	NOSC
Tobocman, W.	Prof	Physics	Case Western Reserve	NSWC
Torrez, W.G.	Asst Prof	Statistics	U Cal. Riverside	NOSC
Wachman, M.	Prof	Mathematics	U Connecticut	NUSC
Wechter, M.A.	Assoc Prof	Chemistry	Southern Mass	NRL
Wolf, A.A.	Assoc Prof	Physics	Davidson College	NRL
Zilberberg, Y.M.	Asst Prof	Mech Eng	U Lowell	NSRDC
Zimmermann, K.P.	Assoc Prof	Elec Eng	U Missouri	NCSC

Participants	Rank	Academic Department	College/University	Navy Lab
Pytel, J.L.	Asst Prof	Eng Sci & Mech	Penn State	NADC
Renfroe, D.A.	Asst Prof	Mech Eng	U Arkansas	NSRDC
Rhodes, B.H.	Assoc Prof	Math Sci	Villanova U	NADC
Riley, G.F.	Asst Prof	Chemistry	Cumberland College	NRL
Rillema, D.P.	Assoc Prof	Chemistry	U North Carolina	NRL
Robinson, E.L.	Prof	Physics	Austin College	NRL
Rollins, R.R.	Prof	Mining Eng	West Virginia U	NWC
Roxin, E.O.	Prof	Mathematics	U Rhode Island	NUSC
Rudzinski, W.E.	Asst Prof	Chemistry	Southwest Texas State	NRL
Rymer, H.R.	Prof	Physics	U Bridgeport	NUSC
Saccuzzo, D.P.	Prof	Psychology	San Diego State	NPRDC
Sanders, W.A.	Assoc Prof	Chemistry	Catholic U	NRL
Schneck, D.J.	Prof	Eng Sci & Mech	VA Polytech Inst	NMRI
Schott, J.R.	Asst Prof	Photo Arts & Sci	Rochester Inst Tech	NRL
Siegmann, W.L.	Assoc Prof	Math Sci	Rennsaeler Polytech	NUSC
Sink, C.W.	Prof	Chemistry & Physics	Edinboro State Coll	NRL
Spikes, W.C.	Director Testing	Math Stat & Comp Sci	Ft Valley State Coll	NADC
Spiteri, C.J.	Asst Prof	Elec & Comp Tech	Queens Comp Coll	NOSC
Spreer, L.O.	Prof	Chemistry	U Pacific	NWC
St. Mary, D.F.	Assoc Prof	Math & Stat	U Massachusetts	NUSC

Participants	Rank	Academic Department	College/University	Navy Lab
Lesiecki, M.L.	Assoc Prof	Chemistry	U Puerto Rico	NSWC
Liimatta, P.E.	Prof	Eng Tech	Anne Arundel Com Col	NSRDC
Lilly, J.H.	Asst Prof	Elec Eng	SUNY-Stoney Brook	NRL
Longo, S.A.	Assoc Prof	Physics	LaSalle College	NADC
Lucas, T.R.	Assoc Prof	Math & Comp Sci	U North Carolina	NSRDC
Mann-Nachbar, P.	Lecturer	Civil Eng	San Diego State	NOSC
May, L.	Assoc Prof	Chemistry	Catholic U	NMRI
Mielczarek, E.V.	Prof	Physics	George Mason	NRL
Nemeroff, N.H.	Assoc Prof	Textiles/Sci	Phil Coll Text. & Sci	NADC
Neumann, R.M.	Res Assoc	Polymer Sci	U Massachusetts	NRL
Ngwa-Suh, N.	Asst Prof	Math & Sci	Bowie State College	NMRI
Nye, A.H.	Asst Prof	Mech Eng	Rochester Inst Tech	NRL
Padron, M.	Prof	Ind Eng	U Puerto Rico	NPRDC
Parker, H.R.	Prof	Surgery	U California-Davis	NOSC
Parks, V.J.	Prof	Civil Eng	Catholic U	NRL
Paul, M.P.	Prof	Ind Tech	Alcorn State	NADC
Pfluger, C.E.	Prof	Chemistry	Syracuse U	NRL
Pinto, J.G.	Prof	Mech Eng	San Diego State	NOSC
Plotkin, B.J.	Res Assoc	Phys Sci	Chicago State	NMRI
Poularikas, A.D.	Prof	Elec Eng	U Rhode Island	NUSC

Participants	Rank	Academic Department	College/University	Navy Lab
Greenstein, J.S.	Asst Prof	Ind Eng & Ops Res	Virg Polytech Inst	NOSC
Hagelberg, M.P.	Prof	Physics	Wittenberg U	NRL
Hamerly, R.G.	Prof	Physics	U North Colorado	NOSC
Harris, B.	Assoc Prof	Elec Eng	Manhattan College	NADC
Hayward, A.G.	Asst Prof	Science	Fayetteville State	NMRI
Heisler, R.	Prof	Engineering	Walla Walla	NRL
Henkens, R.W.	Assoc Prof	Chemistry	Duke U	NMRI
Hurdle, L.S.	Asst Prof	Psychology	Norfolk State	NSWC
Hutter, D.J.	Asst Prof	Physics	Rose-Hulman Inst Tech	NRL
Johnson, R.I.	Assoc Prof	Comp Sci	U North Dakota	NPRDC
Johnston, L.H.	Prof	Physics	U Idaho	NWC
Jones, W.H.	Prof	Chemistry	U West Florida	NSWC
Kamman, J.W.	Res Assoc	Mech & Ind Eng	U Cincinnati	NCSC
Kaufman, C.	Assoc Prof	Physics	U Rhode Island	NUSC
Ko, F.K.	Assoc Prof	Textiles Eng	Phil Col Textile&Sci	NADC
Kriegsmann, G.A.	Assoc Prof	Eng Sci & App Math	Northwestern U	NUSC
Landolt, R.G.	Assoc Prof	Chemistry	Texas Wesleyan	NRL
Larson, D.C.	Assoc Prof	Phys & Atmos Sci	Drexel U	NADC
Lee, M.A.	Prof	Nat Sci & Math	Dickinson State	NRL
Leipnik, R.B.	Prof	Mathematics	U California - Santa Barbara	NWC

Participants	Rank	Academic Department	College/University	Navy Lab
Cronyn, W.M.	Assoc Prof	Physics	San Diego State	NOSC
Cross, G.R.	Asst Prof	Comp Sci	Louisiana State	NRL
Cruthirds, J.E.	Asst Prof	Math & Stat	U So. Alabama	NOSC
Cudeck, R.A.	Asst Prof	Psychology	U Minnesota	NPRDC
Culbreth, Jr., W.G.	Asst Prof	Mech Eng	Naval P.G. School	NRL
Cyran, J.A.	Lab Coordinator	Biology	Morris County Col	NRL
Dandois, J.E.	Assoc Prof	General Eng	Penn State	NADC
Davey, K.R.	Asst Prof	Elec Eng	Georgia Inst Tech	NCSC
Davis, J.P.	Asst Prof	Chemistry	Penn State	NADC
Douglass, Jr., C.H.	Asst Prof	Chemistry	Trinity Col-Wash,DC	NRL
Embretson, S.E.	Assoc Prof	Psychology	U Kansas	NPRDC
Engle, I.M.	Assoc Prof	Physics	Naval Academy	NRL
Fallon, D.J.	Asst Prof	Civil Eng	Old Dominion	NSRDC
Fan, D.N.	Prof	Mech Eng	Howard U	NSWC
Featherstone, G.J.	Asst Prof	Eng Tech	Bluefield State	NWC
Frederick, G.T.	Assoc Prof	Biology	Rochester Inst Tech	NMRI
Gaglione, A.M.	Asst Prof	Mathematics	Naval Academy	NSRDC
Gerrard, M.	Asst Prof	Psychology	U Kansas	NPRDC
Gill, T.L.	Assoc Prof	Mathematics	Howard U	NRL
Gray, N.R.	Assoc Prof	Math & Comp Sci	Western Wash U	NOSC

Table II

1983 NAVY SUMMER FACULTY RESEARCH PROGRAM PARTICIPANTS

Participants	Rank	Academic Department	College/University	Navy Lab
Annamalai, N.K.	Assoc Prof	ECE Dept	Clarkson Tech	NRL
Arndt, S.V.	Consultant	Soc Sci Lab	Univ Notre Dame	NPRDC
Barber, P.G.	Assoc Prof	Chemistry	Longwood College	NSRDC
Blackerby, B.A.	Prof	Geology	Cal State-Fresno	NWC
Blanchard, J.S.	Asst Prof	Education	Texas Tech U	NPRDC
Bohren, C.F.	Assoc Prof	Meteorology	Penn State	NOSC
Boyer, L.F.	Research Assoc	Geology & Geo Phys	Yale U	NUSC
Brock, L.M.	Prof	Eng Mech	U Kentucky	NRL
Brown, J.W.	Assoc Prof	Psychology	San Diego State	NPRDC
Bukowski, J.V.	Asst Prof	Systems Eng	U Pennsylvania	NADC
Baumgardner, C.L.	Prof	Chemistry	North Carolina State	NRL
Carson, F.W.	Assoc Prof	Chemistry	American U	NMRI
Chattergy, R.	Prof	Elec Eng	U Hawaii-Manoa	NOSC
Chen, M.M.	Assoc Prof	Management	San Diego State	NPRDC
Choi, J.	Asst Prof	Elec & Comp Eng	Florida Inst Tech	NCSC
Chriss, D.	Instructor	Chemistry	Southern U	NWC
Cooney, J.A.	Prof	Physics	Drexel U	NADC
Corso, G.M.	Assoc Prof	Psychology	Georgia Inst Tech	NADC
Courter, R.W.	Assoc Prof	Mech Eng	Louisiana State	NSWC
Crawford, C.G.	Asst Prof	Mathematics	Naval Academy	NSRDC

The names and addresses of the 1983 participants themselves as well as the names of their Research Colleagues at the Navy laboratories appear on the abstracts of their reports in Sections IV through XIII and additional statistical information on the participants, including an alphabetical listing of them, is presented along with other data in the following paragraphs.

Some Statistics for the 1983 Program

The 111 NSFRP program participants in 1983 -- 53 of whom were supported by ONR under the basic program and 58 of whom were supported by the Navy laboratories -- were distributed amongst the latter as shown in Table I.

Table I

DISTRIBUTION OF 1983 NSFRP PARTICIPANTS
AT THE NAVY LABORATORIES

Navy Laboratory	Funded by ONR	Funded by Laboratory	Totals
NRL	8	22	30
NMRI	6	2	8
NADC	5	11	16
NCSC	4	0	4
NOSC	5	7	12
NPRDC	4	6	10
NSRDC	6	3	9
NSWC	5	1	6
NUSC	5	4	9
NWC	5	2	7
Totals	53	58	111

Indicated separately therein also are the number of participants supported at each Navy laboratory by ONR and the numbers supported by the Navy laboratories themselves.

The names of the 1983 program participants arranged in alphabetical order along with their academic ranks, departmental affiliations and home colleges or universities and the Navy laboratories at which they spent the summer are listed similarly in Table II below.

Personnel in the 1983 Program

The address for John Lisack, Jr. and Jeff Jarosz, the Program Directors at ASEE, and the names and affiliations of the Program Coordinators at the 10 Navy laboratories taking part in the program for 1983 are listed below:

John Lisack, Jr. and Jeff Jarosz
American Society for Engineering Education
Suite 200
111 Dupont Circle
Washington, DC 20036

Agda A. Cohen
Naval Research Laboratory

R. L. Sphar
Naval Medical Research Institute

Henry Beyer
Naval Air Development Center

John Wynn
Naval Coastal Systems Center

Eugene P. Cooper
Naval Ocean Systems Center

Bernard Rimland
Naval Personnel Research and
Development Center

Elizabeth Cuthill
Naval Ship Research and
Development Center

Rita Shomette
Naval Surface Weapons Center

Paul Scully-Power
Naval Underwater Systems Center

Dick Wisdom
Naval Weapons Center

II. MANAGEMENT, PERSONNEL, STATISTICAL DATA AND COSTS FOR THE 1983 PROGRAM

Administration and Program Execution

The NSFRP program in 1983 was again administered by ASEE for ONR. John Lisack, Jr. and Jeff Jarosz served as Project Directors for the program at ASEE and the writer served at ONR as Scientific Officer.

The 1983 program as previously was advertised by ASEE in the fall of 1982 and announcements of the program were sent to more than 40,000 members of ASEE and the American Association for the Advancement of Science. In addition, announcements were sent separately to about 12,000 deans and department chairpersons in American colleges and universities including coverage of departments of mathematics, physics, chemistry, astronomy, geology, geography, information and communication sciences, statistics, atmospheric and hydrospheric sciences, general sciences, and the social, biological and economic sciences.

Applications received at ASEE in response to the announcements were forwarded to the 10 Navy laboratories, distributed according to the preferred first choice Navy laboratories indicated by the applicants. These were then circulated at each Navy laboratory to find appropriate matches of talents and interests following which the Navy laboratories made their selections and winning applicants were offered appointments to the program by ASEE.

At each of the Navy laboratories a Program Coordinator acted as a focal point for local administration of the program and each NSFRP participant was associated, at the Navy laboratory to which he or she was assigned, with one or more selected Navy scientists -- referred to in this report as the participant's Research Colleagues.

Preprogram visits of the 111 participants to their assigned Navy laboratories were arranged in order to plan the participants' summer research and make preliminary arrangements for their association with the Navy laboratories during the summer and to facilitate finding of suitable housing for the participants and their dependents and so forth. These preprogram visits to the participants' Navy laboratories permitted a "running start" on the participants' research in many cases and facilitated efficient use of the participants' and their Research Colleagues' time and energy for the program.

At the end of their ten weeks tenure at their assigned Navy laboratories the participants each received a certificate from ONR and ASEE attesting to his or her successful participation in the 1983 program and each participant prepared a report on his or her summer's work, abstracts of which appear in this report in Sections IV through XIII as noted previously.

In general the administration and operation of the NSFRP program in 1983 thus followed the same pattern as in previous years, the only substantial differences being in the gradual expansion and growth of the program.

II. MANAGEMENT, PERSONNEL, STATISTICAL DATA AND COSTS FOR THE 1983 PROGRAM

Table IV

NAVY SUMMER FACULTY RESEARCH PROGRAM PARTICIPANTS
DURING THE FIRST FIVE YEARS OF THE PROGRAM

1979	1980	1981	1982	1983
Ahsan, R.	Busby, N.R.	Ahrnsbrak, W.	Aburdene, M. F.	Annamalai, N.K.
Benitez, F.L.	Carroll, R.L.	Anderson, P.A.	Ahrnsbrak, W. *	Arndt, S.V.
Bowman, T.T.	Cramer, M.S.	Baratta, A.J.	Bakshi, P.M.	Barber, P.G. *
Cheng, K.L.	Dailey, M.D.	Barber, P.G.	Bania, T.M.	Blackerby, B.A.
Cramer, M.S.	Donaldson, B.K.	Busby, H.R. *	Berkhout, J.I.	Blanchard, J.S.
Ferraris, J.P.	Dube, R.L.	Campbell, D.J.	Bhar, T.N.	Bohren, C.F.
Gould, J.	Dunn, H.S.	Carroll, R.L. *	Bohren, C.F.	Boyer, L.F.
Leiter, D.	Eberiel, D.T.	Chattergy, R.	Boyle, A.B.	Brock, L.M.
Ling, S.C.	Gilmore, C.M.	Church, C.K.	Bredeson, J.G.	Brown, J.W.
Mathers, J.P.	Goeringer, G.C.	Cook, T.M.	Bukowski, J.V.	Bukowski, J.W.
McCain, C.E.	Howard, B.E.	Cooper, P.B.	Chiang, J.	Baumgardner, C.L.
Miller, P.J.	Huebner, J.S.	Drake, A.D.	Chung, D.Y.	Carson, F.W.
Pollack, G.L.	Jacobs, G.	Dwass, M.	Coyne, P.J.	Chattergy, R.
Turriff, D.E.	Johnson, D.H.	Eoll, J.G.	Creese, R.C.	Chen, M.M.
Vawter, D.L.	Kamil, E.M.	Ferguson, E.J.	Czarnecki, M.F.	Choir, J.
Young, C.T.	Kilchell, B.S.	Fleishman, L.I.	Davey, K.R.	Chriss, D.
	Linz, A.	Funk, K.H.	Donaldson, B.K. *	Cooney, J.A.
	Lyons, D.P.	Garcia, S.R.	Douglass, C.H.	Corso, G.M.
	Manka, C.K.	Giles, C.L.	Drake, A.D. *	Courter, R.W.
	Mathewson, J.H.	Hagelberg, M.P.	Dumas, P.E.	Crawford, C.G.

1980	1981	1982	1983
Morrell, M.L.	Hatfield, F.J.	Durrett, H.J.	Cronyn, W.M.
Nelson, J.H.	Heath, A.	Eastman, R.M.	Cross, A.R.
Newton, T.A.	Horan, S.	Edwards, M.E.	Cruthirds, J.E.
Plotkin, A.	Howard, B.E. *	Eoll, J.G. *	Cudeck, R.A.
Roberts, C.A.	Johnston, L.H.	Feng, F.D.	Culbreth, Jr., W.G.
Wernicki, M.C.	Joshi, M.	Ferguson, E.J.	Cryan, J.A.
	Kalata, P.	Frahm, C.P.	Dandois, J.E.
	Korbly, L.J.	Frederick, G.T.	Davey, K.R.
	Kurtz, L.A.	Funk, K.H.	Davis, J.P.
	Lada, C.J.	Gardner, R.M.	Douglass, Jr., C.H.
	Lee, J.C.	Gattis, J.L.	Embretson, S.E.
	Lane, D.	Geraci, J.R.	Engle, I.M.
	LeBlanc, L.R.	Hagedoorn, A.H.	Fallon, D.J.
	Linz, A. *	Hammond, E.C.	Fan, D.N.
	MacIntyre, F.	Hand, C.W.	Featherstone, G.J.
	Manka, C.K.	Hargrove, A.	Frederick, G.T.
	Marchand, A.P.	Hedgepeth, T.W.	Gaglione, A.M.
	Martinez, T.T.	Heisler, R.	Gerrard, M.
	McLauchlan, R.A.	Heller, M.W.	Gill, T.L.
	Mikesell, R.P.	Htun, K.M.	Gray, N.R.

1981	1982	1983
Reneke, J.A.	Hubbard, D.W.	Greenstein, J.S.
Riesbeck, C.K.	Johnston, L.H. *	Hagelberg, M.P.
Rivera, L.A.	Jones, W.H.	Hamerly, R.G.
Rubin, R.A.	Kaufman, M.J.	Harris, B.
Samuel, A.	Ko, F.K.	Hayward, A.G.
Sasaki, E.H.	Kriegsmann, G.A.	Heisler, R.
Schmiedekamp, C.	Landolt, R.G.	Henkens, R.W.
Schumpert, J.M.	LeBlanc, L.R. *	Hurdle, L.S.
Shelton, W.W.	Lind, A.	Hutter, D.J.
Shubeck, P.P.	Longo, S.A.	Johnson, R.I.
Sung, C.C.	Loo, F.T.C.	Johnston, L.H. **
Syed, V.	Manka, C.K. *	Jones, W.H. *
Tamaki, J.K.	Mann-Nachbar, P.	Kausman, J.W.
Taylor, T.D.	McLauchlan, R.A. *	Kaufman, C.
Thomas, J.J.	Myers, W.F.	Ko, F.K. *
Vietti, M.A.	Newburg, E.A.	Kriegsmann, G.A. *
Walmsley, J.A.	Newton, T.A.	Landolt, R.G. *
Walsh, P.J.	Noodleman, S.	Larson, D.C.
Yuschik, M.J.	Oliver, F.W.	Lee, M.A.
	Olson, A.M.	Leipnik, R.B.

1982	1983
Pandey, R.K.	Lesiecki, M.L.
Parchment, O.C.	Liimatta, P.E.
Paul, M.P.	Lilly, J.H.
Reed, R.W.	Longo, S.A. *
Rhodes, B.H.	Lucas, T.R.
Richardson, F.S.	Mann-Nachbor, P. *
Rickard, L.J.	May, L.
Riehl, J.P.	Mielczarek, E.V.
Robinson, E.L.	Nameroff, N.H.
Samuel, A. *	Neumann, R.M.
Sanders, T.H.B.	Ngwa-Suh, N.
Sasaki, E.H. *	Nye, A.H.
Sebrechts, M.M.	Padron, M.
Seevers, R.E.	Parker, H.R.
Sink, C.W.	Parks, V.S.
Sloan, V.Y.	Paul, M.P. *
Spiteri, C.J.	Pfluger, C.E.
Stiffler, A.K.	Pinto, J.G.
Taggart, G.B.	Plotkin, B.J.
Tamaki, J.K. *	Poularikas, A.D.

1982

Tapia, M.A.
Tatum, B.C.
Templeton, J.L.
Tillman, C.
Uzes, C.A.

Vechten, D.V.
Varley, R.L.
Vanderah, D.J.
Wachman, M.
Walker, C.C.

Walsh, P.J. *
Wechter, M.A.
Weisgerber, F.E.
Williams, W.
Wolf, A.A.

Yfantis, E.A.
Yuschik, M. *

1983

Pytel, J.L.
Renfroe, D.A.
Rhodes, B.H.
Riley, G.F.
Rilema, D.P.

Robinson, E.L. *
Rollins, R.R.
Roxin, E.O.
Rudzinski, W.E.
Rymer, H.R.

Saccuzzo, D.P.
Sanders, W.A.
Schneck, D.J.
Schott, J.R.
Siegmann, W.L.

Sink, C.W. *
Spikes, W.C.
Spiteri, C.J. *
Spreer, L.O.
St. Mary, D.F.

Stein, J.J.
Sweat, A.J.
Tappert, F.D.
Tillman, C.
Tobocman, W.

Torrez, W.G.
Wachman, M.
Wechter, M.A.
Wolf, A.A.
Zilberberg, Y.M.

Zimmerman, K.P.

* Second time appointments
** Third time appointments

Participation by Women and Minorities

During 1979, the first year of the NSFRP program with only 16 participants all told, there was no part taken by either women or minority group members. However, beginning in 1980, out of a total of 26 participants about 10 percent were women or members of minority groups and throughout the following three years of the program participation by women and minorities ran about 25 percent or more each summer. There was no participation by Black Americans prior to the summer of 1982 but in that year and again in 1983 participation by Black faculty members was in each case about eight to 10 percent. Details are presented in Table V below.

Table V

PARTICIPATION BY WOMEN, BLACK AMERICANS AND MINORITIES IN GENERAL

Minority Categorization	1979	1980	1981	1982	1983
Women & All Minorities	0	3	15	29	27
Non-Minority Women	0	1	4	5	13
Black Americans	0	0	0	9	8
Other Minorities	0	2	11	15	6
All Participants	16	26	59	97	111

The growth of participation of the various categories of minorities and women is further illustrated in Figure 3.

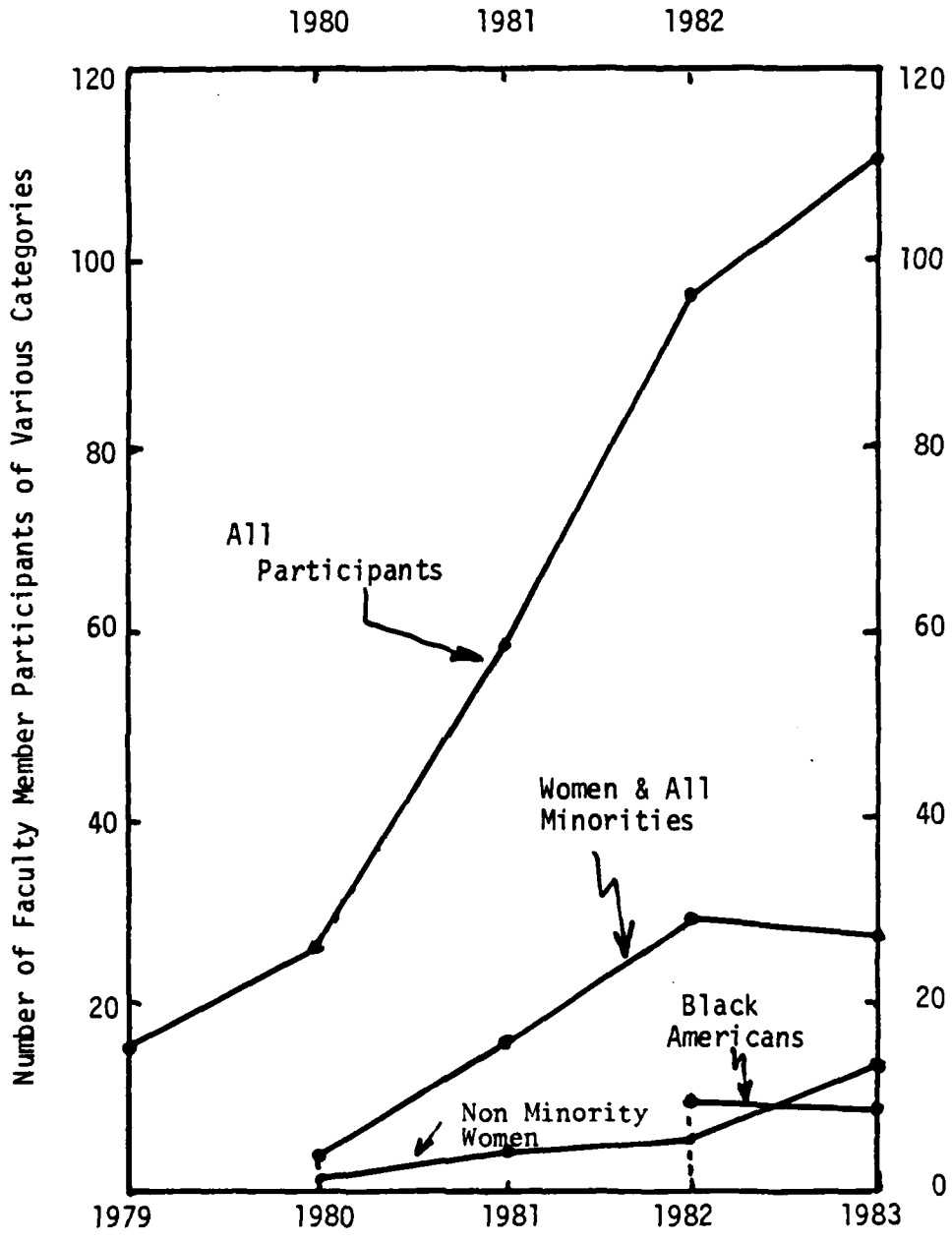

Figure 3

Distribution of Participants Among
Women, Black Americans and Minorities in General

Costs and Distribution of Support

As noted previously in the Introduction and Executive Summary, the NSFRP program was supported entirely by ONR during its first two years but beginning in 1981 and continuing in 1982 and 1983 the Navy laboratories elected to contribute additional funds to the program so that it might thereby be expanded.

The resulting approximate distribution of financial support for the NSFRP program from 1979 through 1983 is shown in Table VI below and is illustrated graphically in Figure 4.

Table VI

DISTRIBUTION OF COSTS BETWEEN ONR AND THE NAVY LABORATORIES IN THOUSANDS OF DOLLARS

Source of Funds	1979	1980	1981	1982	1983
ONR	99.7	159.3	241.0	305.9	366.5
Navy Laboratories	0	0	97.5	345.1	400.7
Totals	99.7	159.3	338.5	651.0	767.2

As the data in Table VI indicates the Navy laboratories collectively supported a little more than half of the total costs in the years 1982 and 1983.

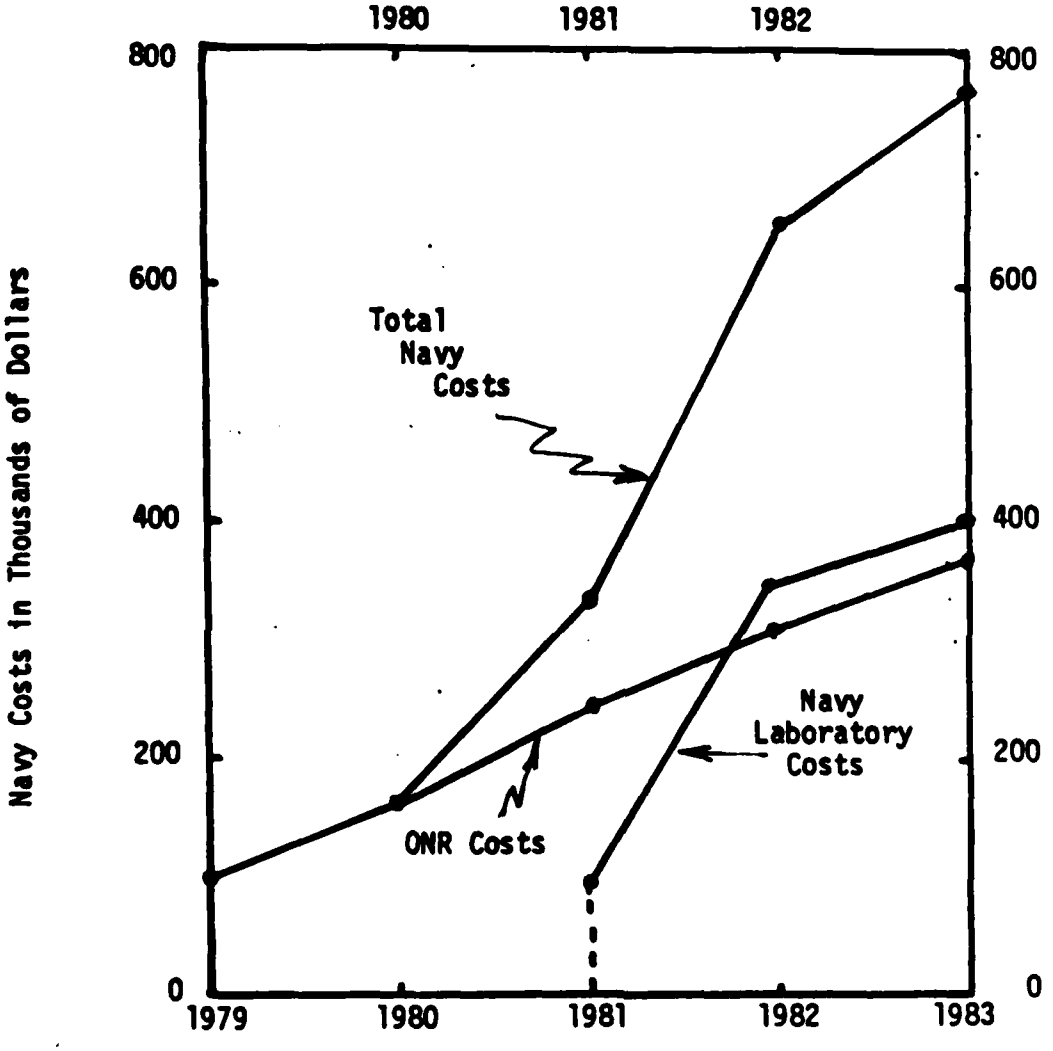

Figure 4

Distribution of Navy Costs Between ONR and the Navy Laboratories

IV. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL RESEARCH LABORATORY

Washington, DC

Program Coordinator at NRL: A. Cohen

1983

LEAKAGE CURRENTS IN N-CHANNEL SOS MOSFETS

Nagappan K. Annamalai

Department of Electrical and Computer Engineering
Clarkson College of Technology
Potsdam, New York

ABSTRACT

High value of leakage current was noticed in n-channel silicon-on-sapphire metal oxide semiconductor field effect transistors (SOS MOSFETs) by many researchers. The large leakage current was described in terms of the back channel formed due to Al_2O_3-Si interface charge or by the reverse biased junction leakage. Leakage current measurements were carried on devices fabricated at NRL both by 1) epitaxial and 2) chemical vapor deposition (CVD) techniques. These low level current measurements were made with a computer controlled circuit set up. The leakage currents were measured on a number of devices on each substrate. After making threshold measurements, a gate voltage of -5V was chosen to turn off the channel formed along the top surface between the source and drain. The leakage currents ($I_L=I_D$) were measured by applying a constant drain voltage and for various body voltages. The measurements were repeated for various drain voltages.

It was seen that the junction leakage was large compared to the Al_2O_3-Si interface leakage in the NRL devices. Therefore the I_D-V_{BS} characteristics of the NRL n-channel devices were not the same as the ones reported by P. Gentil (Tome 13, Dec 1978, 609).

To separate the leakage components, HP-4175-A semiconductor parameter analyzer system was used. A constant value of I_D was injected through the drain and various values of I_{BS} was extracted in steps and values of I_S, V_{DS}, V_{BS} and I_G were measured. The measurement yielded the information on the leakage components. A comparison is made between epitaxial and CVD devices in terms of leakage currents. Existing theory (by P. Gentil) assumes a smaller junction leakage and hence not adequate for the NRL devices. To develop a general theory, a modification of the existing theory is necessary. This is a good problem for future investigation.

Research Colleague at NRL: E. Richmond 1983

POLYMER FORMATION VIA NUCLEOPHILIC ADDITION TO ACETYLENES

Carl L. Bumgardner

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North Carolina State University
Raleigh, North Carolina

ABSTRACT

Utilizing the ability of acetylenes to add nucleophiles, two new polymer-forming reactions were examined.

The first involved hydroquinone and 1, 4-diethynylbenzene, which, under base calatysis, gave a new semiconducting polymer having the structure $\{CH{=}CH\text{-}C_6H_4\text{-}CH{=}CH\text{-}O\text{-}C_6H_4\text{-}O\}$.

In the second case preparation and reaction in base of 1, 3-bias (2-hydroxy-hexafluoro-2-propyl)-5-(3,3,3-trifluropropynyl) benzene are described. The transparent rubbery (but insoluble) film obtained from this highly fluorinated yne-diol is assigned a network structure resulting from intermolecular nucleophilic addition of an alkoxide to the acetylenic carbon atom α-to the aromatic ring.

Research Colleague at NRL: J. Griffith 1983

AN ACCURATE YET TRACTABLE DYNAMIC ANALYSIS OF A NOTCHED BEAM DURING IMPACT

Louis M. Brock

Department of Engineering Mechanics
University of Kentucky
Lexington, Kentucky

ABSTRACT

Dynamic Fracture - as opposed to fracture under static (slow) loading - is not well understood, yet is a critical problem in structural design. The relatively simple experiment of fracturing a notched beam by impacting it with a falling weight can provide a means of testing dynamic fracture theories against experimental results.

However, this testing can only be made if a mathematical analysis of the beam response during impact is available which is not only accurate but simple enough in form to be manipulated easily in solving the complicated integral equations arising from Newton's Laws for the beam and falling weight.

Using a modification of classic beam theory, such an analysis was generated this summer and the integral equation solved for the impact force on the beam. Agreement between this force and experimentally measured forces for known crack extension histories was excellent. Future work will use various fracture theories in place of known crack histories so that the force comparison can be used to test the theories.

Some details of material response, in particular elastic wave propagation in the beam during impact, are obscured by the theory, unfortunately. Therefore, some exact solutions for the wave pattern near the beam notch generated by the impact waves were also derived. The results are to be included in a paper currently being prepared to submit in the fall of 1983 for publication.

Research Colleague at NRL: M. Jolles 1983

DESIGN OF A KNOWLEDGE-BASED MULTI-SENSOR INFORMATION INTEGRATION SYSTEM

George R. Cross

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Louisiana State University
Baton Rouge, Louisiana

ABSTRACT

We describe the design of a multi-sensor information integration system. Multi-sensor refers to a collection of electronic sensors such as radar, sonar, ESM, and ISAR. Our attention is limited to sensor reports from surface and sub-surface platforms. Information integration is the process of combining the raw sensor reports into descriptions of the platforms within the range of the sensors. Finally, knowledge-based means that the information integration task is performed using artificial intelligence techniques exploiting expert knowledge about classification of platforms, interpretation of sensors, and tracking algorithms.

Possible organizations for such a system are discussed and evaluated. The design presented is based on the architecture of the HEARSAY-II speech understanding system, a well-understood and elegant method of integrating disparate knowledge sources without the overhead and organizational difficulties associated with geographically distributed processing. The blackboard in our system is a list of imcomplete platform descriptions updated by knowledge sources. By starting with an established system design, the system implementors can concentrate on the difficult questions of evidence coordination, knowledge representation, and sensor modeling. Since the knowledge sources are independent, evaluation of their individual contributions to the problem solution is possible. The report explains the design of the initial knowledge sources including correlation knowledge, and expert ship classification procedures. A sensor representation language is proposed to model and describe the output of the sensors.

Research Colleague at NRL: L. Davis 1983

THE DETERMINATION OF MOLECULAR STRUCTURE BY SINGLE-CRYSTAL X-RAY DIFFRACTOMETRY

Clarence E. Pfluger

Department of Chemistry
Syracuse University
Syracuse, New York

ABSTRACT

The crystal and molecular structure of six materials have been determined during the 10 week program period using single-crystal X-ray diffraction methods. These are as follows: (1) The room temperature structures of 3 crystal modifications of the compound 4,4'-bis(ethoxy)azoxybenzene, a compound exhibiting a luquid crystalline phase from 137° to 168°C. These structures represent the initial phase of a systematic variable temperature X-ray crystallographic study of several members of a homologous series in an attempt to obtain some fundamental information regarding the intra- and inter-molecular interactions which must account for liquid crystalline behavior of this series of compounds; (2) The structure of Nickel(II)Ethylenedinitrilotetraacetamidoxime Sulfate Tri-hydrate to obtain information regarding the mode of coordination of the hexadentate emidoxime ligand to nickel(II); (3) The structure of tetrakis [μ_3-methoxo-2,4-pentanedionatomethanolnickel(II)] as part of a study of the coordination chemistry of alcohols; and (4) The structure of an enol benzoate obtained from 1,4-addition reaction of phenyl magnesium bromide and benzalacetom-esitylene to determine its exact stereochemistry.

Research Colleague at NRL: I. L. Karle 1983

A GRAPHIC DESCRIPTION OF THE HOLOGRAPHIC PROCESS: GRID REFLECTION TO ANALYZE CURVATURE

Vincent J. Parks

Department of Civil Engineering
The Catholic University of America
Washington, DC

ABSTRACT

1. A Graphic Description of the Holographic Process

Graphical models of various sets of light waves, that interfere to produce holograms, are given. It is shown graphically that the lines of interference on a hologram, when illuminated by one set of light waves from which it was produced, will diffract some of the light waves from the second set, if the second set consists of light reflected or scattered from an object, a 3 D image of the subject is produced.

The key concept illustrated by the graphics is: "If one of a pair of illuminating beams used to form a hologram is impinged on the developed hologram, the hologram will diffract a portion of the light to reconstruct the other beam.

2. Grid Reflection to Analyze Curvature

The relation of curvature of a reflective surface to image magnification is presented for use with grids to determine curvature over the entire reflective surface. Two practical examples are reported: a curved mirror with serious irregularities and a reinforced rubber slab.

Research Colleagues at NRL: H. Huang

1983

SUPERSONIC DOWNFLOWS IN SUNSPOT TRANSITION REGIONS

Alan H. Nye

Mechanical Engineering Department
Rochester Institute of Technology
Rochester, New York

ABSTRACT

During Rocket Flights on 21 July, 1975 and 13 February, 1978 observations were made with the High Resolution Telescope and Spectrograph (HRTS) of the transition region above sunspots. In both sets of data, conspicuous supersonic downflows ($\sim$100 km s^{-1}) were observed that were associated with light bridges in each sunspot. This appears to be a steady state phenomenon, typical of sunspots with light bridges, which was unobservable before the HRTS Rocket Flights. Since the downflow is supersonic it must go through a shock to match conditions in the chromosphere. This would increase the gas pressure by a factor $\sim$20 and the plasma termperature after the shock would jump to $6(10^5)$K. This temperature is unobservable in the wavelength range of the HRTS Data. However, Ne VII observations ($T\sim5(10^5)$K) from skylab have shown enhanced Ne VII plumes extending above sunspots. These could be the footpoints of the loops containing the supersonic transition region downflows observed by HRTS.

The supersonic downflows in the 13 February, 1978 observations extended $\sim$ 40 arcseconds along the slit, ending abruptly at the location of the light bridge. The Doppler shifted component widens as it approaches the light bridge but its centroid remains at about 100 km s^{-1}. This feature, which was not present in the 21 July, 1975 observations, may be due to a rotating flow along a converging magnetic flux tube. As the cross-sectional area of the tube decreases, conservation of angular momentum requires an increase in rotational velocity. If the tube is inclined with respect to the line of sight, this would produce a broadening of the supersonic velocity component, as observed.

Research Colleague at NRL: J. Cook 1983

PHASE TRANSITIONS IN FLUIDS

Richard M. Neumann

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University of Massachusetts
Amherst, Massachusetts

ABSTRACT

An intuitive statistical thermodynamic theory of the phase condensation of dense fluids is presented. The theory provides a criterion by which the critical temperature in gases and the freezing temperature in liquids can be located. The phase transition occurs during cooling when the less dense phase becomes unstable with respect to the formation of bound particle pairs. The criterion can be expressed using the two-particle radial distribution function. The inert gases and molten alkali halides are systems describable by this approach. Furthermore, the melting formula derived for the molten salts is identical to the two-dimensional-model-system result of Kosterlitz and Thouless (K.T.)

Because both the present theory when applied to the molten salts and the K.T. theory involve the dielectric constant, an idea is presented as to how this constant might be measured. A falling drop of molten salt is accelerated horizontally in an inhomogeneous electric field. The lateral displacement of the drop can be calculated as a function of the applied field strength and dielectric constant.

Research Colleague at NRL: D. Nagel 1983

SEMIEMPIRICAL CALCULATIONS OF NUCLEAR REACTION CROSS SECTIONS

Millard A. Lee

Department of Physics
Dickinson State College
Dickinson, North Dakota

ABSTRACT

The work is a continuation of a project undertaken by Dr. Edward Petersen at the NRL Cyclotron Laboratory. There has been renewed interest in the project recently due to possible applications in the area of single-event upset in semiconductor memory elements.

A simple model is developed which is useful for describing the gross structure of nuclear excitation functions for projectiles of energy up to 100 MeV incident on target nuclei of any mass. For a given projectile-target combination the model allows calculation of cross sections for the various reactions which can take place and provides for calculation of particle production cross sections.

The model departs from traditional approaches in that it does not begin with details of angular momentum states or excitons. Rather, it begins with a calculation of the total reaction cross section. This cross section is then separated into direct and statistical fractions, for which in turn pre- and post-equilibrium contributions are estimated. At any given energy there are only a few reactions which will occur, and the model assumes that the choice as to which reactions will occur is made on the basis of elementary concepts such as reaction Q-values. It then assumes simple mathematical forms for the individual excitation functions and combines these for an overall view of the various reactions which occur.

A computer program has been written to carry out the calculations and has been run on a SEL 32/55 computer. Future plans call for further work by the participant in trying additional mathematical functions and carrying out the calculations for a representative sample of reactions. These results will be compared with experimental values, and when sufficient data have been obtained an article will be submitted to the appropriate journal.

Research Colleague at NRL: E. Petersen 1983

CHEMICAL DECONTAMINATION: CANDIDATE SIMULANT/HYPOCHLORITE-CITRATE INTERACTIONS/LITERATURE DATA BASE

Robert G. Landolt

Department of Chemistry
Texas Wesleyan College
Fort Worth, Texas

ABSTRACT

Research at the Naval Research Laboratory in the summer of 1983 was devoted to the following objectives:

A. The feasibility of the use of diphenyl chlorophosphate as a simulant for nerve agent decontamination studies with hypochlorite was explored.

B. A preliminary profile was developed of relative reactivity of the citric acid/sodium citrate system with hypochlorite as a function of pH, and preliminary assessment was made of the influence of metal cations on reactivity.

C. The current literature relevant to hypohalite-based decontamination procedures was reviewed, and a cross section of papers was compiled into a computer data base to be used for information retrieval.

Research Colleague at NRL: R. Little 1983

EXTENDED X-RAY EMISSION FROM CLUSTERS OF GALAXIES
PROGRESS REPORT

Donald J. Hutter

Department of Physics
Rose-Hulman Institute of Technology
Terre Haute, Indiana

ABSTRACT

The goal of my work as an ASEE/Navy Summer Faculty Fellow at the Naval Research Laboratory, during the period of June-August 1983, was to use the data base of the HEAO-A1 experiment to study the extended x-ray emission associated with clusters of galaxies. Specifically, I wished to use all of the available data from the NRL large-area survey instrument (A-1), obtained with the $\frac{1}{2}^{o}$ x 1^{o} collimated proportional counters, to identify and map extended faint x-ray halos which surround some clusters of galaxies.

The principal accomplishments of the work I completed this summer were in adapting a number of computer programs which are needed in this project. The change in computer hardware used by the A1 group has necessitated the conversion of the FORTRAN programs used in x-ray data reduction to the new VAX and Eclipse computers. I worked on the adaptation of software which extracts from the data base the data from scans (made by the rotating detectors) which pass within a specified angular distance of the cluster location on the sky. A much larger amount of time was required to adapt the program "Setscan" which screens the extracted data for a number of bad data conditions (instrument looking at the earth or moon, high background count, contamination by particle events, etc.) and then bins the data into maps of the specified region of the sky (the count rate being normalized for collector area exposure).

Two major areas in the software conversion which are not yet completed are, first, to write a program to do reliable 'deglitching' of the data and, second to fit an empirical two dimensional model to the x-ray map of each cluster. The deglitching program is to remove short duration spikes in the count rate vs time distribution resulting from the scanning mode operation of the instrument. To date there is no reliable way of removing these spikes other than by visual inspection of the data. I intend to adapt a program called STEPIT (J. P. Chandler, Oklahoma State Univ.), which minimizes the chi-square statistics to fit multiparameter model functions to a given data distribution, in order to characterize the x-ray 'image' of each cluster.

I am presently preparing to continue work on this project, using the VAX 11/780 at my home institution. I am in the process of applying for financial support for this project through NASA and the Research Corp. (Cottrell Research Grants).

Research Colleague at NRL: K. Wood 1983

WIDEBAND, FREQUENCY-DOMAIN BEAMFORMING FOR COHERENT SIGNAL PROCESSING

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ABSTRACT

Coherent detection processors for sonar (e.g. matched filters for active systems) require continuous time-series as input and have conventionally been associated with delay-and-sum time-domain beamformers. As an alternative, we have extended frequency-domain beamforming techniques to retain the coherence of wideband signals and have demonstrated efficient software for computing continuous time-series beams for flexible post-processing. Using computer-generated "acoustic-array" data, the beamformer was shown to preserve the envelope, spectrum and correlation properties of signals while yielding near theoretical performance in reducing beam sidelobe levels. Advantages over a conventional delay-and-sum beamformer are: (1) elimination of the need for high imput sampling rates to achieve acceptable beam patterns -- the frequency-domain approach is insensitive to the sampling rate provided it exceeds the (bandpass) Nyquist rate; (2) reduction of high beam sidelobe levels caused by malfunctioning array elements -- the response of missing array elements is readily estimated in the frequency-domain by interpolating from the spectra of neighboring sensors; (3) minimization of hardware requirements -- all stages of signal processing (bandpass filtering, holefixing, beamforming, time-line reconstruction and matched filtering) can be efficiently performed in a general purpose array processor.

Research Colleagues at NRL: M. Weber and E. Franchi 1983

A SMALL PRESSURIZED VESSEL FOR MEASURING THE ACOUSTIC PROPERTIES OF MATERIALS

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ABSTRACT

A system is described that measures the acoustic properties of materials in the frequency range from 10 to 100 kHz, at pressures to 150 psi (1000 kPa), and from 0 to 40°C. By using transducer arrays and broadband pulses together with digital data acquisition and analysis techniques it is possible to contain this system in a vessel with a volume of only 0.42 m^3. The system provides measurements of complex reflection and transmission coefficients as an essentially continuous function of frequency. From these data one can obtain the following material parameters: sound speed, frequency dependent sound attenuation coefficient, complex acoustic impedence, echo reduction and insertion. Results are presented for a variety of samples to illustrate the capability of this system.

Research Colleague at NRL: R. Corsaro 1983

EXTENSION OF THE LEBESGUE INTEGRAL AND A NEW BANACH SPACE

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ABSTRACT

The purpose of this research effort is to provide the mathematical foundations for the Feynman path integral. We show that there is a natural Banach space associated with the class of Riemann complete integrable functions. This space contains L_1 as a dense set and is a Banach algebra with unit. This means that our approach provides a more natural framework for the incorporation of the Dirac delta function into mathematics. Our space is closed under convolutions and contains the Feynman kernel.

Research Colleagues at NRL: A. Saenz and W. Zachary 1983

COMET KOHOUTEK ION TAIL MODELING

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ABSTRACT

On 25.9 December, 1973, a 1250-1600 A^o broad-band image of Comet Kohoutek was taken using the NRL S-201 ultraviolet camera on Skylab 4. That image, taken in daylight, is believed to be that of an ion tail and, with the comet nucleus placed at about 0.1818 AU from the sun, the closest-to-the-sun ion tail that had been observed to date. The investigators (Opal and Carruthers, 1976) believed that the ion source was probably single-ionized carbon. No specific spectroscopic data were available, but the various possible alternative ion species were considered and ruled out, either because of their spectra or their very short lifetimes. The singly-ionized carbon atom C^+ is fairly long-lived when produced and has two prominent emission lines in the solar spectrum at 1334.5 and 1335.7 A^o. Intensity profiles, calculated assuming scattered solar radiation as the source of the photons, have been prepared, using the observed brightness contours and the computed geometry of the cometary orbit as control parameters. The results do not compare well with observations unless one assumes that the carbon ions, on the average, were nearly at rest with respect to the sun, which would mean a tailward drift velocity of only about 36 km/sec throughout the long tail or, even more improbable, an absorption of solar photons emitted at the smaller wavelength but Doppler red-shifted by 265 km/sec would be absorbed by the comet ions. This would imply a precise tailward drift velocity of 249 km/sec throughout the approximately 10^7 km extent of the tail.

An alternative scenario for the process in the ion tail responsible for the observed image is suggested.

Research Colleague at NRL: R. Meier

1983

FLOWING AFTERGLOW STUDY OF ICN^+

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ABSTRACT

A flowing afterglow technique for the study of spectroscopic properties of molecular ions has been developed. A noble gas (usually helium) is passed through an electrical discharge generated by a cylindrical cathode and a central wire anode. The discharge produces both helium ions and helium atoms excited to a metastable electronic state. The precursor gas is introduced to the system at a point just downstream from the discharge. Molecular ions are formed by Penning ionization of the precursor or by ion-molecule reactions in the cell. The ions are detected both by emission from ions formed in an excited electronic state and by laser-induced fluorescence (LIF). The experimental system has been used to study ICN^+, an ion not previously observed by LIF. Various conditions of total pressure, ICN pressure, discharge current and voltage, and distance between the discharge and the introduction of ICN were tested to determine optimum operating parameters. LIF spectra were recorded in the wavelength region from 460 nm to 550 nm. Interpretation of the spectra is currently underway and will be reported in the future.

Research Colleague at NRL: J. McDonald 1983

LYSIS OF DNP AND F(AB) LABELED LIPID VESICLES USING ANTIBODIES AND COMPLEMENT

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ABSTRACT

The model system, DNP-cap labeled vesicles loaded with carboxy fluorescein, lysed in the presence of anti DNP (IgM) and complement, no lysis was seen in the absence of antibody. Both isotonic (50 mM carboxyfluorescein) and hypertonic (100 mM carboxyfluorescein) vesicles showed lysis after a "lag" period of about 10 minutes, hypertonic vesicles showed a higher fluorescent signal upon lysis. Dialysis effectively lowered interference from fluorescence in the antibody and complement solutions.

Shiip F(ab)' labeled vesicles lysed in the presence of complement alone anti sheep F(ab)' antibody decreased complement lysis.

Research Colleague at NRL: R. Priest

1983

COMPUTER CONTROL OF THE NRL LOW-NOISE WATER TUNNEL AND TURBULENT PRESSURE DATA ANALYSIS

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United States Naval Postgraduate School
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ABSTRACT

The summer's work was conducted under R. J. Hanson, Code 5844 and was divided into two areas. First, an HP-85 computer and a data acquisition system was interfaced to a low-noise water tunnel used in underwater acoustics measurements. The computer allowed control of the water tunnel by measuring flow velocity as a function of time and by opening and closing control valves.

The second area of work involved the use of an HP-1000 computer and the development of software to analyze pressure transducer data generated in the low-noise water tunnel. For each experiment, several million pressure samples from two adjacent snesors were analyzed to obtain spectral densities, correlations, coherency, and the phase velocities of turbulent structures in turbulent flows.

Research Colleague at NRL: R. Hanson 1983

PROBLEMS RELATED TO CATALYTIC CARBON DIOXIDE REMOVAL

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ABSTRACT

My research work this summer involved two projects related to the larger problem of catalytic carbon dioxide removal from enclosed environments. My written report consists of a descriptive narrative of my activities, conclusions and suggestions.

The first project involved investigation of the interaction of carbon dioxide with tris(2,4-pentanedionato) manganese(III) [$Mn(acac)_3$]. Methanol solutions of this complex gave preliminary evidence of undergoing a significant change upon exposure to various amounts of carbon dioxide. Detailed investigation led to the observations that the supply material was partially decomposed and that trace amounts of water were probably assisting in the carbon dioxide/manganese complex interaction. Synthesis of $[Mn(acac)_2(H_2O)]Cl$ and subsequent spectral studies led to the conclusion that the primary manganese species in solution after CO_2 absorption is $[Mn(acac)_2(H_2O)]^+$.

The second project involved a closer look at the nuclear magnetic resonance (NMR) spectra of solutions of copper chloromethoxide in pyridine and methanol/pyridine mixtures before and after exposure to carbon dioxide. It is the conslusion of this author that a reasonable interpretation of the observed NMR spectra indicates that the small peaks observed at 5.1ppm and 3.2ppm represent residual methanol (from synthesis or reaction with water) and that the new peak observed at 5.5ppm represents water introduced during the CO_2 bubbling operation.

Research Colleague at NRL: J. Cooper 1983

DERIVATIZED ELECTRODES: SURFACE MODIFICATIION WITH NICKEL(II) MACROCYCLES

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ABSTRACT

Electrode surface modifications with NiM_R, where M is a macrocyle and R is H, NO_2, CH_3, CO_2CH_3, or $CO_2CH_2CH_2CH_3$, and the subsequent electrode properties were investigated. The macrocycles deposited on platinum, gold and glassy carbon in acetonitrile and propylene carbonate containing various electrolytes. CV's of the NiM_H film formed by oxidation at +1.3V* showed diffusional characteristics in the positive region. The CV's of the NiM_H films formed by repetitive cycling in the positive region (+0.0 to +0.7 or +1.3) were more nearly surface waves, but did have a small diffusional component. NiM_H films formed by repetitive cycling of both positive and negative regions (+1.3 to -2.0V) showed CV surface waves in the positive region, a wave with diffusional character at potentials more negative than -1.8V, and hugh redox-coupled spikes centered at approximately 0 and -1.8V. The films were stable conditions of (a) repetitive cycling from -0.5 to -2.0V and (b) repetitive cycling from the rest potential ($\sim$+0.5) to +1.3V. The films slowly lost redox activity upon repetitive scanning from +1.3 to 0 or -2.0V. The solid film material that deposited on a platinum foil by oxidation at +0.7V was dissolved in DMF and showed an absorption maximum at 595 nm, approximately 10 nm red shifted compared to the absorption maximum of 585 nm for NiM_H in the same solvent. The visible absorption spectrum of the film was also obtained on SnO_2. The maximum under these conditions was at 610 nm. A propylene carbonate solution containing the solid material was esr active indicating that an intermediating free radical species may form upon oxidation. The use of the films for catalytic CO_2 reduction was attempted but was unsuccessful with NiM_H films. (Similar results were found on a coated and uncoated Pt surface.) The potential for reduction of the NiM_H film spike was too negative. Thus, the catalytic activity of other films such as CuM_{Cl} (spikes at +0.2 and -1.0V) are now being investigated for CO_2 reduction.

Research Colleague at NRL: R. Nowak 1983

FOUR PRODUCT ACOUSTO-OPTIC PROCESSOR

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ABSTRACT

An experimental study of a proposal to construct a coherent, time-integrating optical processor using acousto-optic devices was undertaken. A novel feature of the design is the use of both Bragg cells and Surface Acoustic Wave (SAW) devices. The processor design, a two-dimensional correlator, called for the correlation of the signals in two vertically-oriented, electrically-driven acoustic Bragg cells. These cells are illuminated by separate beams of coherent light, and both are imaged onto a single, horizontal SAW device with transducers at each end driven by linear frequency-modulated signals (chirps). The output plane of this processor consists of the correlation between two input signals as a function of the frequency difference between them (horizontal axis) and the time delay of arrival between the two signals (vertical axis) i.e., the arrangement service as an ambiguity function processor. A processor of this type should prove useful in applications such as spread spectrum radar systems.

The use of a SAW device with counter-propagating, tilted acoustic wave-fronts imposes fairly stringent conditions on the incident light beams, and the majority of the time and effort of the present work was devoted to finding a workable configuration of components which would meet these conditions. The final arrangement places a Bragg cell in each leg of a modified Michelson interferometer; the beams diffracted by the Bragg cells leave the interferometer coverging toward each other in the horizontal plane with the appropriate angle between them so as to interact with the counter propagating acoustic waves in the SAW device. The two doubly diffracted beams from the saw device exit co-linearly and illuminate a two-dimensional, time-integrating detector array. While the present effort did not achieve a working processor system, the design which evolved is believed to be the most promising for any future work.

Research Colleagues at NRL: A. Tveten and J. Lee 1983

HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC ANALYSIS OF ETHYLENEDIAMINETETRAACETIC ACID IN BOILER WATER FORMULATIONS

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ABSTRACT

A procedure has been developed for the analysis of tetrasodium ethylenediaminetetraacetate (NA,EDTA) in boiler water. The method is based on a reversed-phase high performance liquid chromatographic (HPLC) determination of EDTA as the Fe (EDTA)$^{-1}$ complex. Tetrabutylammonium bromide in acetate buffer is the mobile phase. The method yields accurate results in the presence of the following interferents: Fe^{+3}, Ni^{+2}, Cu^{+2}, Ca^{+2} and Mg^{+2}. Phosphate interferes slightly. The relative standard deviation of the chromatographic procedure is 1.5%. The linear range extends from 1000 ppm to 0.5 ppm with a limit of detection of 0.3 ppm.

Research Colleague at NRL: D. Venezky

1983

DETAILED STUDY OF VISIBLE-UV CHEMILUMINESCENCE IN THE F-ATOM PLUS METHANOL SYSTEM

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ABSTRACT

During the summer of 1983 I continued research already in progress in collaboration with Dr. Denis Bogan (Code 6180). The primary focus of the work was the study of chemiluminescent emission resulting from the reaction of fluorine atoms with methanol in a gas-phase flow reactor. This reaction is being investigated as a source of methoxy radicals for combustion-related kinetic studies.

Several unresolved questions were answered by a series of control experiments with oxygen carefully excluded from the flow reactor. In particular, the results suggested strongly that previous observations of glyoxal emission were due to trace amounts of oxygen. The oxygen-free chemiluminescence was shown to consist primarily of HF vibrational overtones, plus electronic transitions from excited states of formaldehyde. It is believed that the predominant formaldehyde emissions originate from the triplet excited state, which has not been observed previously by chemical excitation.

I made several significant modifications to the experimental apparatus during the summer to improve the quality and convenience of data acquisition. One of these was the construction of an electronic integrator to improve the signal-to-noise ratio of both chemiluminescence and laser-induced fluorescence data. Subsequently I developed both hardware and computer programs for the automatic repetitive scanning and processing of low-level emission spectra.

A portion of this work will be presented at the International Conference on Photochemistry (abstract attached). Further results will be reported in a manuscript currently being prepared for submission to a refereed journal.

Research Colleague at NRL: D. Bogan 1983

DIRECT COMPOUND CLASS QUANTITATION JP-5 JET TURBINE FUEL BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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ABSTRACT

One important specification of jet fuel is the compound class composition (the relative amounts of saturated and aromatic hydrocarbon) because the composition directly affects the performance properties of the fuel. No simple technique is currently available to provide quick reliable quantitation of this property. The object of this project was to examine the potential of obtaining quantitative analysis during the HPLC separation of fuels and to develop a method that could provide quantitative data in agreement with current methods. This is needed since current methods are very time consuming and subject to several limitations.

This method utilizes typical HPLC equipment with refraction index detectors. This was chosen because each compound class has an approximately constant refractive index. The detector response was recorded by electronic integration and calibrated with a simulated jet fuel that was prepared by combining weighed amounts of each compound class. These fractions were obtained from a typical jet fuel that had been separated by HPLC and purified. The critical factor in calibration is matching the refractive index of each compound class of the standard to the fuel to be analyzed. When this is done, satisfactory calibration can also be achieved from pure combined derived standards.

This work reveals that not all commercially available refractive index detectors were applicable. Some do not give linear response to a given change in refractive index over their full range of response. Therefore, in using this technique one needs to be sure the analysis is being performed under conditions where the detector is responding linearly.

Several fuels were analyzed over a period of a year and found to give consistent results which were also in agreement with values obtained by other techniques. These results indicate that HPLC can provide a reliable, rapid alternative to the current methods of jet fuel analysis.

Research Colleague at NRL: 1981

OXYGEN UPTAKE STUDIES IN SHALE DIESEL FUEL

Marge Wechter

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ABSTRACT

The rate of sediment formation in shale diesel fuel doped with 2,5-dimethylpyrrole (DMP) was measured as a function of oxygen uptake. The fuel used was D-11, a shale DFM fuel with antioxidant present. Experimental goals included: confirmation of the reaction order as suggested by other work associated with this project; determination of the elemental ratios of the sediment formed; and elucidation of the chemical role of oxygen in sediment formation.

Preliminary results suggest that the reaction studied is first order in both DMP and O_2*. A similar study which was carried out in dodecane rather than fuel yielded results which were quite consistent with those obtained with the doped fuel samples. None of the solvents yielded evidence (by GC analysis) indicating formation of other soluble reaction products. Sediment samples produced in this study are being subjected to elemental analysis.

An interesting preliminary result indicates that: the volume of oxygen taken up per gram of sediment formed is apparently constant regardless of stress time or temperature, initial concentrations of reacting species, or solvent.

* - This experimental finding substantiates results of previous work done by others at NRL.

Research Colleague at NRL: R. Hazlett

1983

RADIATION-INDUCED DEFECTS IN GLASSES WITH HIGH WATER CONTENT

Albert Wolf

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ABSTRACT

My work at the Naval Research Laboratory this summer consisted of three distinct phases: (1) Putting the finishing touches on work begun last summer and preparing the final draft of a paper presented to the VIIth University Conference on Glass Science meeting at the Technical University of Clausthal on July 15. A copy of this paper appeard in a special volume of the Journal of Non-Crystalline Solids; (2) Studying the electron spin resonance spectrum of vapor-deposited thin films of carbon. A brief note describing these results is being prepared; (3) Studying, by means of electron spin resonance, the molecular re-arrangements which take place when silicon polymers (gels) undergo the transition to the glass phase. A paper describing these results is also in preparation.

Research Colleague at NRL: E. Friebele 1983

V. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL MEDICAL RESEARCH INSTITUTE

Bethesda, Maryland

Program Coordinator at NMRI: R. L. Sphar

1983

DEVELOPMENT OF A SENSITIVE ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA) EMPLOYING THE AVIDIN-BIOTIN COMPLEX (ABC)

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ABSTRACT

An enzyme-linked immunosorbent assay (ELISA) with amplification through an avidin-biotinylated horse radish peroxidase (donor:hydrogen-peroxide oxidoreductase, EC 1.11.1.7) complex (ABC) was developed as a sensitive test for antigens (Ag's) as well as a screen for monoclonal antibodies (MAb's) against them. Purified Rickettsia typhi Ag was used as a model with a view toward developing a crude infected mouse L cell homogenate screen of anti-typhus MAb's. Parallel work on Plasmodium gallinaceum sporozoites was undertaken not only to test MAb's but to develop a generally useful, sensitive assay for malarial antigens. Polystyrene microtitration plates with a high affinity for protein were employed in an optimized end-point spectrophotometric assay at 25°C of horse radish peroxidase activity reported as Absorbance at 414 nm after 30 min reaction time using 2,2'-azinobis (3-ethyl-2,3-dihydro-6-benzothiazole sulfonic acid) diammonium salt (ABTS) and hydrogen peroxide as cosubstrates. Relative activities exceeding a value of two have been normalized to account for the fact that less than the standard amount of enzyme had to be used in these cases. A 3:1 molar ratio of biotinylated horse radish peroxidase to avidin DH gave a very strong response to 100 ng samples of protein after immobilization. This quantity of protein was used wherever possible to compare solution state and solid state activities of the enzyme. Relative activities for systems with all components in solution were: enzyme, 9.8 ± 0.3; ABC, 6.0 ± 0.3; 100 ng of biotinylated horse and anti-mouse IgG (B-Ig) + ABC, 5.1 ± 0.2; 100 ng of mouse gamma globulin (MgG) + ABC, 5.1 ± 0.4; and 100 ng of MgG + 100 ng of B-Ig + ABC, 3.6 ± 0.4. In the immobilized case relative activities were: 100 ng of B-Ig + ABC, 2.3 ± 0.2; 100 ng of MgG + 100 ng of B-Ig + ABC, 1.5 ± 0.2; 3000 ng of R. typhi MAb + 100 ng of B-Ig + ABC, 1.5 ± 0.1; negative control, 0.11 ± 0.02; and blank, 0.11 ± 0.01. These results indicate that complexation of horse radish peroxidase with avidin decreases the response by 39%, additional complexation with B-Ig and MgG (a model for purified MAb's) decreases it another 24% and immobilization reduces the response of the complete system by a final 22%. Thus, the complete, immobilized system gives a signal only 6.5 times lower than that of the free enzyme in solution and it is unlikely that attempts to improve this ratio would be fruitful. The amplification resulting from attachment of several enzyme molecules to one Ag molecule far outweighs these losses. Furthermore, the background response due to nonspecific binding appears to be insignificant, as shown by identical blank and negative control values. The system has a sensitivity below 100 ng of R. typhi Ag per sample. Testing of crude cell homogenates of R. typhi and of P. gallinaceum sporozoites is in progress.

Research Colleague at NMRI: R. Beaudoin 1983

ELECTRON MICROSCOPIC OBSERVATIONS OF THE INTERACTION OF CAMPYLOBACTER JEJUNI, A HUMAN ENTERIC PATHOGEN, WITH THE EPITHELIAL LAYER OF THE INTESTINAL

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ABSTRACT

The rabbit RITARD (Removable Intestinal-Tie Adult Rabbit Diarrhea) model was used to study the interaction of Campylobacter je juni, a human enteric pathogen, with the epithelial cell layer lining the ileum, caecum and proximal colon. Intestinal tissues were collected from each of two rabbits at 2, 4, 8, and 28 hours post-exposure (via intraluminal injection) to C. jejuni. Each tissue sample was observed with light (LM) and transmission electron microscopy (TEM). Two ideal samples from each rabbit were observed using scanning electron microscopy (SEM). No gross pathology was seen in any of the specimens viewed by LM. Spiral forms of C. jejuni were detected in all ileal speciments viewed by SEM, and in all ileal and some caecal and proximal colon specimens viewed by TEM. Thus the organism appeard to be distributed throughout the terminal ileum following intraluminal injection into the proximal ileum. At 2 and 4 hours post-injection C. jejuni organisms were found trapped in the mucus overlaying the epithelial cells, with some located in close proximity to the microvillous border. C. jejuni bacteria were the only microorganisms consistently found near the epithelial cell border. This suggests the existence of some mechanism for penetration of the mucus layer other than a passive one. The next phase of interaction, observed at 4 and 8 hours post-injection, appeared to be contact between the bacterial cell and individual microvilli via a flagellum or outer membrane fragments. At 8 hours post-injection, several areas of the microvillous border in all ileal speciments displayed degeneration and "budding-off" of individual microvilli. The edges of degenerate areas correspond with the positions of cell junctions, suggesting that this process affected individual epithelial cells. However, no evidence of invasion of any intestinal tissue by C. jejuni was observed by TEM. This is not conclusive evidence that the strain of C. jejuni used in these studies was non-invasive, since the organism could significantly alter its morphology once it established an intracellular residence. Further studies or radiolabeled bacterial cells (eg., autoradiography) are needed to determine if fragments of C. jejuni or altered forms of this organism are located within, or between, epithelial cells. At 28 hours post-explosure, isolated areas of ileal tissue displayed wide, irregular spaces between epithelial cells and between the epithelial cell layer and the underlying lamina propria, suggesting some minor disruption of tissue integrity. However, no C. jejuni were observed in these intercellular spaces. Studies using tissue from animals exposed to this organism for periods of up to 7 days are needed to determine if this tissue disruption is transient or leads to further degeneration and perhaps ulceration.

Research Colleagues at NMRI: R. Walker and B. Caldwell 1983

THE EVALUATION OF METHODS FOR DETECTING BIOGENIC AMINE PRODUCING CELLS

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ABSTRACT

This study involved the evaluation of various histological methods for detecting biogenic amine producing cells in the central nervous system of rats. Four separate procedures were selected for analysis, one utilizing a hostostaining technique and the others a histofluorescence procedure. The purely histological method was a modified procedure used to detect protein determinants of monoamine rich bodies in neurons of man (Panayolacopaulou et al, 1982, Arch Neurol, 39:635-639). The method involved a double staining procedure aimed at relating the neuronal cytoplasmic Nissl substance containing ribonucleoprotein with the presence of protein bodies rich in biogenic amines. Four micron (4μm) thick sections of brain were stained with toluidine blue which identified neurons by staining Nissl substance in the cytoplasm. Adjacent sections were stained with a 1% aqueous solution of phosphotungstic acid (PATH) following an acidified potassium permanganate oxidation. This procedure consistently identified noradrenegic or biogenic amine rich neurons by the presence of spherical protein bodies in the perikaryon and dentritic terminals. In addition the staining procedure responded well to the aldehyde fixatives necessary for subsequent electron microscopy.

The histofluorescent studies, a Zeiss Photomicroscope II was used fitted with a high pressure vapor lamp and fluorescence filter combinations providing excitation and emission values of 340 μm and 420 μm respectively. The first procedure using histofluorescence involved the formaldehyde condensation with biogenic amines (Flack and Owen, 1965, Acta Univ. Lund 2:1-23). Fresh brain was cut into thin sections, with subsequent quenching, freeze drying, and exposure of sections to a formaldhyde vapor which reacts with biogenic amines within the cells permitting fluorescent analysis. The second procedure (Chiba et al, 1976, Histochem. 49:95-106) involved perfusing the rat brain with 2% glyoxylic acid which induces fluorescence followed by a perfusion of paraformaldehyde-glutaraldehyde fixative. The third procedure used perfusion with a mixture of formaldyhde (4%) and glutaraldehyde (0.5%) giving histochemical localization of catecholamines by fluorescence without additional treatment (Furness et al., 1977, Histochem. J. 9:745-750).

The results of this study indicated that the Glyoxylic aldehyde perfusion procedure (Chiba et al, 1976, Histochem. 49:95-100) gave the most reproductive, efficient and low background fluorescent analysis for the presence of biogenic amines in neurons. Fluorescence was equal to that of the formaldhyde vapor technique. However, the tissue was better preserved by the latter procedure in proving the ability to subsequently examine the same tissue sections at the ultrastructural level.

The procedures evaluated here permit utilization of the optimized technique for application to several areas of study at the Naval Medical Research Institute including nerve regeneration, CNS microwave exposure effects, and hyperbaric decompression changes on brain and spinal cord.

Research Colleague at NMRI: C. Dorsey 1983

NMR INVESTIGATIONS OF SUBSTRATE BINDING AND CATALYSIS BY COBALT (II) HUMAN CARBONIC ANHYDRASE

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ABSTRACT

Until now, kinetic and structural data on the mechanism of action of cobalt carbonic anhydrase has been obtained separately under different experimental conditions. Now, by measuring the ^{13}C nuclear magnetic resonance longitudinal and tranverse relaxation times of HCO_3^- equilibrated with cobalt human carbonic anhydrase I, we have been able to obtain both the paramagnetic enhancement of longitudinal relaxation, T_{1p}, that is due to the substrate loosely bound near the metal in the active site of the enzyme and the line broadening that is due to the enzyme catalyzed reversible hydration of CO_2. The apparent substrate dissociation constant was estimated directly from the values of T_{1p} taken at various concentrations of HCO_3^-. The maximum exchange rate constant was determined from line broadening measured at various concentrations of HCO_3^-. Paramagnetic enhancement of T_1 in the presence of benzene sulfonamide showed that the substrate or product is bound in the presence of this inhibitor or a ^{13}C-Co(II) distance of $\pm$ 1 Å. These dynamic ^{13}C NMR methods lead to a general way of exploring the active site structure and kinetics of cobalt carbonic anhydrase.

Research Colleague at NMRI: T. Williams 1983

USE OF EPR SPIN-LABEL PROBES IN THE STUDY OF THE EFFECT OF ELECTRIC FIELDS ON PHOSPHOLIPID FILMS AND THE EFFECT OF CYCLOSPORINE ON LIPOSOMES

Leopold May

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ABSTRACT

he study on the effect of electric fields on phospholipid films is a ontinuation of the previous research using infrared spectroscopy (L. May, t al., J. Membrane Biol., 2, 192 (1970); 14, 63 (1973)). Films of phos- hatidyl serine were prepared on silver chloride plates. The lipid and the pin label, doxyl stearic acid, were evaporated onto the silver chloride late. The electron paramagnetic resonance (EPR) spectrum of the film as observed. The application of direct current fields up to 100 volts roduced small changes in the spectrum of the films with no applied field. here were measurable changes in the heights of the lines and the distances etween the outer lines.

n the second study, the liposomes were prepared from a mixture of egg icithin and cholesterol and labeled with 3-doxyl-5 cholestane. The EPR pectra of liposomes treated with cyclosporine showed changes when compared o the spectra of untreated liposomes that indicated an increase in the rder parameter and a decrease in the rotational correlation time.

esearch Colleague at NMRI: D. Millar 1983

SYNTHESIS AND PURIFICATION OF α,α'-DIAMINO -1,4 -DIISOPROPYLBENZENE

Norman Nemeroff

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ABSTRACT

In an effort to prepare an improved epoxy resin for use in the repair of aircraft composite materials, I carried out the synthesis and purification of α,α'-diamino-1,4-diisopropylbenzene (I) according to a procedure adopted from a patent held by E. I. DuPont Co. The synthesis is carried out in two steps. The first step involves the preparation of α,α'-diisothioncyanato -1,4- diispropylbenzene (II) from 1,4- diisopropenylbenzene and potassium thiocyanate. The product from step one is then hydrolyzed by refluxing with potassium hydroxide in ethanol to produce the diamine (I). A procedure was then developed for the purification of (I) by recrystallization from hexane on cooling to 78°oC. The pure diamine (I) is now being tested as an epoxy resin curing agent.

Research Colleague at NADC: R. Trobocco 1983

SOFTWARE COSTING MODELS

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ABSTRACT

The goal of this study was to examine various software costing models and to offer comments as to how these models can best serve NADC's Software and Computer Directorate. Though there are a number of models, a lack of explanatory and supporting articles quickly limited meaningful investigation to three models - COCOMO, SLIM and the Halstead model. COCOMO and SLIM are empirical and heuristic in their analysis. Their main input parameter is the number of lines of delivered source instructions (DSI). They use very general concepts to make any refinements, and in that sense they are considered macro models. The Halstead model tries to approach costing as a scientific phenomenon. The fundamental parameters of this model are the number of opcodes and operands appearing in a program. Because of this approach the model is referred to as a micro model.

Because of a lack of NADC data more effort was spent on a relative comparason of the models rather than an actual fit to NADC information. In order to do this a number of programs were written. Both COCOMO and SLIM predict effort and time using DSI and heuristic parameters. When acceptable parameters are chosen so that both models yield the same effort they do not predict the same schedule time. COCOMO's schedule prediction is always larger, about four times as much as SLIM's. Also, because of their general approach these models have difficulty with small projects (under 5 KDSI).

The Halstead model offers a way to analyze a written program, and does well with predicting number of errors and modules, and the quality of a program. The model is also designed to preduct software metrics using I/O parameters as model drivers. I feel that more research is necessary before these predictive equations can be properly applied to large projects.

To make further comments on the use of these models at NADC it will be necessary that data be collected and in a form that can be used by these three models. Minimally, DSI and time, as well as the number of routines and their formal parameters must be counted.

Research Colleague at NADC: A. Kuhn 1983

FERROMAGNETIC RESONANCE CHARACTERIZATION OF MAGNETOSTRICTIVE METALLIC GLASS COATINGS

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ABSTRACT

Amorphous ferromagnetic alloys are a promising class of materials that have been successfully used as magnetostrictive elements in fiber optic magnetic sensors. We have used ferromagnetic resonance (FMR) at 9.5 GHz to characterize highly magnetostrictive film coatings of amorphous ferromagnetic alloys. Radio frequency sputtering was used to prepare 0.1 to 0.2 μm thick coatings onto bare single mode optical fibers of diameter 80 μm.

Using a silvered capillary jacket with a window for the microwave field, 1.5 mm sections of the coated fiber were probed for longitudinal structural homogeneity. Cylindrical uniformity of the coatings was investigated by rotating the sample in the microwave cavity with respect to the externally applied magnetic field. The degree of homogeneity was interpreted from FMR linewidth and line position measurements.

Due to its inherent sensitivity, the FMR technique is shown to be an excellent nondestructive technique for investigating microscopic as well as macroscopic structural inhomogeneities that may arise from the fabrication process itself or subsequent handling of the coated optical fibers. An added advantage of the FMR technique is that it also allows a simultaneous determination of such material parameters as the saturation magnetization, the magnetostrictive constant and the g-factor. Comparison of the present technique with other conventional techniques will also be discussed.

Research Colleague at NADC: R. Trobocco 1983

ANALYSIS AND OPTIMIZATION OF A MAGNAWEAVE COMPOSITE

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ABSTRACT

This study is an extension of a research program initiated last summer at NADC. The objectives of this study are to generate a data base for the basic structural component (the yarn) of the fabric preform and to evaluate the tensile properties of a 1x1x1 Magnaweave graphite/epoxy composite. Based on the yarn stress-strain properties and the yarn orientation in the fabric a geometric model was developed to predict the tensile strength and modulus of the 3-D fabric composite. Based on the experimental tensile properties of the composite, recommendations were made to optimize performance of the composite.

Tensile test of dry AS4 and Celion graphite yarns with various bundle size (3K to 12K) at different gage lengths (5cm to 25cm) showed no significant difference between the two yarns. It was found that tensile strength of the yarns decreases as the gage length increases. The 6K yarns had the highest strength while the strength of the 3K and 12K yarns were approximately the same.

Significant difference was observed for the tensile properties of the continuous (samples made to test dimensions) and discontinuous (samples cut to test dimensions) 3-D composites. The strength, modulus and Poisson's ratio of the continuous and discontinuous composite specimens were 190ksi, 17 Msi, .75 and 96 ksi, 13Msi, 1.06 respectively.

To address the problem of high Poisson's ratio, experiments have been carried out to insert yarns in the transverse (horizontal) direction. This study will provide a basis for the future development of the 3-D fabric reinforced composite.

Research Colleague at NADC: L. Gause 1983

IMPEDANCE OF A VLF ANTENNA & SHAPE OF AN ANTENNA SUSPENDED FROM A BALLOON

Bernard Harris

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ABSTRACT

1. Shape of an Antenna Suspended From a Balloon

A long thin wire antenna about 18,000 feet long is suspended from a balloon which rises from the ground to about 75,000 feet. The antenna is subject to gravity, lift, and wind forces during the ascent. An algorithm is determined for evaluating the effect of these forces on the shape of the antenna. The antenna is modelled as a sequence of links. The notation is similar to those used in modelling robot manipulators except the Euler angular coordinate system includes a buoyant (x,y), whereas robots do not fly. Only the two dimensional problem is considered here although the method may be extended to three dimensions.

2. Impedence of a VLF Antenna

A half-wavelength antenna comprised of 19 strands of #29 Al wire is deployed from a balloon which rises from ground to 75,000 feet. The antenna, which is 18,000 feet long is excited at mid-point at a frequency of 27k Hz. The input impedance was evaluated and shown not to be affected by the inosphere. The affect of the ground causes the impedance to vary from 177 ohms at 8 degrees to 206 ohms at 12 degrees.

Research Colleague at NADC: N. Pye

1983

ELECTRONIC RELAXATION TIMES IN ATMOSPHERIC MOLECULES

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Abington, Pennsylvania

ABSTRACT

The original objective of the summers research was to have been investigation and/or compilation of lifetimes of electronically excited atmospheric molecules. The need for this was based on the assumed inadequacy of Xenon as a species potentially useful for remote sensing of magnetic fields.

Preliminary experiments by L. Bobb and M. Rankin had indicated that the two-photon absorption cross section for a given transition was a factor of 30 smaller than theoretically predicted; this was the basis for the inadequacy of Xenon. However, further experiments at higher photon concentrations indicated that perhaps the interpretation of the experimental results was not as straightforward as thought. Some of the observed anomalies were: (1) too large a line width, (2) linear, rather than quadratic, increase of fluorescence intensity with increase of input power, (3) too short of lifetime of the excited state compared to other experiments.

My first contribution was to numerically/analytically calculate the expected fluorescence linewidth and shape from the (highly irregular) input laser linewidth and shape. This confirmed the expectation that the output linewidth was too large.

L. Bobb suggested that the other anomalies might all arise from a common cause: gain in fluorescence intensity along the axis of the cylindrical absorption region. My second contribution has been to analytically/numerically calculate gain factors using physical models of varying sophistication. The simplest such model indicates not enough gain to affect the results. The next level shows too much gain, so much in fact that the experimental results could not have been obtained. A third level which, except for fluctuation phenomena, should be getting fairly close to the actual physical situation would be expected to give gain factors intermediate between the two simpler models considered thus far.

The next steps will therefore be to perform the numerical calculations with this third model, incorporate power and spontaneous emission fluctuations and compare with the now more extensive experimental data in an attempt to calculate a more reliable two-photon cross section.

Research Colleague at NADC: L. Bobb 1983

PLAN TO IMPLEMENT A FLEXIBLE TESTBED FOR PERFORMING DISTRIBUTED PROCESSING AND FAULT TOLERANCE INVESTIGATIONS

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ABSTRACT

This study was done to determine the components needed for a flexible testbed for 68000 microprocessor based, commercially available, multiple microcomputer configurations. The Motorola 68000 was selected as a baseline microprocessor so that future benefits could be gained from Ada support software currently being developed at NAVAIRDEVCEN for the 68000.

An analysis of systemic interconnection configurations which would be of interest to naval applications was made. From the drawings, a list of the minimum number of needed devices was made. Information was then collected on bus structures which currently support the 68000 microprocessor. From this combined information a bus (the VMEbus) is recommended on the basis of its availability, rugged construction, ease of reconfiguration, advanced design, and multiprocessor support.

A list of modules was then compiled that satisfied the minimum device list and were available for the VMEbus. The approximate hardware cost for the testbed would be $68,960.

Research Colleague at NADC: R. Mejzak

1983

A PRELIMINARY APPRAISAL OF THE HUMAN FACTORS ISSUES PERTAINING TO THE USE OF HUDS, HMDS, AND MFKS IN NAVAL AIRCRAFT SYSTEMS

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Georgis Institute of Technology
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ABSTRACT

This report presents the findings from an evaluation of the human factors issues associated with head-up displays, helmet-mounted displays and multi-function keyboards. In general, these issues centered around those independent variables critical to display and control design and those which influence human performance. Specific recommendations were suggested for the design of experiments to assess the effects of interface modification on human performance within complex dynamic systems. Central to the design recommendation is the utilization of a split-plot factorial experimental design using naive subjects. Such an experimental design should eliminate range, carry-over and other experimental artifacts that could result in biased empirical findings. Also recommended is a thorough review of the literature pertaining to the reviewed technologies.

Research Colleague at NADC: W. Helm 1983

ATMOSPHERIC LIDAR MEASUREMENTS RESEARCH

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ABSTRACT

The work accomplished during this program consisted of two parts: (1) Design of the electro-optical receiver subcomponent of the NAVAIRDEVCEN lidar to permit acquisition of atmospheric temperature profiles; (2) Data reduction and processing for the lidar acquired atmospheric water vapor profiles.

For the temperature profiles, the spectroscopic constraints, set by error requirements and by the appropriate scattering theory were converted into overall hardeare design specifications. The basic design performance of the electro-optic subcomponents was satisfied by the use of a Fabry-Perot Interferometer (FPI). Thus appropriate performance of the receivers was detailed in terms of such (FPI) parameters as contrast and finesse and free spectral range. Such parameters then provided the FPI vendor with manufacturing specifications he needed.

The work on the water vapor data consisted of exploring with various procedures of data processing. Basically two channels of lidar backscatter data were processed to obtain the water vapor mixing ratio as a function of altitude. Because of the unknown correlations of the several noise background signals, various procedures were tried in order to optimize the unbiased estimations of the sample mean and sample variance. As an example since the water vapor mixing ratio involved the quotient of the data from two channels, data reduction was confronted with the problem of selection of the preferred procedure between the average values of the ratio or the ratio of the average ratios. Some aspects of this problem were felt to be meterological and some purely mathematical. For more sophisticated tests it was decided that until certain computer codes became available the ratio of the mean values more closely represented the physical variable sought.

Research Colleague at NADC: K. Petri 1983

A BAYESIAN METHODOLOGY FOR FAILURE DATA ANALYSIS

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ABSTRACT

During system development and early test phases, quantitative reliability prediction for new equipment is difficult because test data are usually sparse. Classical statistical techniques for parameter estimation are not very powerful for relatively small numbers of failure data. Further, classical techniques provide no means for incorporating other relevant information, such as the test histories of similar but not identical equipments already in use, an engineer's judgement reflecting his past experience with similar design techniques, etc. On the other hand, Bayesian statistics provides a valid means for incorporating appropriate knowledge and judgements into the failure data analysis.

This research effort has developed a methodology for applying Bayesian techniques to the analysis of failure data from both a laboratory testing environment and from actual field experience. It provides specific methods by which the engineer may incorporate all information judged to be relevant and may, in effect, weight the failure data to reflect his confidence in the accuracy of the data source. Three separate data analysis techniques are available. These have been computerized and are documented in the Appendices of the report.

Research Colleagues at NADC: J. McCain and H. Shectman 1983

VI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL AIR DEVELOPMENT CENTER

Warminster, Pennsylvania

Program Coordinator at NADC: H. Beyer 1983

A NON-DIMENSIONAL ANALYSIS OF CARDIOVASCULAR RESPONSE TO COLD STRESS; PART I: IDENTIFICATION OF THE PHYSICAL PARAMETERS THAT GOVERN THE THERMOREGULATORY FUNCTION OF THE CARDIOVASCULAR SYSTEM

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ABSTRACT

Whether in combat-type situations, or during peace-time, Man constantly strives to increase the envelope of human performance capabilities. One environmental factor that appears to seriously impede such capabilities is the ambient temperature within which the performance takes place. Cold stress and/or the consequences of hypothermia can lead to adverse effects that range from severe impairment of physiologic function to death, itself.

The prevailing belief today is that vascular changes and tissue hypoxia are directly responsible for all types of local cold injury, and that variation in the clinical features or manifestations reflects variation in the nature of the insult and the host response. With this in mind, this study has examined the human cardiovascular system in terms of its four basic elements: The fluid (blood), The pump (heart), The flow pipes (vascular system) and the control mechanisms (intrinsic factors, the central and autonomic nervous systems, and the endocrine system). Then, cardiovascular thermoregulation has been described in terms of how each of these elements responds to cold stress, with the ultimate intent of performing a non-dimensional analysis of this response. As a first step towards such an analysis, some 400 physical and chemical parameters that govern the thermoregulatory function of the cardiovascular system have been identified. These can then be grouped into dimensionless variables that: (i) shed considerable light on the physics of the problem at hand; (ii) constitute the basis for making simplifying assumptions in the formulation of subsequent mathematical analyses; and, (iii) bring to the surface the important parameters that need to be measured when performing experiments on physiological responses to environmental insults.

Research Colleagues at NMRI: CDR W. Bishop and A. Bachrach 1981

CAMPHYLOBACTER JEJUNI ENTERITIS: ANALYSIS OF POTENTIAL ANIMAL MODEL AND BACTERIAL ADHERENCE

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ABSTRACT

There does not exist a good animal model for camphylobacter enteritis as it is manifested in humans. Toward the development of such a model, experiments were done to induce diarrhea in newly hatched chicks. For these experiments, less than 12 hr. old chicks (n=4 for each group) were fed in excess of 10^{10} bacteria/ml of Tris buffer. Isolates Min, E8B, and MP were used. At half hour intervals post-feeding, rectal swabs were obtained. After 36 hrs. no diarrheal symptoms were observed. Further, there didn't appear to be a good correlation between passage rates in groups of chicks.

The ability of C. jejuni to adhere to mammalian cells was also examined. All five isolates (HC37, Min, E8B, WR1, and ATCJ) adhered to the three cell lines tested (ATCC CRL1459, ATCC CCL 239, and HE1); although the level of adherence to CCL 239, a mucus producing human mucosal epitheial cell line, was reduced in all cases. The effect of time and pH on adherence was examined for isolates HC37 and E8B. The level of adherence over time showed biphasic characteristics for both isolates. The level of adherence also increased with a rise in pH for both isolates. Although there were differences observed in the relative hydrophobicity of isolates (E8B being relatively hydrophilic and HC37 relatively hydrophobic) no overt differences in their adherence were observed. Other parameters such as the effect of various chemicals, specific antiserum, and exogenous mucin on adherence were also examined.

Research Colleague at NMRI: S. Stewart 1983

THE EFFECTS OF SCHISTOSOMA MANSONI INFECTIONS ON MOUSE KUPFFER CELL EXPRESSION OF SURFACE F_c RECEPTOR SITES FOR IgE MOLECULES

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ABSTRACT

Serum immunoglobulin E levels are significantly elevated in humans, rats and mice infected with helminths, however, the role of such humoral antibody increases on cell expression of surface receptor sites for IgE molecules (Fc_ER) remains unclear.

To determine the effects of helminthic infections on Kupffer cell surface Fc_ER, strain C57BL/6J female mice were inoculated by tail exposure to 1040 Schistosoma mansoni cercariae previously irradiated with 50KRad (Cesium Source). One month following primary immunization, Kupffer cells were isolated from perfused livers of sacrificed animals and examined for the presence of surface Fc_ER sites. Fixed folumes of purified cell suspensions obtained from both experimental and control mice were separately enumerated with a Coulter channelizer and samples were stained with bivalent labeling affinity reagents (DIBADL IgE Conter anti-E, AntiFerritin). The fluorophore labeled cells were analyzed by flow microfluorometry using a fluorescence activated cell sorter. Kupffer cells from experimental animals exhibited a higher percentage fluorescence (40%) compared to the percentage fluorescence (31%) obtained from control cell samples. The difference in the data, although not very remarkable, indicates that a primary S. mansoni inoculum induces an increase in the surface Fc_ER expressed on Kupffer cells of infected mice. Since these Fc_ER sites bind IgE molecules to cell surfaces, the crosslinkage probably transmits signals of antibody-antigen interactions to the cell interior and thus provides a mechanism for regulating IgE-dependent immune responses to infections.

Research Colleague at NMRI: I. Katona

1983

THEORETICAL PREDICTIONS FOR VLF RADIO PROPAGATION

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ABSTRACT

The very low frequency (VLF, 3 to 30 KHz) part of the radio frequency spectrum is characterized by low attenuation rate, high phase and frequency stability, and high signal to noise ratio. Consequently, VLF radio propagation is used for many practical applications, e.g., frequency standardization, clock synchronization, and reliable long-distance radio communications. Because of these distinct advantages of VLF radio propagation, the U.S. Navy will be conducting a balloon-to-balloon-borne cross link communication experiment to study the feasibility of VLF radio propagation for Navy's long-distance communication link for submarines. In this Technical Report, an attempt has been made to make a theoretical computations of the vertical components of the individual and multimode field strengths as a function of distance based on waveguide mode theory. The variations of various ionospheric parameters, e.g., attenuation rates, the height of the ionospheric reflection point, the height gain factors for appropriate combination of the transmitting and receiving antenna elevations, along with the presence of the earth's geomagnetic field, especially for the East-West propagation, have been duly considered. The results obtained have been presented in tabular and graphical forms and are consistent with the values obtained by earlier workers. These field strength values will be compared against the experimental values when the above-mentioned ambitious experiment is carried out in the Pacific in the late Summer of 1983.

Research Colleague at NADC: E. Wykes 1983

FAMILIARIZATION WITH PROGRAMS THAT MODEL AND PLOT EJECTION SEQUENCES

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ABSTRACT

Mr. Georg Frisch has spent years adapting and developing programs that model the human response during an ejection sequence in Navy aircraft, and then produce a visual display within the appropriate crew station. My summer research activities were primarily directed at becoming familiar with these programs.

Mr. Frisch spent a great deal of time explaining the input requirements to the CALSPAN motion simulation program and to the BIOMAN graphics program. BIOMAN can be used to plot any specified crew station and the biostereometric representation of a crew member in that crew station, as a function of time, based on the position coordinates generated by CALSPAN.

The system was exercised this summer by running a simulation of an F-14 ejecion in a crew station where the location of one of the panels was altered. The simulation was conducted to determine whether a 98th percentile Navy aviator may impact the altered plan during a typical ejection. I was able to determine what type of data were necessary as inputs, in what form, and what programs were needed to condition the inputs into useful forms for the simulation and plotting programs.

Through many discussions with Mr. Frisch and some other Crew Systems personnel, I learned something of the way that the Navy carries out tasks and projects. I discussed with people in Life Sciences and Escape Systems the types of projects that were going on and the type of work they felt would be needed in the future.

Upon my return to Penn State Univ., I plan to request from the Navy copies of the modelling programs (CALSPAN and BOEMAN) and plotting programs (BIOMAN and ELIPSMAN) that I became acquainted with this summer. I will adapt these programs to the Penn State computing system so that I can use them to address problems that are of relevance to the Navy.

Research Colleague at NADC: G. Frisch 1983

INTERACTIVE PLANNING AID TO SCHEDULE TANKERS FOR AERIAL REFUELING OF MISSION AIRCRAFT IN LONG-TERM AIRBORNE DUTY

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Villanova University
Villanova, Pennsylvania

ABSTRACT

This research project has resulted in implementation of an interactive, computer-based planning aid for scheduling tankers to support the CAP component of Fleet Air Defense. With this system the scheduler on board a carrier can develop and assess alternative tanker schedules in terms of number of tanker sorties, number of refueling events, total amount of fuel passed, and impact on CAP plan. The system can be used during actual operations to revise tanking schedules when fuel requirements deviate from nominal. The scheduler can integrate constraints regarding tanker launch and recovery times and tanker availability into the schedule.

The planning aid has been demonstrated for Third Fleet, Hawaii, where it is expected to be used experimentally. In its present form, the system is an operating prototype. Enhancements in video display and flexibility, and by introduction of learning through automatic assessment of scheduler use are contemplated. Direction for enhancement will be obtained from Third Fleet, based in part upon results of experimental use.

Research Colleagues at NADC: F. Barker and F. Scheetz 1983

COMPUTER SCIENCE SOFTWARE RESEARCH

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ABSTRACT

Two projects are abstracted in this report. The first project was to secure and use a version of the programming language Ada. Ada software was secured and debugged sufficiently so that programs written in Ada compiled and ran successfully on the three-pass Ada Compiler.

The second project was to develop SPSS (Statistical Package for the Social Sciences) programs that would generate line graphs fast and accurately. An SPSS Program was written that will generate high quality line-plots on a CalComp printer.

Research Colleague at NADC: H. Steubing 1983

VII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL COASTAL SYSTEMS CENTER

Panama City, Florida

Program Coordinator at NCSC: J. Wynn

1983

THE FEASIBILITY STUDY OF TARGET DETECTION AND CLASSIFICATION VIA UNDERWATER ACOUSTIC IMAGING

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ABSTRACT

Several detection and classification techniques were presented in lieu of the possible application to the underwater acoustic imaging. One of the most delicate problems in the image processing is the target detection and classification. After the brief introduction of the current problems in the sonar image processings, the basic principles of the modern communication theory - detection theory, were discussed to show the applicability. The feasibility of the extension from one-dimensional signal processing to the two-dimensional spatial processing was fully introduced for both matched filtering and likelihood ratio techniques. The complexity and difficulty of the image classification was described with the up-to-date problems and further recommendations. The most favorable technique is a maximum likelihood technique since it is applicable to both detection and classification problems under non-white noise field while the matched filtering techniques are favorable under the Gaussian noise field in the optimum sense.

Research Colleagues at NCSC: L. Adair and A. Matthews 1983

MINE COUNTERMEASURES & OCEAN WAVE MAGNETIC FIELDS

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ABSTRACT

My work at the NCSC Center under the auspices of ASEE, 1983 has had its focus in three primary areas. The first is a Mine Countermeasure Tracking Program. Given the temporal signature of a ship (modeled as a single magnetic dipole), at a single field point location, the program seeks to predict the direction, heading, and strength of a dipole. Two separate programs were developed depending on whether movement was primarily transverse to the Earth's geomagnetic field (East-West movement to within $\pm$ 10°) or longitudinal (North-South between 10° and 170°). Accuracy was predicted to within 5% in these cases. Certainly, when the relative sensor to ship distance is greater than a ship length the single dipole model of the ship is a reasonable one; extention of the theory to multidipole representations should be considered for sensor/ship relative distances less than one ship length.

A second focus of research has been in the area of real time degaussing. Given the normal magnetic field around the surface of a ship and its gradient, can the magnetic field at any specified location be known? The exact magnetic field surrounding a magnetizable body in the Earth's field surrounded by energized degaussing coils was determined for a cylinder and sphere; the integral technique proved to be able to predict external fields given local fields to an accuracy less than .01% error for these models.

Finally, attention has been given to predicting magnetic fields from asymmetric ocean flows, (specifically surface waves) using Sommerfield integral techniques. The technique appears to be quite useful, agreeing with former researchers (Podney) in the symmetrical flow field limit.

Research Colleague at NCSC: W. Barnes 1983

USER'S MANUAL FOR CABLE - A TWO-DIMENSIONAL, FINITE SEGMENT COMPUTER CODE FOR SUBMERGED AND PARTIALLY SUBMERGED CABLE SYSTEMS

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ABSTRACT

This report presents a User's Manual for the computer program UCIN-CABLE III. The program is designed to study the two dimensional dynamics of submerged and partially submerged towing cable systems. A towing cable system includes the towing cables as well as a set of towed bodies. The system may have one or many branches, but no closed loops may be formed.

The cable is modelled as a series of rigid cylinders connected end-to-end by hinge joints. The fluid forces on each segment include the effects of normal and tangential drag, added mass, and buoyancy. The fluid forces on the towed bodies are calculated from a set of 25 hydrodynamic coefficients. These account for fluid drag and added mass effects. Buoyancy forces are included separately.

This manual provides instruction for using CABLE to study such cable systems. It also provides sample input and output data.

Research Colleague at NCSC: D. Summey

TARGET SURFACE CHARACTERIZATION FOR MINE HUNTING SONAR

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ABSTRACT

The image processing typically implemented for sonar data produces a ternary display where for example, zero is background, 1 is highlight, and 2 is shadow. Target detection/recognition schemes on ternary data encounter difficulties when trying to segregate targets into classes.

This concept paper proposes a scheme to acquire information about the surface transfer function of the targets, potentially allowing for the display of targets on a quaternary scale (e.g., metallic/non metallic highlights, shadow, background). The additional degree of freedom thus acquired will open the door for more sophisticated detection/recognition algorithms.

Research Colleague at NCSC: D. Skinner 1983

VIII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL OCEAN SYSTEMS CENTER

San Diego, California

Program Coordinator at NOSC: E. P. Cooper 1983

MILLIMETER WAVE ABSORPTION BY CLOUD DROPLETS

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ABSTRACT

Detailed calculations of absorption by water droplets at millimeter wavelengths have been done in the past. Although such calculations are often valuable, greater understanding is sometimes acquired if approximate formulas are used to display explicit dependence. Accordingly, absorption by water droplets has been examined within the framework of simple Debye theory combined with Rayleigh theory.

Absorption by water increases monotonically with frequency from zero to a constant asymptotic value; the angular frequency at which absorption is half this value is approximately $3/\tau$, where τ is the relaxation time. Absorption by a small water droplet behaves similarly, but with several notable differences. Maximum absorption by a water droplet is less than that by water, about a factor of three. The frequency at which absorption is half its maximum value shifts upward for a water droplet to $1/\bar{\tau}$, where the shifted relaxation time $\bar{\tau}$ is determined solely by the high-frequency and low-frequency limits of the Debye dielectric function: $\bar{\tau} = \tau\ (\varepsilon_{oo} + 2)/(\varepsilon_o + 2)$.

The temperature dependence of droplet absorption may be either positive or negative depending on the frequency. At angular frequencies greater than $1/\bar{\tau}$ it is positive; at lower frequencies it is negative. The temperature dependence of droplet absorption can be accounted for almost entirely by the temperature dependence of the relaxation time τ; other factors are of secondary importance.

Comparisons of approximate with detailed calculations indicates no appreciable differences, especially when one considers the accuracy with which measurements can be made.

Research Colleague at NOSC: H. Hughes 1983

SOME HEURISTICS FOR THE NAVIGATION OF A ROBOT

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ABSTRACT

A mobile robot is required to navigate around barriers in an unexplored environment. Some heuristic methods, as aids in such navigation, are discussed here. Being heuristic in nature, such methods can neither be exhaustively tested nor proven to be effective in all cases. However, examples are given to demonstrate their usefulness in obstacle avoidance. In a simple case of sufficient generality, the methods are shown to be effective.

Index Terms - Robotics, collision avoidance, heuristics, robot navigation.

Research Colleague at NOSC: D. Smith 1983

ALGEBRAIC TECHNIQUES FOR SYSTOLIC ARRAY DESIGN

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ABSTRACT

As a participant in the A.S.E.E. Navy Summer Faculty Research Program at the Naval Ocean Systems Center, I worked with NOSC scientist Harlan Sexton on FY 83 IR Project "Algebraic Techniques for Systolic Array Design". The primary objectives during my participation in the project were the continuing search for high density (d,k) graphs and the implementation of the study of the node transitive graphs known as Cayley graphs. My efforts were focused in two areas: (1) statistical studies of the diameter of graphs generated in a random manner by computer programs; (2) preliminary consultations with Harlan Sexton and associate project investigator Gunnar Carlsson to see how to modify previous programs and approaches so as to be able to generate Cayley graphs.

The statistical work demonstrated how the diameters of the graphs generated were basically a linear function of the logarithm of the number of points in the graphs. The diameters of the randomly generated graphs also compared favorably with the previously known best graphs.

The incentive for developing the work on the Cayley graphs was the size of the family of (d,k) graphs, where d is the degree and k is the diameter. The Cayley graphs have the properties of being node transitive, highly regular, and fairly easy to generate. The early results of the Cayley graph programs have been extremely encouraging, and it appears that this will be an important area for further investigation.

Research Colleague at NOSC: H. Sexton 1983

SAR IMAGES

Neil R. Gray

Department of Mathematics and Computer Science
Western Washington University
Bellingham, Washington

ABSTRACT

My efforts were almost entirely devoted to assisting the preparation for the Code 1603 experiment on SAR images of ship wakes to be run (JOINTLY with Canadian Naval Personnel) July 18 - August 5, 1993. In addition to a fair amount of general mathematical trouble - shooting and verification my contributions were: (1) Refinement of several formulas to be used in the mathematical modeling of ship wakes; (2) Advice on the design of a sensing array; (3) An algorithm for correcting the errors in sensor readings induced by the motion of the sensing array platform due to WWD and wake waves; and (4) The digital-to-analog conversion section of a program to do a real-time analysis of the recorded data.

Research Colleague at NOSC: R. Hammond 1983

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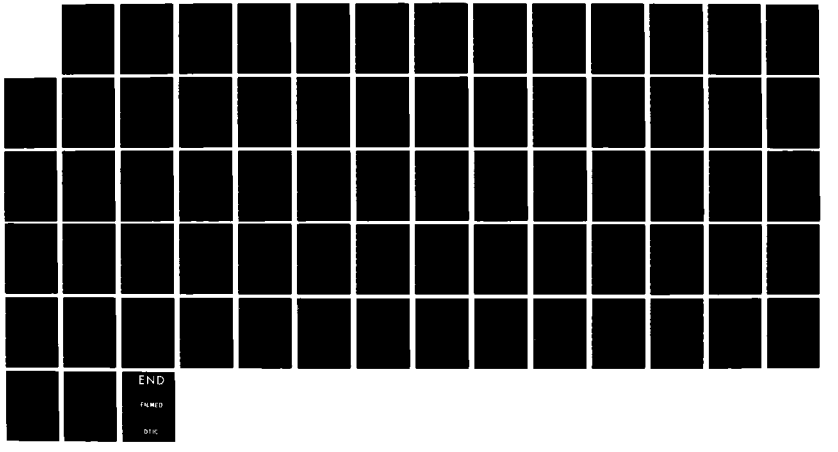

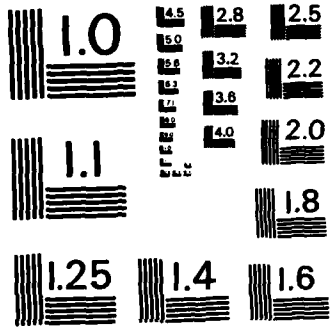

HUMAN ENGINEERING AND BEHAVIORAL STUDIES FOR COMPUTER APPLICATIONS

Joel S. Greenstein

Industrial Engineering and Operations Research
Virginia Polytechnic Institute and State University
Blacksburg, Virginia

ABSTRACT

Dr. Greenstein participated in the formulation of an internal report Human Enginnering Study Needs for the Lightweight Modular Display System (LMDS) and a proposal for complementary research and development funding to support man-machine interface research critical to successful implementation of the LMDS. He also reviewed and provided inputs to the Personnel-Computer Interface Design Guide being developed under contract by Richard Coburn.

Finally, Dr. Greenstein designed, programmed, and conducted a behavioral study investigating the effects of three monochrome and four color automated status board display formats on operator task performance. Fourteen male personnel of the Advanced Command Center Technology Division voluntarily served as subjects. Subjects were screened for corrected 20/20 vision using a standard Snellen eye chart and were given a simple test of color discrimination ability. The task environment consisted of a representation of an automated status board display with which the subject monitored a set of fourteen targets. The subject was asked to determine specific status items using the board and to enter these items via a numeric keypad. Two independent variables, display format (seven levels) and task type (two levels) were investigated. The subjects received all treatments in a within-subjects Latin square design chosen to partition intersubject variability and control for order effects. Two response time measures of subject performance were recorded for each trial. A 7-point subjective rating scale questionnaire was also administered upon completion of the session. The hardware configuration consisted of an IBM Personal Computer with keyboard interfaced with an Amdek Color-II monitor. Each subject was administered seven blocks of 38 trials with each block employing a different display format. Data anlysis and reporting of this study will be completed upon Dr. Greenstein's return to Virginia Polytechnic Institute. The report, along with the software and experimental protocols already transferred to NOSC personnel, will enable NOSC to continue this line of research with follow-on studies.

Research Colleagues at NOSC: R. Fleming and G. Osga 1983

EVALUATION OF THE HUGHES FBE ALGORITHM - STATISTICAL MODEL SELECTION AND EXPERIMENTAL DESIGN

Pauline Mann-Nachbar

Department of Civil Engineering
San Diego State University
San Diego, California

ABSTRACT

The question is considered of an appropriate statistical model and experimental design for evaluation of the performance of the Hughes FBE algorithm. A multi-stage analysis-of-variance procedure is suggested, with the first stage an assessment of the possible importance of random effects. The presence of significant random effects not only influences the choice of the model, i.e., fixed effects versus mixed, but is of intrinsic interest since such effects would contribute to the total scatter in algorithm predictions. This scatter is an essential ingredient in any measure of algorithm performance.

In discussion of the various models (random effects, fixed effects, and mixed) special consideration is given to the difficulties introduced by violation of the necessary assumptions of independence, normality, and stability of variance, both from the point of view of possible ways to avoid distortion of results and of the special care needed in interpreting results.

Some results are presented of a preliminary screening if the FTP-12 data using a one-way composite-factor ANOVA.

Research Colleague at NOSC: J. Pugh

1983

EFFECT OF STRESS ON DIVING MAMMALS

Harold R. Parker

Department of Surgery
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Davis, California

ABSTRACT

Initial experiments at the NOSC Hawaii Lab to study renal function in dolphins as a means for determining levels of stress have been successful. The necessary first objective was to develop techniques for assessing renal function while managing the animal in a manner that would simulate a transport; a procedure commonly used with Navy dolphins. The first objective was satisfied. Using a SCAT (Self Contained Animal Transporter), the unit normally employed for transporting dolphins, as a restraining device added realism to the experiment. It also provided essential access to the animals during the six to twelve hours experiments.

The study was based on the assumption that aquatic mammals experience some level of stress when removed from their natural environment for extended periods. Additional stress probably resulted when animals, which usually are in motion, are closely restrained for the purposes of transport. Very little data are available regarding the impact of transport on dolphins. Therefore, we evaluated physiological, biochemical and endocrine responses to stress (simulated trnsport) as well as the vital signs (pulse rate, respiratory rate and body temperature), the ECG and blood pressure.

Analytical procedures were directed toward measuring substances known to be released under conditions of stress in other animals and which play an important role in homeostasis. Included were prostaglandins, plasma renin activity (PRA), catecholamines and cortisol. In addition, measurement of plasma and urine composition at hourly intervals allowed continued evaluation of the kidneys' role in accommodation to the abnormal enviornment.

Preliminary results suggest that dolphins do undergo objectively measurable responses to stress under conditions of these experiments (simulated transport). The complex nature of enzyme and hormone analyses will require several months for completion. Therefore, more detailed results will not be available before then.

The technical success achieved in these experiments strongly suggest that they be repeated in an extended mode to simulate longer transport periods (up to 24 hours) and then be performed during an actual aerial transport. This is the only way we can fully understand the impact on dolphin health of transporting these valuable animals over long distances.

Research Colleague at NOSC: J. Schroeder 1983

LOW LEVEL EM ENERGY EFFECTS ON NERVE CELLS

John G. Pinto

Department of Mechanical Engineering
San Diego State University
San Diego, California

ABSTRACT

During the ten week tenure of the Navy/ASEE fellowship this investigator worked on a project dealing with Low-Level Electromagnetic Energy Effects on Nerve Cells. In this research ganglion cells of sea hares (Aplysia californica) are irradiated in a microwave stripline at 2,45 GHz and .3 Watt input power (= 100 mw/cm^2) (1). It is unknown however, how much power is deposited in the ganglion. A measure of the absorbed power is important in the interpretation of experimental results.

Following literature study we designed experiments to determine the absorbed power (termed Specific Absorption Rate, SAR and expressed in milliwatts per gram of Sample). These experiments are underway at the present time. For measurement, two alternate approaches are used. One approach involves measurement of incident and reflected power at suitable locations along the stripline. The other approach involves the determination of temperature rise in a known amount of saline elicited by its exposure to microwaves.

Absorbed power is also determined theoretically. Here, numerical computations are modelled after similar work by Wachtel *et al.* (2, 3). Improvements are made in this work to account for reflections at material interfaces.

Research Colleagues at NOSC: N. Campbell, L. Brandt and W. Rasmussen 1983

LMDS (LIGHTWEIGHT MODULAR DISPLAY SYSTEM) INTERFACE

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ABSTRACT

The Lightweight Modular Display System (LMDS) is a tactical CRT display intended for small and medium scale platforms. As part of the Navy Tactical Display System (NTDS), it must interface with shipboard computers via a Central Data Buffer (CDB). This is accomplished through the Interface Module. A communications algorithm and architecture is proposed to allow the LMDS to communicate with the CDB.

The other LMDS modules are interconnected via an Ethernet Local Area Network (LAN). The Interface is also responsible for the routing and packaging of data intended for these modules, as well as higher protocol levels of the LAN. Methods of Error and Flow Control are proposed to complete the communications protocol. In addition, a data block format is suggested, which will allow messages coming from the CDB to be efficiently transmitted to the destination modules. Since the messages are already sent under several formats, several "standard" data blocks are given to encompass the various formats. An effort has also been made to design a universal data block, one which not only embodies the existing formats, but also allows for new formats. The details and rationale for the design are given.

The utilization of Local Networks in military applications is expanding. It is a purpose of this paper to illustrate that the implementation of such systems is not only possible, but representative of current technological design procedures.

Research Colleague at NOSC: D. Gomez 1981

THE DETERMINATION OF RADIOACTIVE NUCLIDES IN SAMPLES COLLECTED ON THE VARIFRONT V CRUISE

Celestine Tillman

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Baton Rouge, Louisiana

ABSTRACT

In the Varifront V Cruise that started from Glasgow and extended north into Norwegian Sea and returned to Bergen, Norway, a series of net tows were taken at frequent intervals to collect planktonic forms. These materials were analyzed for their gamma-ray emissions with a germanium-lithium detector coupled to a Canberra 1024 channel analyzer.

All detectable photopeaks were integrated by the usual procedure and normalized for counting time. The statistical counting error (1 σ) associated with these counts was also calculated. From a calibration curve associated with known radionuclides, the energy of the photopeak was determined, whereby the identity of the peak was established.

With the exception of sample designated Tow-32, the gamma-ray spectrum for all samples considered with that of the background for the detector system, within statistical bounds. The nuclides identified in these spectra are the natural emitters Ra-226, Pb-214, Ac-228, Tl-208, Bi-214, and K-40 and the artifically induced Co-60.

With respect to Tow-32 photopeaks of energies 0.316 and 0.472 MeV were also detected. This sample was recounted 34 days after the initial count. The energies when coupled with the rate of decay did not afford identity of their emissions. Only 9% of the 0.316 MeV and none of the 0.472 MeV emissions remained after this time.

Research Colleague at NOSC: H. Weiss 1983

MAXIMUM ENTROPY POWER SPECTRUM ESTIMATION FOR SIGNAL EXTRACTION

William Torrez

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University of California at Riverside
San Diego, California

ABSTRACT

If a positive, real signal is considered a power spectral density, then its Fourier transform is an autocovariance function. This correspondence can be used to model a signal process as a weakly stationary process whose power spectrum is the signal to be extracted. In this report, some aspects of this signal extraction problem are discussed including algorithms which are designed to correct for windows, noise, and other factors which may cause the non-positive definiteness of the autocovariance function. The main estimation technique considered in the maximum entropy power spectrum estimation method.

Research Colleague at NOSC: L. Stotts 1983

IX. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER

San Diego, California

Program Coordinator at NPRDC: B. Rimland 1983

COMPUTER-BASED FUNCTIONAL SKILLS TRAINING

Jay S. Blanchard

College of Education, Specializations
Texas Tech University
Lubbock, Texas

ABSTRACT

I worked on the initial development phase of the Navy's computer-based functional skills program (FST). The project is expected to culminate in 45 hours of computer-based functional skills software for use by enlisted Navy personnel at all duty stations.

The first few weeks at NPRDC were spent familiarizing myself with previous Armed Services and Navy basic skills and literacy efforts as well as efforts outside the realm of the Armed Services. At the end of that period, I presented (to a representative of the Chief, Naval Education and Training (CNET)) a report summarizing various instructional strategies and formats available for possible Navy use.

I next worked on selecting appropriate Navy content for the FST software. A final decision was made to select, as the content for the software, the Basic Military Requirements Manual (E-2/3), the Military Requirements Manual for PO3/2 and the Military Requirements Manual for PO]/Chief. A software development flow chart was then designed and accepted by CNET as providing acceptable direction for the FST software. Basically, the flowchart features a two-pronged attack on Navy basic skills and literacy problems: (i) "Conventional" instructional and evaluation formats will be computerized. This is done to give the sailors experience dealing with the various formats they will encounter during test-taking in the Navy; (ii) Problem-solving activities will be designed and computerized to teach not only Navy content but basic problem-solving skills needed in military and civilian life. This is an unusual approach for the delivery of basic skills and literacy instruction--but one which shows great promise.

Research Colleagues at NPRDC: T. Sticht and F. Chang 1983

ORIENTING RESPONSES AND INTELLECTUAL ACTIVITY

James W. Brown

Department of Psychology
San Diego State University
San Diego, California

ABSTRACT

This project pursued the relationship between unlearned largely "automatic" attentional behavior and the performance of intellectual activities. Literature relating attentional measures to cognitive performance was reviewed, and several measures were chosen for further study. An experimental design using cardiac rate changes was developed. Instrumentation and stimulus presentation and data acquisition computer programs were developed for an empirical investigation of orienting/cognitive relationships. Subjects will be 100 freshman students at San Diego State University. Experimental testing will commence in the Fall 1983 semester, as a follow-on of this five-week summer project. Co-investigators are D. Saccuzzo of San Diego State University and B. Rimland of the Navy Personnel Research and Development Center.

Research Colleague at NPRDC: B. Rimland 1983

OFFICER ALLOCATION MODELING: REVIEW AND SUGGESTIONS

Milton M. Chen

Department of Management
San Diego State University
San Diego, California

ABSTRACT

This study evaluates the Officer Manning Plan used at the Naval Military Personnel Command (NMPC) and suggests possible alternatives for modeling the system. First, a simple description of the present allocation system and its deficiencies as perceived by some personnel managers in NMPC are summarized. Second, possible alternative approaches to the present system are critically evaluated. These include various configurations of formal or heuristic operations research techniques. Third, suggestions on possible modeling approaches are made after eliminating some of the possibilities. Fourth, an integrated allocation and assignment system is briefly suggested for further exploration.

Specific modeling modifications of the present Officer Manning Plan is also recommended as a part of the study. They include: 1) expanding the present network/transshipment model to incorporate subspecialty, AQD, sex, etc.; 2) replace the solution code with a faster software package; 3) make the system interactive; 4) derive the relative desirability factor using formal scaling techniques such as category scaling; 5) print out various statistical summary measures relating to manning level; 6) perform the proportional distribution within the network/transshipment model; and 7) develop methodologies for reducing the number of arcs and nodes.

Research Colleague at NPRDC: T. Blanco 1983

A STRUCTURAL COMPARISON OF CONVENTIONAL AND ADAPTIVE VERSIONS OF THE ASVAB

Robert Cudeck

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University of Minnesota
Minneapolis, Minnesota

ABSTRACT

This paper examines several structural models of similarity between a battery of conventional tests and a battery of computerized adaptive tests designed to measure the same aptitudes. Twelve plausible models are reviewed and are fitted to sample data in a double cross-validation design. Three of the 12 models provided reasonable summaries of the data. One model with a multiplicative structure (Browne, 1983) performed quite well. This model provides an estimate of the disattenuated method correlation between conventional testing and adaptive testing. In the current data, this correlation was estimated to be 0.97 and 0.98 in the two halves of the data. These results were interpreted as very supportive of the CAT tests as replacements for the conventional tests.

Research Colleague at NPRDC: J. McBride 1983

XI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL SURFACE WEAPONS CENTER

Silver Spring, Maryland

and

Dahlgren, Virginia

Program Coordinator at NSWC: R. Shomette 1983

FEASIBILITY STUDY OF HEAT RECOVERY FROM NAVAL AIR CONDITIONING

Yakov Zilberberg

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University of Lowell
Lowell, Massachusetts

ABSTRACT

The project was performed under the auspices of the Office of Naval Research-American Society for Engineering Education Summer Faculty Research Program. The topic was proposed, and technical guidance provided by DTNSRDC, Annapolis Laboratories.

During the course of the project preliminary studies of heat recovery by an R12 HPAC (heat pump/air conditioning) unit, with screw compressor and double-bundle heat transfer apparatuses (i.e. evaporator and condenser), have been conducted. Specifically the following subjects have been developed: (1) Principles and Examples of HPAC Unit Sizing; (2) Description and Analysis of Main Control Strategies; (3) Computerized simulations of HPAC unit thermal performance under various conditions (i.e. temperatures) of heat recovery.

It has been shown that the proposed application of a shipboard HPAC unit for cooling and heating simultaneously posesses a significant potential for energy savings.

To be able to make a complete conclusion about the feasibility of the proposed approach, the following topics for continuation of research have been suggested: (1) Complete analysis of potential energy savings from application of HPAC unit for heating purposes; (2) Analysis of unit performance with different refrigerants (R22, R114); (3) Investigation of prospects for application of double-stage compressors with separating stages; (4) Analysis of unit performance with a "switch-over" seawater bundle; (5) Optimal sizing of unit's heat transfer equipment; (6) Evaluation of oil impact on heat transfer equipment performance; (7) Investigation of alternative temperature control strategies.

In addition, a shipboard impact analysis for the use of HPAC system is recommended.

Research Colleague at NSRDC: B. Hwang 1983

ASSESSMENT OF ADIABATIC ENGINE TECHNOLOGY

David A. Renfroe

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Fayetteville, Arkansas

ABSTRACT

The Navy is desirous of an efficient, long lived, multifueled engine for use in ship service power. For the past several years the Army in conjunction with Cummins has been working on a ceramically insulated combustion chamber for a diesel engine. Such an engine configuration allows the advantages of elimination of the cooling system which allows 50% reduction in maintenance cost and a more compact, lighter power unit, 48% thermal efficiency, quieter operation, and the possibility of lowering the compression ratio. The adiabatic configuration of the diesel engine appears to be a technically feasible power system which can fulfill the needs of the Navy for ship service power.

After several years of effort the Army has equipped a 5 ton truck with an adiabatic diesel engine and it has been driven over 7000 miles without engine failure. The engine used a partially stabilized zirconia (PSZ) cylinder liner, piston cap, valve coating, and cylinder head face plate, and alumina titanate manifold insulators. The resulting high temperature exhaust gases pass through a turbocharger and a turbocompounding unit to extract more available energy.

The problem yet to be overcome before this could be a serviceable Navy engine are upper cylinder ring and cylinder life and life of the ceramic parts in the engine. The present Army engine has a design life of 250 hours whereas the Navy engine should last 10,000 hours between overhauls and 50,000 hours ultimate life. Further research sponsored by the Navy will be required to produce an adiabatic engine of the power and life needed.

Research Colleague at NSRDC: R. Muench 1983

THE DEVELOPMENT OF HIGH QUALITY DEPENDABLE SOFTWARE FOR NONVISCOUS SHIP WAVE RESISTANCE AS AN AID TO HULL DESIGN

Thomas R. Lucas

Department of Mathematics and Computer Sciences
University of North Carolina at Charlotte
Charlotte, North Carolina

ABSTRACT

I had a choice between working on ship boundary layer problems or the ship free surface problem of nonviscous drag simulation. I chose the latter for two reasons: the mathematics and physics were better understood; and I felt that a general breakthrough would occur in the next five years, and I wanted to be part of that. I spent about half the summer identifying and reading papers on this and related subjects, and about half studying one of the Navy's two existing computer programs in this area: The SWIM (Surface Wave Integral Method) program by Dr. Ming Chang. (The other is the XYZFS program by the late C. Dawson). I have become quite familiar with the details of that program as an approach using the Havelock potential in an integral method. As a contract had just come in to use the CRAY-1 to make some hull evaluations, I decided to spend a significant part of my time converting the program to the CRAY-1 and restructuring it to take advantage of the advanced hardware features and to make the program affordable to use with paneling of sufficient detail to reasonably represent proposed hull designs.

I was quite successful in this, achieving a significant speed-up on the CRAY-1, which (with some additional work) would make the program affordable for production use. This work, as expected, led to an excellent understanding of the main computational blocks of SWIM, and I am now one of two people who have a large scale understanding of this implementation. Regretably, I still lack a detailed overview of the whole SWIM program on a level where I could independently reproduce it. I am very interested in continuing research in these directions, including documenting SWIM, testing SWIM for accuracy and robustness and considering a number of alternative approaches in an overall strategy to come up with dependable high quality software for the free surface problem.

As a numerical analyst I have found this problem very interesting, and also very difficult. I plan to apply for a second summer at DTNSRDC to complete my understanding of the current work on this problem, including some alternative approaches, and to develop some research proposals. I expect, with support from the Navy, to be able to significantly improve existing analysis and software in this area over the next several years. I would like to express my appreciation to Dr. Lin and his colleague in Code 15 for their generous help in these areas.

Research Colleague at NSRDC: T. Thomason 1983

SOFTWARE & HARDWARE FOR CAD/CAM APPLICATIONS

Peter E. Liimatta

Engineering and Technology Department
Anne Arundel Community College
Arnold, Maryland

ABSTRACT

The report provides documentation of multifaceted research projects involving software and hardware development toward CAD/CAM applications at David Taylor Naval Ship Research and Development Center in Annapolis, Maryland.

Three main areas covered include: (1) Implementation of a computer assisted start-up system and a utilities program for disc system operations on a Tektronix 4054 computer to make it easier to use; (2) A method to merge a design and a drawing program that uses the disc system, is user friendly, and passes parameters from one to another through automatic accessing of a common file; (3) The design of a prototype interface that will allow interfacing machine shop multiaxis precision measuring device made by Portage Machine Company and a Tektronix 4052 computer to incorporate precision measurements with CAD/CAM applications. Basically, the interface involves multiplexing four separate 32 bit channels each containing 6 BCD values, the plus or minus sign, and select controls for bringing them into the computer under program control for applications as desired.

Research Colleague at NSRDC: T. Calvert 1983

DYNAMIC ANALYSIS OF THE DDG-51

Dennis J. Fallon

Department of Civil Engineering
Old Dominion University
Norfolk, Virginia

ABSTRACT

The purpose of this report is to briefly summarize the research work conducted by the author during the summer of 1983 at the Underwater Explosions Research Division (UERD), Portsmouth, Va. The objective of this work was to investigate the structural dynamic behavior of the DDG-51, a new class of destroyer, to underwater explosions. An ancillary objective was to assist research engineers at the Underwater Explosions Research Division in the development of a finite element model of the DDG-51 ship hull.

A finite element model using beam elements was formulated using preliminary design data for the DDG-51. An arbitrary underwater explosive loading (weight and standoff) was assigned by researchers at UERD. The results of the structural analysis demonstrated the sensitivity of the dynamic response to exclusion of shear deformation in the analysis. This sensitivity is due to the high frequency loading of an underwater explosion. Researchers at EURD are presently investigating other types of structures to see if similar effects can be detected.

A series of analyses were made to evaluate equipment responses aboard the DDG-51. This was accomplished by a simple mass-spring system being added to the mathematical model described above. The results clearly indicate that the interaction between the equipment, the ship and the loading has a significant effect on the structural response of the equipment. At present more complex finite element models are being formulated to more accurately evaluate equipment response.

A more detailed report is being compiled and will be forwarded when complete.

Research Colleague at NSRDC: V. Bloodgood 1983

APPLICATIONS OF ASPECT GRAPHS TO ROBOT VISION SYSTEM DESIGN

Carol G. Crawford

Department of Mathematics
United States Naval Academy
Annapolis, Maryland

ABSTRACT

My research at DTNSRDC has been directed in the area of robotics. Specifically, my major project involved developing algorithms for aspect graph construction for regular solids to form a basis for a robot vision parts recognition scheme. This research included investigating methods of application of the theory to recognition of objects by robotics systems using sensory feedback devices, representation of objects, and the informational limits on the use of real time sensory feedback. In addition, my research has led to the development of a theory of aspects graphs and their properties.

My work at Carderock was also carried out in conjunction with the Robot Vision System Project at the National Bureau of Standards. I have been working directly with Dr. Glen Castore and Dr. Ernest Kent, the director of the vision group at NBS. Dr. Stuart Ullman has been my project director at DTNSRDC.

Naval applications of my research will be directed in the area of interpretation of visual feedback for automatic assembly and repair of objects related to aircraft maintenance. The algorithms discovered this past summer will be tested this fall at NBS. DTNSRDC is in the process of purchasing two new robots which will provide an additional opportunity for hands-on experimentation for my work.

I have been asked by DTNSRDC to continue working with them throughout the next year in developing their robotics project. I will be serving as a research liaison with NBS; will sit on a global committee of researchers from various naval departments and government agencies; and I will be taking a robotics programming course to work with the newly purchased robots for Carderock.

Research Colleague at NSRDC: S. Ullman 1983

COMPUTER PROGRAM DEVELOPMENT FOR GRAPHIC DISPLAY OF MOLE-FRACTION DATA

Patrick G. Barber

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Longwood College
Farmville, Virginia

ABSTRACT

The extent of hot corrosion in marine gas turbine engines is studied using the burner-rig test, but this experimental procedure requires time and the number of experimental variables affecting the extent of corrosion is too extensive for each to be tested individually. Computer programs originally developed by NASA have been used to calculate the chemical thermodynamics of the fuel burning under conditions encountered in the gas turbine engine. The results of these calculations is an extensive series of mole-fractions at selected temperatures, but numerous pages of these small numbers are difficult and time-consuming to interpret. It was therefore recommended that a computer program be developed that will take this extensive list of data and display them graphically. This report describes the development and the programs that were written to accomplish this task, and it describes four other tasks that were accomplished in connection with this thermodynamic project.

Research Colleague at NSRDC: D. Rathnamma 1983

X. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Annapolis and Carderock, Maryland

Program Coordinator at NSRDC: E. Cuthill 1983

NATO SEA SPARROW MISSILE SYSTEM (NSSMS), TECHNICAL TEXT COMPREHENSION PROJECT

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Memphis, Tennessee

ABSTRACT

The writer served with a research team investigating text comprehension of the NATO Sea Sparrow Missile System (NSSMS) ordinance publications. The study was sponsored by the Instructional Technology Department at the Navy Personnel Research and Development Center (NPRDC), San Diego. Team members included three psychologists from NPRDC and UCLA, two engineers from Hughes Aircraft Corporation and Memphis State University, and a research assistant from San Diego State University.

The purpose of the study was to examine how background experience and text factors determine the nature, amount, and ease of comprehension. The primary theoretical issue involved is the role of experience in structuring information. The primary practical issue is the determination of effective feedback that can be provided to the tech writer to aid in revising text.

The sample subjects were U.S. Navy technicians in three categories: NSSMS expert, NSSMS novice, and Non-NSSMS expert. Experimental data included verbal protocols and pre- and post-treatment diagrams of one mode of NSSMS operation.

Specific tasks identified by the team included development of algorithms for scoring and analyzing the diagrams, and for scoring and analyzing the semantic and syntactic characteristics of the text sigments and protocols. To date, the data have been collected and transcribed, the diagrams have been scored, and one algorithm has been developed for scoring the verbal protocols.

Refinement of the scoring, completion of analysis, and reporting the experiment remain to be done. The writer intends to continue working with the team, at his own institution, until the project is completed.

Research Colleague at NPRDC: T. Duffy 1983

INTELLIGENCE, APTITUDE, PERSONALITY AND INFORMATIONAL PROCESSING

Dennis P. Saccuzzo

Department of Psychology
San Diego State University
San Diego, California

ABSTRACT

The goal of this project was to confirm and extend previous findings concerning the relationship among speed of information processing, aptitude, and intelligence. The basic objectives were as follows: (1) determine the correlations among academic achievement (as evaluated by high school and/or college grades), academic aptitude (as evaluated by scores on the Scholastic Aptitude Test), intelligence (as evaluated by the Vocabulary and Block Design subtests of the Wechsler Intelligence Scale-Revised), personality (as evaluated by Eysenck's Personality Questionnaire and the Eysenck Personality Inventory), degree of lateralization hypnotic susceptibility, and various measures of speed of information processing including (1) the ability to identify a brief taschistoscopic visual stimulus in a backward masking paradigm, (2) the ability to identify the longer of two briefly exposed lines presented via computer in a backward masking paradigm, (3) identify a briefly presented sound in an auditory backward masking task.

This work was conducted in conjunction with James Brown, who evaluated habituation of the orienting response in the same subjects. Dr. Bernard Rimland was the Research Colleague at the Navy R&D Center.

The potential significance of this work and its possible implications are currently being evaluated.

Research Colleague at NPRDC: B. Rimland

1983

NEED ANALYSIS FOR A DSS FOR NISTARS OAKLAND

Mario Padron

Department of Industrial Engineering
University of Puerto Rico
Mayaguez, Puerto Rico

ABSTRACT

The Navy is in the process of installing two integrated storage, tracking and retrieval systems (NISTARS) at warehouse locations in Oakland and San Diego. As part of a research project which intends to compare different management systems, the Navy Personnel R & D center in San Diego will try to develop a Decision Support System (DSS) for the Oakland NISTARS project. My job for the summer was to help in the development of a "Needs Analysis" for such a DSS. After extensive literature research and on site interviews my recommendations emphasized the need for a Digital-Dynamic-Systems Simulator, a computerized personnel assignment algorithm, and for emphasizing the statistical aspects of Deming's Management Philosophy.

Research Colleague at NPRDC: 1983

NPRDC COMPUTER SUPPORT (CODE 205) REORGANIZATION PLAN CONSULTANT APPRAISAL

Richard I. Johnson

Computer Sciences Department
University of North Dakota
Grand Forks, North Dakota

ABSTRACT

NPRDC Code 205, Computer Support, has serious internal and external management and image problems. Demand for computer support has not been matched with resources (management, personnel, equipment, skills, etc.) necessary to satisfy this demand. As a result, the R&D user view is that Code 205 has not been responsive to their "R&D needs" and Code 205 personnel have become frustrated with their inability to satisfy the user community. A major reorganization of functions and personnel is necessary to resolve these problems. The proposed reorganization should make the computer support resources more responsive to the R&D users and to the overall mission of NPRDC. This document summarizes the systems analysis process used to define and classify the problems, collect and analyze relevant data, propose solutions, determine the feasibility of the solutions and analyze the impact on the organization. The reorganization plan was developed by personnel within the code being reorganized but also included external data in the formation of the final recommendations.

Research Colleague at NPRDC: J. Harley 1983

ANTECEDENTS AND CORRELATES OF PREGNANCY, ATTRITION, AND PREGNANCY ATTRITION IN FIRST TIME WOMEN MARINES

Meg Gerrard

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ABSTRACT

This study involved analysis of archival data housed at NDRDC, San Diego. Factor analysis and reliability analyses were used to construct a number of scales measuring satisfaction, isolation and traditionality. These scales were then used in multivariate analyses designed to determine which factors predict pregnancy, attrition, and pregnancy attrition in first term women marines. The results indicate that isolation, satisfaction and traditionality predict attrition. The journal article and technical report resulting from these analyses will discuss the implications of these findings for the retention of women marines.

In addition to this basic research, I also worked with NDRDC staff to develop and pilot a sex and contraception knowledge test. This test will be used to evaluate a marine corps pilot sex and contraception education program to be conducted at Camp Lejeune this coming year.

Research Colleague at NPRDC: M. Royle 1983

THE FLUID DYNAMICS OF MUZZLE BLAST FROM SIXTEEN-INCH GUNS

Robert W. Courter

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ABSTRACT

A test program has recently been completed at the Naval Surface Weapons Center to evaluate the effects of the muzzle blast from sixteen-inch guns on surrounding shipboard systems and structure. The program was motivated by the recent reactivation of battleships into the Fleet. In the present study pressure transducer data and high-speed motion picture film records of the tests have been used to perform a detailed study of the fluid dynamics of the blast wave. The data utilized in the study were acquired both from the main range at the Dahlgren Laboratory and at sea from the battleship New Jersey.

Several of the high speed films from the New Jersey firings showed the strong blast wave propagation in a shadowgraph effect against the water surface background. These films were analyzed to determine the projected shock wave shape as a function of time and angular position from the muzzle axis. In addition the projected contact surface shape was also determined by assuming it to be coincident with the advancing flame front. These data were then reproduced on the computer with a numerical B-spline curve fitting procedure. The field lines (normal lines to the set of instantaneous wave shapes) were then determined with an algorithm which also used a B-spline procedure. The displacement per unit time along the field line represents the local velocity of the disturbance, so the procedure provides the shape and velocity of the projections of both the shock wave and the contact surface. The shock wave and contact surface trajectories thus generated were used in conjunction with the Rankine-Hugoniot relations and data from pressure sensors mounted in the blast field to determine initial conditions for a one-dimensional unsteady method of characteristics solution of the flow field between the shock wave and the contact surface. Agreement between computed and measured pressures in the blast field was generally good at the shock wave, but it deteriorated near the contact surface. The method is strongly dependent on the fidelity with which the shock wave and contact surface profiles can be read from the motion picture film. Suggestions were made regarding test methods which could be incorporated to enhance shock wave visibility and tracking in future tests. It is felt that the procedure which was used in this study has merit in the detailed analysis of blast wave flow fields in a full scale environment.

Research Colleague at NSWC: J. Yagla 1983

STRESS WAVES IN TWO COLLIDING FINITE CYLINDRICAL RODS

Dah-Nien Fan

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Washington, DC

ABSTRACT

The object of the research is to determine analytically elastic stress waves in two finite cylindrical rods of equal radii subjected to an end-end collision under axisymmetric conditions, with potential applications to rod-plate impacts. Except the impacting surfaces the remaining rod surfaces are free from any stresses. Attempts to find an exact analytic solution of the partial differential equations for the displacement field, though linear, were too ambitious. The tractionless boundary conditions at the two ends render the method of transforms, much reported in literature, useless.

An approximate scheme to handle the present problem has thus been proposed, where the radial (r) and axial (z) displacements are expanded in their respective power series of r. The coefficients (functions of z and t) satisfy an infinite system of partial differential equations. The equations as well as the boundary and initial conditions can be successfully truncated to provide supposedly better and better accuracy.

In the lowest order of approximation the axial displacement U_z obeys the one-dimensional wave quation with a propagation speed of $(E/\rho)^{\frac{1}{2}}$, where E is the Young's modulus and ρ is the density of the rod material. There is a radial displacement $-\nu r \partial U_z/\partial_z$ where ν is the Poisson's ratio. Also the approximation requires an additional axial displacement of $(\frac{1}{2})\nu r^2 \partial^2 U_z/\partial_z{}^2$. The approach here sheds some interesting light on the derivation of the governing equation of waves in long rods.

Research Colleagues at NSWC: D. Brunson, W. Holt, W. Mock and W. Soper

1983

BATTLE ORGANIZATION SURVEY

L. Stovall Hurdle

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Norfolk State University
Norfolk, Virginia

ABSTRACT

The primary purpose of the Battle Organization Experiment is to assess the interaction between the hierarchial structure aboard ships and to improve organizational effectiveness in combat systems.

During the first stage of this experiment, a survey was designed to identify the critical variables affecting battle organization personnel. The results are available upon request.

Research Colleague at NSWC: C. Mangleburg

1983

BOND LENGTH-BOND ORDER CORRELATIONS FOR NITROAROMATIC EXPLOSIVES

Walter H. Jones

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The University of West Florida
Pensacola, Florida

ABSTRACT

The objective of the study was to develop a theoretical method of correlating bond lengths and bond orders in nitroaromatic explosives, in order to assess the reliability of crystal structure data.

Results obtained were as follows: The review of Holden and Dickinson showed a general correlation between C-N bond length and average adjacent C-C bond length for a large number of aromatic compounds containing ring NO_2 and, in many cases, NH_2 groups. It was first attempted to correlate these data, in a C-N bond length versus C-C bond order plot, with the corresponding C-N and C-C bond orders derived from molecular orbital calculations on the experimental geometries, by the MNDO method. Reference points on the axes were established with benzene (B) and triaminotrinitrobenzene (TATB). The correlation was poor, and it was noted that the discrepancies on the C-N axes were in opposite directions for the NO_2 and NH_2 groups. Correlations were then sought between MNDO-optimized geometries and bond orders, using nitrobenzene (NB) and aniline (A) as reference points. This fit was acceptable on the C-C axis, but failed on the C-N axis. Analysis of the data showed good separate correlations between bond length and bond order for the C-NO_2 and C-NH_2 bonds. This is reasonable because of possible differences in ionicity and N-hybridization. Two different scales were then used for the C-N bond order axis, and a good fit resulted. Compounds used in the fit were A, B, NB, trinitrobenzene (TNB), TATB, paradinitrobenzene (PDNB), paranitroaniline (PNA), and metanitroaniline (MNA).

Plans for continued work were formulated based on the following observations. Although it was demonstrated that a MNDO bond length-bond order correlation exists for the compounds of interest, there was no apparent correlation between MNDO-optimized geometry and experimental geometry. Three possible reasons are: (1) inherent differences between geometries determined by x-ray crystallography and "true" molecular geometries; this question is being analyzed; (2) possible unsuitability of the MNDO method, because of lack of N-O bonds in the compounds used for its parameterization; a different method, CNDO, is being tried; and (3) intermolecular effects, which are being explored by calculations on dimer structures derived from crystal data.

Research Colleague at NSWC: R. Bardo 1983

CURRENT RESEARCH AND DEVELOPMENT IN OCCULAR PROTECTION AT DISCRETE LASER WAVELENGTHS

Michael L. Lesiecki

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Rio Piedras, Puerto Rico

ABSTRACT

This report first summarizes the current state of research and development in the area of Occular Protection. Absorptive type filters using organic or inorganic chromophores are briefly discussed followed by a detailed discussion of interference type filters of the holographic and rugated design. Some areas of the technology are restricted on a classified basis. An appendix is included which summarizes the active personnel and programs in these areas.

The second part of the document presents two separate proposals that identify unique concepts that appear to be viable alternatives to the present technology. The proposed research introduces Chloresteric Liquid Crystals as selective thin film passive reflectors in the liquid crystal and liquid crystal glass phases. The concept of absorption line narrowing in ordered media is discussed and finally an active optical device based on non-linear reflection in Chloresteric Liquid Crystals is proposed.

Research Colleague at NSWC: M. Ramsburg

1983

BOUNDARY INTEGRAL METHODS AND SCATTERING THEORY

W. Tobocman

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Case Western Reserve University
Cleveland, Ohio

ABSTRACT

I worked on two projects in acoustics this summer: (1) the application of the integral equation method (boundary integral method) to acoustic scattering, and (2) the application of resonance scattering theory to the determination of the density and elastic constants of a steel sphere through acoustic scattering.

The integral equation method has proved to be useful in calculating radiation from objects having complicated shapes. Therefore we expect it will be an effective method for analyzing the scattering by such objects. As a first step in developing a computer program to do such calculations, we have developed a computer program to use the integral equation method to calculate the scattering of plane acoustic waves by rigid spheroids. We find that the method fails at higher frequencies (ka) > 10). We believe the cause of the failure is the effect of the characteristic frequencies. The literature contains techniques for overcoming this problem. One of our next projects will be to apply some of these techniques in our scattering calculation to enable us to do calculations at higher frequencies.

We have analyzed the acoustic scattering resonances of a steel sphere in callaboration with W. Gaunaurd. The relationships between the physical properties of the sphere and the resonance parameters have been determined. We plan to continue our callaboration with W. Gaunaurd to see if these relationships can be used to devise a practical scheme to employ acoustic resonances to determine the physical properties of steel spheres.

Research Colleague at NSWC: W. Gaunaurd 1983

XII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL UNDERWATER SYSTEMS CENTER

Newport, Rhode Island

and

New London, Connecticut

Program Coordinator at NUSC: P. Scully - Power 1983

EVALUATION, ALIGNMENT AND TESTING OF A SCANNING LASER-DOPPLER-VORTICITY-METER (LDVM)

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Milwaukee, Wisconsin

ABSTRACT

The study of small-scale fluid behavior is of continued interest both to the general oceanographer sector (fluid dynamicists, biologists, geologists, etc.) and to various groups in the Navy. Remote measurement of small-scale fluid behavior is now possible with the advent of reliable higher power lasers, utilizing essentially similar techniques first pointed out by Yeh and Cummings in 1964. Today, remote measurements of fluid vorticities (1 mm-10 m) and fluid/particle movements, at standoff ranges of 10-20 meters, are possible using laser-doppler-velocimeter techniques in the back scatter mode. At NUSC, the concept of a laser-doppler-vorticity-meter (LDVM) has been developed, tested, and a prototype scanning system is being refined and evaluated before construction of a more sophisticated system. The purpose of my A.S.E.E. summer fellowship was to augment the existing expertise at NUSC, (Bill Stachnik and his group) to evaluate the optical and mechanical design of the prototype scanner, and to attempt to coax this prototype into a reliable working model to promote construction of the next generation of remote, scanning, laser devices.

In this report, the development and evolution of LDV optic systems is covered, along with an evaluation of design choices for the LDVM scanning prototype. Moreover, the LDVM was successfully optically aligned and tested in air, with signal to noise ratios for doppler frequencies of 14KHz of 30 to 40 db. at 10% of transmitted power (using neutral density filters on the 750 MW Blue-green 488 μm portion of the Argon laser). This involved axial alignment of all optical surfaces including a beam focusing device (built especially for this project), and the rotational axis of the LDVM and the test tank window. A large portion of the report will discuss specific alignment techniques. After successful alignment, focusing, and static operation in air with signals from a dusted, rotating glass disk, the test tank was cleaned and prepared for testing in fresh water. The laser transmitting and receiving optics were realigned and refocused in water, and the LDVM was again tested in the static mode (no scanning). Unfortunately, we were unable to receive a signal without a disk to rotate under water. The LDVM was then rotated in scanning mode to produce (if all systems were aligned and working) a doppler frequency signal characteristic of the LDVM rotation. We were unable to receive a signal from this scanning mode. The neutral density filter was removed, and full laser power used with no appreciable results. An evaluation of the LDVM mechanics was made and several large problems were discovered. Time requirements on the project force me to limit my efforts to recommendations for modifications to the existing instrument and on future design criteria.

Research Colleague at NUSC: W. Stachnik 1983

NOTES ON HYDRODYNAMIC FACTORS AFFECTING ACOUSTIC SCATTERING

Charles Kaufman

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University of Rhode Island
Kingston, Rhode Island

ABSTRACT

Some hydrodynamic factors are considered which relate to the scattering of acoustic energy from a collection of small moving objects assumed to be entrained in a flow field. The scatterers are assumed to have velocities and positions which are known only in an overall sense. The average characteristics of the scattered acoustic energy are determined by the entrained scatterer motion, which is described by the statistical characteristics of the flow field such as the one-point and two-point correlation functions of velocity. A particular property of the velocity variability which can be developed from these statistical quantities is the average magnitude of the point-to-point velocity difference within the scattering volume, often referred to as the structure function. An approach has been developed to assess this property as a function of scattering volume size and shape. Results have implications which relate, for example, to the average frequency broadening of a scattered narrowband acoustic pulse due to velocity variability. Such characteristics are significant and may be exploitable in certain oceanographic measurement applications.

Research Colleagues at NUSC: K. Kemp and A. Jilling 1983

SOME COMPUTATIONAL PROBLEMS IN UNDERWATER SOUND PROPAGATION

Gregory A. Kriegsmann

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Northwestern University
Evanston, Illinois

ABSTRACT

During the past summer Dr. Lee and I have worked on a variety of problems arising in underwater acoustics. Specifically, we finished developing a three dimensional wide-angled parabolic equation which models the propagation f sound in the ocean. This work was done with our mutual colleague Professor William Seigmann. It will soon be submitted for publication to the Journal of the Acoustical Society of America. The preliminary notions for this collaboration began last summer under the ASEE-Navy Summer Faculty Research Program.

Also during the past summer, Dr. Lee, Professor Fredrick Tappert, and I have developed a new parabolic equation which takes into account the density variations of the ocean. This new equation allows us to model realistic ocean environments which are of great interest to the Navy. The new variable density parabolic equation (VDPE) incorporates and extends previous attempts to take statification effects into account. We have also developed a difference scheme which models our equation and conserves the proper flux. We are presently developing an experimental code for testing our theory.

In addition to my work with Dr. Lee and his colleagues, Professor William Seigmann and I have begun a theoretical study and comparison of the rays associated with the Helmholtz equation, the parabolic wave equation and the wide-angled parabolic wave equation. We hope to establish when the simpler parabolic rays are adequate.

Research Colleague at NUSC: D. Lee 1983

AMPLITUDE PROBABILITY DISTRIBUTION OF BIOLUMINESCENCE IN THE SEA

Alexander D. Poularikas

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University of Denver
Denver, Colorado

ABSTRACT

The probability distribution of the bioluminescence noise in the sea was derived. In addition the probability distribution of peak values and time intervals of events were also found.

Research Collague at NUSC: W. Stachnik 1983

EVALUATION AND OPTIMIZATION OF THE USE OF SSN WEAPONS

Emilio O. Roxin

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Kingston, Rhode Island

ABSTRACT

This report is to some degree a sequel to TM No. 831013 and TM No.
by Dr. W. H. Bortels and by Dr. W. H. Bortels and D. R. Samuelson respectively, where the problem of optimizing the SSN weapon mix loadoats was tested using linear programming and dynamical programming respectively.

This report includes, as a substantial part, considerations on how to make an optimal decision, at the level of a single engagement, about which weapon to use (or not to use) under determined circumstances. After pointing out the relations of this problem with the one of optimal weapon mix loadouts, some simple models are formulated and discussed.

A dynamic programming computer program was written to calculate optimal weapon mix and at the same time obtain the information needed to make optimal decisions at the level of a single engagement. Models are discussed where the effectiveness of the weapons depends continuously on some variables as for example the range.

In order to estimate the probability of encounters, the model of a Poisson process is given. More realistically, when the targets are moving in clusters, the Poisson process is not a good model. Powerful results from the theory of geometric probability or "integral geometry" are given, which are helpful in estimating the probability of single as well as multiple encounters.

Research Colleague at NUSC: R. Streit 1985

UNDERWATER ACOUSTIC FILTER PLATE

H. R. Rymer

Department of Physics
University of Bridgeport
Bridgeport, Connecticut

ABSTRACT

The project concerns the theoretical development of the underwater acoustic filter plate.

The summer project had been originally been considered as a simple programming of the equations as eveloped by Prof. Murray Wachman of the University of Connecticut, Department of Mathematics. Because of the complexity of the formulations it was considered advisable for me to redo the algebraic development as a check for possible errors. No errors were found. Prof. Wachman's work was absolutely faultless.

The programming phase started some what late in the summer and was not completed at the end of the summer. Because of a personal interest in the program I have continued to work on the program, at my own request. I have done this at my own time because of the respect I have for the workers I have been with at the Underwater Systems Center at New London. I really feel that I owe them more than what the end result would have been had I left it at the end of the term. I not only have a personal interest in the work but it is very difficult for someone else to take over another's computer programming.

This project has been most valuable to me as I have acquired new colleague's of like interests but my own work has benefited from the interaction. My intention is to deliver a running program to the group before the summer. At the rate the work is going this should not be difficult to achieve.

Research Colleage at NUSC: J. Kalinowski 1983

A WIDE ANGLE 3-DIMENSIONAL PARABOLIC WAVE EQUATION

William L. Siegmann

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Troy, New York

ABSTRACT

A simple extension of the standard 2-dimensional parabolic wave equation to the 3-dimensional case can be accomplished by retaining the angular derivative term. This extension is limited to deal with small vertical angle of propagation. A new wide angle, 3-dimensional partial differential equation is developed to predict the sound propagation in 3-dimensional ocean. This formulation is achieved by operator theory whose mathematical derivation is given in detail. The validity of the formulation is examined in full through the discussion of the approximation and the multiple scale analysis.

Research Colleague at NUSC: D. Lee 1981

Table VIII

NAVY RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1980 PROGRAM WITH FUNDING IN THOUSANDS OF DOLLARS

Participant	Academic Department	College/ University	Contract No.	Funding	Laboratory
Busby, H.R.	Mech Engineering	N D State	N00140-81-M-DZ14	5	NUSC
Dube, R.L.	Elect Engineering	W New England	N00140-81-M-FZ73	10	NUSC
Gilmore, C.M.	Engineering	GWU	N00019-80-C-0403	56	NRL
Johnson, D.H.	Elect Engineering	Rice U	N00014-81-K-0565	35	NOSC

Total funding for 1980 program contract fallouts in thousands of dollars------106

Table VII

NAVY RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1979 PROGRAM WITH FUNDING IN THOUSANDS OF DOLLARS

Participant	Academic Department	College/ University	Contract No.	Funding	Laboratory
Bowman, T.T.	Mathematics	U Florida	N00167-79-M-4321	10	NSRDC
Cramer, M.S.	Eng Sci & Mech	VPI	N00173-80-M-7172	10	NRL
			N00014-81-C-2286	3	
			N00014-81-C-2314	14	
Pollack, G.L.	Physics	Michigan State	N00014-80-C-0617	82	NMRI
Vawter, D.L.	Eng Sci & Mech	VPI	N00014-81-K-0126	45	NMRI
Young, C.T.	Mech Engineering	OK State	N00167-80-M-0333	10	NSRDC
			N00167-81-M-6260	10	

Total funding for 1979 program contract fallouts in thousands of dollars----------184

- o At least 12 former NSFRP fellows have held Navy intergovernmental personnel act appointments or temporary or intermittant civil service or consulting appointments at NRL, NMRI, NUSC, NSWC and NSRDC in subsequent summers or on a continuing one-day-a-week basis throughout the year;

- o At least two former NSFRP fellows have based their masters or doctoral dissertations on work started under the program and have completed their theses while supported by follow-on Navy contracts resulting from the program;

and

- o At least two former NSFRP fellows have become full-time Navy civil servants at NRL and NSWC.

Further specifics about the research contracts awarded as follow-ons from the 1979, 1980, 1981, 1982 and 1983 NSFRP programs are listed in Tables VII through XIIalong with the names of the 1979, 1980, 1981, 1982 and 1983 NSFRP contract winning participants, their college or university affiliations and the Navy laboratories with which they had been associated under the NSFRP programs during one or more summers in the first five years of the program.

XIV. CUMULATIVE COMPILATION OF DATA ON LATER RESEARCH FALLOUTS FROM THE FIRST FIVE YEARS OF THE PROGRAM

Plan and Procedure

As noted in the Introduction and Executive Summary an important part of the objectives of the NSFRP parogram has been to develop continuing research of Navy interest at the participating faculty members colleges and universities and to establish continuing technical relations among college and university faculty members and their professional scientists and engineering peers in the Navy laboratories.

In an effort to determine to what extent the NSFRP programs have been successful in this regard, plans for tracking the Navy related activities and research of former NSFRP participants were established in 1981 and beginning with the 1981 report the NSFRP participants and the Navy laboratory Program Coordinators from the 1979 and 1980 programs were polled to determine what Navy related technical activities of the NSFRP participants took place subsequent to their summer's experience at the Navy laboratories which were brought about, stimulated by, or otherwise made possible, as a result of their experience under the NSFRP programs. This policy has been continued in the preparation of this report and the NSFRP participants and Navy laboratory Program Coordinators have been polled regarding such technical activities that have come about as a result of the 1981, 1982 and 1983 programs.

Significant highlights of these "research fallouts" as we term them are summarized below for the 1979 through 1983 programs and in future years similar fallouts from the 1984 and later NSFRP programs will be tracked -- for inclusion in future reports -- along with any new fallouts from the 1979, 1980, 1981, 1982 and 1983 programs as they occur.

Research Fallouts and Activities

The types of research fallouts from the NSFRP programs which have thus far been identified fall more or less into three categories which we may describe as: (i) research contracts, (ii) research papers and (iii) later Navy employment or other working relationships which have developed between former NSFRP participants and the Navy laboratories.

Among the research fallouts from the first five years of the program as noted in the Introduction and Executive Summary are the following

- o 40 Research contracts or contract renewals totalling about $1,065,000 dollars have been awarded to 34 former NSFRP fellows as a result of the continuing program;

- o More than 100 scientific papers have been published by former NSFRP participants in refereed journals or have been given as invited or contributed addresses at conferences and symposiums and many more papers are still in preparation -- particularly from the later years of the program -- as a result of work started by the participants while at the Navy laboratories;

XIV. CUMULATIVE COMPILATION OF DATA ON LATER RESEARCH FALLOUTS FROM THE FIRST FIVE YEARS OF THE PROGRAM

ELECTROCHEMICAL REDUCTION OF FORMIC ACID AND FORMATE ION

Larry O. Spreer

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ABSTRACT

For military personnel in closed systems, oxygen must be continuously supplied and carbon dioxide removed from the environment. An attractive means of doing this would be an electrolysis cell in which CO_2 is reduced at the cathode to form methanol and water is oxidized at the anode to form oxygen. The net reaction is

$$CO_2 + 2H_2O - 1.5\ O_2 + CH_3OH$$

Previous studies have shown that the six electron reduction of CO_2 to methanol is accomplished in three two electron steps and the middle reaction of formic acid to formaldehyde is the most difficult to effect

$$HCO_2H + 2H^+ + 2e^- - H_2CO + H_2O$$

Series of electrode materials at different temperatures are being tested for reduction of formate in the presence of small polarizing cations such as lithium, and lanthanum. Some positive results have been noted, particularly with indium. Analytical methods for identification and quantitation of formate, formaldehyde and methanol have been developed and tested. A Palladium/Hydrogen reference electrode was found to be the most appropriate technique for measuring hydrogen ion concentrations in the presence of high concentrations of lithium and sodium ion.

Research Colleague at NWC: A. Fletcher 1981

SURFACE TARGET VULNERABILITY PROGRAM: PENETRATION VERSUS NEW SURFACE IN RUBBLE PILES

Ronald R. Rollins

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ABSTRACT

A total of 4 test firings were made in diorite and 1 in basalt rubble piles by 40-mm projectiles. The penetration depth was measured. The total fragments were collected, screening analyses performed, new surface area created calculated, and projectile kinetic energy determined. Ball mill grinding tests were done to compare energy requirements for comminution.

Research Colleagues at NWC: C. Austin and C. Halsey 1983

CONTROL SYSTEM DESIGN STUDIES

Roy Leipnik

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ABSTRACT

1. Gain-isolation tradeoffs in control systems

Description: Multi-controls for complex systems must compromise between simplicity (for example, decoupled controls) and realizability with existing actuators (gains not too high). By fixing the interaction energy in a classical isolator-type control (K. Ogata, System Dynamics, 7-6, for elementary examples) and otherwise using Kalman-style optimal control theory, a general procedure for combined regulation (vibration reduction and tracking is developed. This permits a parametric family or families of gain-isolation pairs to be determined from standard control theory.

Application: Control of ACIMD or similary missile.

2. Rapid computing of transient optimal control gains

Description: Various algorithms for computing this have appeared since 1971. It is important in automatic tracking of maneuvering targets. The competitive algorithm of Davison requires about $12N^3$ flops for a system of state dimension N. The new algorithm requires $4.5N^3$ flops, permitting faster processing or an increase of 1/3 in system complexity for the same speed.

Application: Several missile systems with on-board computers.

3. Exact perturbation calculations in radar control systems without or with noise

Description: Woodbury-type formulas were suggested to improve system control error estimates.

Application: Most missiles and other controlled systems.

Research Colleague at NWC: G. Hewer

1983

MINERAL RESOURCE EVALUATION OF THE RANDSBURG WASH RANGE, NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA

George J. Featherstone

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Bluefield State College
Bluefield, West Virginia

ABSTRACT

The Randsburg Wash includes that portion of the Mojave B Range, NWC, China Lake, California, lying in the Pilot Knob Valley which forms the locus of the Wash and separates the Mojave B North Range from the South Range. It is 23 miles SE of the Main Base in San Bernardino County, California.

Geologically the North Range is in the Basin and Range province while the South Range is in the Mojave Desert province. They are separated by the Garlock Fault which is the dominant structure and forms the northern boundary of the Wash along an EW stiking line. Water supply is minimal. Access is Navy controlled through the Wash gate. Gravel roads to significant springs are maintained; others are not, and are difficult to locate where washes are crossed. The temperature exceeds 100°F in summer and thunderstorms may cause flash flooding in the washes.

The geology of the Wash consists primarily of guaternary alluviums at Pilot Knob Valley bounded on the western rim of the valley by Plio-Pleistocene non-marine deposits. Prominent features within the Wash include Black Mountain in mid-valley formed of Tertiary volcanics with some pre-cretaceous metasediments forming a small hill to the west. The southern flank of Quail Mountain contains volcanics and non-marine sediments of Tertiary age, while the southern flank of Slate Mountain contains Mesozoic granites and pre-cretaceous granitic and metamorphic rocks. These form the Northern Wash boundary along Garlock Fault. Robbers Mountain is the most prominent feature of the Granite Mountains forming the Southern Wash Boundary which contain Mesozoic granitics grading westerly into Tertiary pyroclastics intruded partly by rhyolite, basalt, and andesite.

Mineral commodities produced or prospected for in the Wash include gold, silver, iron, uranium, mercury, semiprecious gemstones, building stones, and gravel. Production was minimal. No total gross value or production of metal values has been reported or documented. Literary search and limited field evaluation of reported claims supports the conclusion that no minerals found in the Wash are of sufficient grade or tonnage to sustain commercial production. Thirteen gold prospects, one iron, one uranium, one semiprecious gem, one cinnabar, one building stone and one gravel pit existed and were evaluated. Only the pea gravel in the Christmas Canyon area plus three geothermal potential sites showed any promise.

Research Colleague at NWC: C. Austin 1983

STUDY OF SURFACE ADSORBING PIEZOELECTRIC DETECTORS

Derald Chriss

Department of Chemistry
Southern University
Baton Rouge, Louisiana

ABSTRACT

The basis for this work was to determine whether piezoelectric quartz crystals (PZX) could be used as detectors for chemical warfare agents or other organic vapors which may be present on or around Navy ships at sea. Presently Navy ships use charcoal filters to clean the air, and presently there are no concrete means of determining if and when the charcoal should be replaced. The main goal of this project was to determine whether PZX's could be used on these vessels.

The PZX's used vibrate at a frequency of about 9 MHz when 9 volts are placed across the electrodes on its faces. Any weight placed or adsorbed on the faces, changes the resonance frequency, which in effect gives one a microbalance. It has been determined that 1 μg will cause a change of 400 Hz. The crystals and coatings used were tested for selectivity, reversibility (adsorption and desorption), and response time.

The project consisted of two main phases. The first phase involved the coatings used on the electrode surfaces. The coatings tested were: two copper oxide coatings, a number of carbon coatings and a number of silane coatings. This phase also consisted of finding or producing suitable adhesives. The second phase consisted of testing the coated crystals. Our main tool for testing and analyzing were the adsorption isotherms we obtained along with Fourier transform infrared spectroscopy, scanning electron microscopy, and combined Auger, secondary ion mass spectroscopy as complimentary methods. The vapors tested were decane, water, and diisopropylmethylphosphonate (nerve gas simulant). All were tested at various relative pressures, under dry air conditions and under a variety of relatively humid conditions. In addition testing was done using charcoal filters, which simulate conditions on board ships.

Research Colleague at NWC: C. Heller 1983

COMPUTER ASSISTED VOLCANIC HAZARD STUDIES, COSO RANGE, NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA

Bruce A. Blackerby

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Fresno, California

ABSTRACT

Using the energy cone model of Malin and Sheridan (1982) the capability was developed for computer modeling at N.W.C. of an especially hazardous type of volcanic activity--pyroclastic flow/surge resulting from collapse of an eruptive column. The specified eruption parameters of vent location, column height, energy cone slope and volume of erupted material can be independently varied.

The computer model will predict hazard zone limits, contour isopachs (equal thicknesses) of resulting deposits, contour theoretical maximum velocities for the flow/surge. The minimum time required for the flow/surge to travel its maximum distance can be calculated, giving possible reaction time to an eruption. The results can be graphically presented as contour maps, time lapse sequences, or a movie of the postulated eruption.

The May 18, 1980 eruption of Mt. St. Helens (M.S.H.) was used as a working example, using best-fit model parameters determined for M.S.H., by Malin and Sheridan. Some of the computer predicted results of this eruption, in the Devil's Kitchen area, Coso Range, are shown in Figs 1, 2, 3 (attached).

This computer model can be used not only for N.W.C. but, if a digitized topographic data base is available, wherever such potential volcanic hazards exist.

Most of the field work was completed which would allow characterizing a reasonable "worst case" eruption in the Coso Range, based on the geologic record. Chosen for study was an 3 m.y. old deposit referred to as the Coso Tuff (C.T.). It can already be seen that the C.T. eruption was larger than that of M.S.H. The C.T. event produced as pyroclastic flow/surge perhaps 2 to 3 times as much material, which travelled further (at least 29 Km) than would be predicted for M.S.H. (14.3 Km). When field work is completed it should be possible to recreate this "worst case" in the area where an eruption appears most likely (Devil's Kitchen), on present topography, to examine possible consequences.

Research Colleague at NWC: G. Roquemore

1983

XIII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL WEAPONS CENTER

China Lake, California

Program Coordinator at NWC: D. Wisdom

1983

STUDY OF FLUID FLOW PAST A COMPLIANT SURFACE

Murray Wachman

Department of Math
University of Connecticut
Storrs, Connecticut

ABSTRACT

The work accomplished this summer is in two parts: (1) Coordination with H. Rymer on completion of the filter plate problem. This computation will test a concept by which acoustic waves could be filtered with a disc constructed by rotating a wedge. A report has been issued on the numerical and mathematical analysis of this problem. Progress was made on these computations but they were not completed. (2) Much reading and preparatory work was done toward a computational scheme for fluid flow past a compliant surface. This problem is of importance because it will test the hypothesis as to whether self-noise can be reduced by a compliant rather than rigid surface. Work on this problem is to continue.

Research Colleague at NUSC: J. Kalinowski 1983

DERIVATION, CONSISTENCY, AND STABILITY OF AN IMPLICIT FINITE DIFFERENCE SCHEME

Donald F. St. Mary

Department of Mathematics
University of Massachusetts
Amherst, Massachusetts

ABSTRACT

Parabolic Equation (PE) approximations to the reduced wave equation (Helmholtz equation) are used extensively in the prediction of long-range sound propagation in ocean environments. In two dimensions parabolic approximating partial differential equations have been traditionally solved numerically via a Green's function approach (Fast Field Program) and a Fast Fourier Transform (split-step). Recently, Lie et al created an implicit finite difference program (IFD) to solve more general two-dimensional PE approximations (those which accommodate wider angles of propagation).

In this report we present a three-dimensional PE (encompassing small and wide angles), which is a third order partial differential equation, and derive an implicit finite difference scheme to solve it numerically. The numerical scheme is presented in several different ocean environments, a wedge shaped region with absorbent bottom and sides, the same region with hard bottom, and a full 360° propagating region with soft/hard bottom. Matrix formulations are carefully worked out in anticipation of the implementation. We derive the consistency of the scheme with the original partial differential equation and show that the scheme is second order accurate. Finally, we present a discussion of the stability properties which might be exhibited by the scheme.

Research Colleagues at NUSC: D. Kriegsmann, W. Seigmann and F. Tappert 1981

Table IX

NAVY RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1981 PROGRAM WITH FUNDING IN THOUSANDS OF DOLLARS

Participant	Academic Department	College/ University	Contract No.	Funding	Laboratory
Johnston, L.H.	Physics	U Idaho	N60530-82-W-G710	3	NWC
Kolata, P.R.	Elect Eng & Comp Sci	Drexel	N62269-82-C-0431	20	NADC
LeBlanc, L.R.	Ocean Eng	URI	N00140-82-M-UZ44	10	NUSC
MacIntyre, F.	Oceanography	URI	N00140-82-M-PJ78	8	NUSC
McLauchlon, R.A.	Mech Eng	Texas Tech	N66001-82-R-190GP	33	NUSC
Marchand, A.P.	Chemistry	U Okla	N00014-82-K-2019	25	NWC
Mikesell, R.P.	Mech Eng	S Dakota	N00014-82-K-2035	5	NRL
Shelton, W.W.	Elec Eng & Comp	Fl In Tech	N60921-82-M-1668	10	NSWC
Vietti, M.A.	Physics	U Maine	N00173-PR-43-2090	10	NRL

Total funding for 1981 program contract fallouts in thousands of dollars---------124

Table X

NAVY RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1982 PROGRAM WITH FUNDING IN THOUSANDS OF DOLLARS

Participant	Academic Department	College/ University	Contract No.	Funding	Laboratory
Bohren, C.F.	Meteorology	Penn State	N66001-83-C-0178	22	NOSC
Bredeson, J.G.	Elect Eng & Comp Sci	U Okla	N62269-83-M-3128	25	NPRDC
Davey, K.R.	Elect Eng	Georgia Inst Tech	N00612-83-G-0072	7	NCSC
Laudolt, R.G.	Chemistry	Texas Wes Col	N00014-83-K-0543	28	NRL
LeBlanc, L.R.	Ocean Eng	U Rhode Is	N00014-81-C-0062 N00014-82-K-0625	255 34	NUSC
Stiffler, A.K.	Mech Eng	Miss State	N61533-83-M-2799	16	NSRDC
Williams, W.	Physics	Lincoln U	N00014-82-G-0124 N00014-82-G-0125	43 22	NRL

Total funding for 1982 program contracts in thousands of dollars----------452

Table XI

NAVY RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1983 PROGRAM WITH FUNDING IN THOUSANDS OF DOLLARS

Participant	Academic Department	College/ University	Contract No.	Funding	Laboratory
Bohren, C.F.	Meteorology	Penn State	N66001-83-C-0178	20	NOSC
Davey, K.	Electrical Eng	Georgia Tech	N61331-83-Q-2501	7	NCSC
Fallon, D.J.	Civil Eng	Old Dominion	NR0647-28/05-2584	15	NSRDC
Johnston, L.H.	Physics	U Idaho	N60530-82-W-G710	3	NWC
Kriegsmann, G.A.	Eng Sci & App Math	Northwestern	N00014-83-C-0518	44	NUSC
Landolt, R.G.	Chemistry	Texas Wesleyan	N00173-83-R-07088	28	NRL
Larson, D.C.	Phys & Atmos Sci	Drexel U	N62269-84-M-3013	25	NADC
Lesiecki, M.	Chemistry	U Puerto Rico	N60921-83-M-E920 N60921-84-Q-4041	8 20	NSWC
Sanders, W.A.	Chemistry	Catholic U	N00014-84-C-2114	29	NRL

Total funding for 1983 program contracts in thousands of dollars----------199

Recalling the growth of the NSFRP program from 16 participants in 1979 to 111 participants in 1983 it may be noted from the data presented in Tables VII to XI and further summarized in Table XII below that over the first five years of the program 34 participants out of a total of 309, or slightly more than 10 percent, of the participants received Navy research contract support after leaving the program with the average level of such support to date amounting to about $30,000 dollars per contract winning participant.

Table XII

NUMBER OF NSFRP PARTICIPANTS RECEIVING NAVY RESEARCH CONTRACTS AFTER LEAVING THE PROGRAM AND NUMBER OF SUCH CONTRACTS WITH FUNDING IN THOUSANDS OF DOLLARS

Year of Participation	Participants	Contracts	Funding
1979	5	8	184
1980	4	4	106
1981	9	9	124
1982	7	9	452
1983	9	10	199
Totals	34	40	1065

Note that of the eleven contract winning participants listed for 1983 in Table XI, two were also winners in 1981 and 1982, and hence the total number of new winners in 1983 was only nine as listed here in Table XII.

Finally, in connection with the data tabulated in Tables VII through XII note that the Navy contract funding for participants from the 1983 program as tabulated is based on data available only during the first year after completion of the 1983 summer's program and the total number of contracts and the total contract funds resulting from research investigations started under the auspices of the 1983 program will probably grow substantially as time elapses and more opportunities develop for new starts at ONR and elsewhere in the Navy. Note also that several of the NSFRP participants have had repeated contracts and/or multiple contract awards from the Navy. Lastly, it should be also mentioned that in addition to the Navy contracts listed, several NSFRP participants have received research contract awards from the National Science Foundation and other federal agencies that support basic research.

XV. OUTLINE OF PLANS FOR THE FUTURE

XV. OUTLINE OF PLANS FOR THE FUTURE

Plans for 1984 and 1985

As we go to press with this report the 1984 NSFRP program has brought about 125 American faculty members to 12 participating Navy laboratories -- two new ones being included in the 1984 program -- with somewhat less than half of the participants in each case being supported by ONR and the balance again being supported by the Navy laboratories themselves. The new Navy laboratories included in 1984 are the Naval Aerospace Medical Research Laboratory at Pensacola, Florida and the Naval Ocean Research and Development Activity in Bay St. Louis, Mississippi.

For the 1984 program the participants are being paid stipends of 6500 dollars each which represents an eight and one-half or nine percent increase over the 1983 stipends of 6000 dollars per participant.

In 1985 it is currently planned to add still one more Navy laboratory to the program -- the Naval Submarine Medical Research Laboratory in Groton, Connecticut -- and it is anticipated that the overall program may grow to as many as 150 participants while the stipends paid each participant will remain the same as in 1984.

Plans for Continued Tracking of Research Fallouts

As already noted, future occurring "research fallouts" of Navy interest arising from later activities of former 1979, 1980, 1981, 1982, 1983 and 1984 NSFRP participants will continue to be tracked and will be reported in the 1984 and 1985 Annual Reports on a cumulative basis as herein and this procedure will be followed in all subsequent Annual Reports on NSFRP programs.

XVI. INDEX TO THE ABSTRACTS

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