LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

AD-A261 988

DTIC ACCESSION NUMBER

LEVEL

1

INVENTORY

AFOSR-TR-93-0110

DOCUMENT IDENTIFICATION

Dec 92

DISTRIBUTION STATEMENT A

Approved for public release

Distribution Unlimited

DISTRIBUTION STATEMENT

H A N D L E W I T H C A R E

ACCESSION FOR

NTIS GRA&I ☑

DTIC TRAC ☐

UNANNOUNCED ☐

JUSTIFICATION

BY

DISTRIBUTION/

AVAILABILITY CODES

DISTRIBUTION	AVAILABILITY AND/OR SPECIAL	
A-1		

DISTRIBUTION STAMP

DTIC ELECTE MAR 10 1993 S C D

DATE ACCESSIONED

DTIC Q...

DATE RETURNED

~~93 3 4 078~~

93 3 8 163

DATE RECEIVED IN DTIC

93-04706

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

DTIC FORM JUN 90 70A

DOCUMENT PROCESSING SHEET

PREVIOUS EDITIONS MAY BE USED UNTIL STOCK IS EXHAUSTED

LOAN DOCUMENT

UNITED STATES AIR FORCE

SUMMER RESEARCH PROGRAM

1992

VOLUME 1

PROGRAM MANAGEMENT REPORT

RESEARCH & DEVELOPMENT LABORATORIES

5800 UPLANDER WAY

CULVER CITY, CA 90230-6608

SUBMITTED TO:

LT. COL. CLAUDE CAVENDER
PROGRAM MANAGER

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

BOLLING AIR FORCE BASE

WASHINGTON, D.C.

DECEMBER 1992

REPORT DOCUMENTATION PAGE

AGENCY USE ONLY (Leave blank)	REPORT DATE	REPORT TYPE AND DATES COVERED
	28 Dec 92	Annual 1 Sep 91 - 31 Aug 92

TITLE AND SUBTITLE

UL

1992 Summer Faculty Research Program (SFRP)
Volumes 1 - 16

F49620-90-C-0076

Mr Gary Moore

PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Research & Development Laboratoreis (RDL)
5800 Uplander Way
Culver City CA 90230-6600

SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

AFOSR/NI
110 Duncan Ave., Suite B115
Bldg 410
Bolling AFB DC 20332-0001
Lt Col Claude Cavender

SUPPLEMENTARY NOTES

DISTRIBUTION/AVAILABILITY STATEMENT

UNLIMITED

ABSTRACT (Maximum 200 words)

The purpose of this program is to develop the basis for cintinuing research of interest to the Air Force at the institution of the faculty member; to stiumlate continuing relations among faculty members and professional peers in the Air Force to enhance the research interests and capabilities of scientific and engineering educators; and to provide follow-on funding for research of particular promise that was started at an Air Force laboratory under the Summer Faculty Research Program.

During the summer of 1992 185 university faculty conducted research at Air Force laboratories for a period of 10 weeks. Each participant provided a report of their research, and these reports are consolidated into this annual report.

SUBJECT TERMS

SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

NSN 7540-01-280-5500

UNITED STATES AIR FORCE

SUMMER RESEARCH PROGRAM

1992

VOLUME 1

PROGRAM MANAGEMENT REPORT

RESEARCH & DEVELOPMENT LABORATORIES

5800 Uplander Way

Culver City, CA 90230-6608

Program Director, RDL
Gary Moore

Program Manager, AFOSR
Lt. Col. Claude Cavender

Program Manager, RDL
Billy Kelley

Program Administrator, RDL
Gwendolyn Smith

Submitted to:

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

Bolling Air Force Base

Washington, D.C.

December 1992

TABLE OF CONTENTS

1992 SUMMER RESEARCH PROGRAM FINAL REPORT

1. INTRODUCTION

The Summer Research Program (SRP) is managed by the Air Force Office of Scientific Research (AFOSR), Bolling AFB, Washington D.C. The SRP provides 8 to 12 continuous weeks of opportunity during the summer period (1 April through 30 September) for SRP associates to participate in professional and academic research and development at United States Air Force Laboratories. Faculty participants can be united states citizens or permanent residents; graduate students must be united states citizens.

Initiated in 1979, the SRP was designed to attract college faculty members to United States Air Force laboratories for the purpose of conducting research during the summer months. In 1982 the program was expanded to include graduate students and in 1986 to include high school students. A fourth element of the SRP traces back to the research "Minigrant Program" which began in 1979 and was renamed the "Research Initiation Program" (RIP) in 1983. The RIP is designed to allow continued research at the home institutions of distinguished faculty and exceptional graduate associates after the completion of the annual SRP. A separate annual report is compiled on the RIP.

The objectives of the Summer Research Program are:

a. Summer Faculty Research Program (SFRP): (1) to develop the basis for continuing research of interest to the United States Air Force at the faculty member's institution, (2) to stimulate continuing relations between faculty members and their professional peers in the United States Air Force, and (3) to enhance the research interests and capabilities of scientific engineering and educators in scientific areas of interest to the United States Air Force.

b. Graduate Student Research Program (GSRP): (1) to provide a productive means for a graduate student to participate in research under the direction of a faculty member or laboratory researcher at a United States Air Force laboratory or center, (2) to stimulate continuing professional association among graduate students, their supervising professors, and professional peers in the United States Air Force, (3) to further the research objectives of the United States Air Force; and (4) to expose graduate students to potential thesis topics in areas of interest to the United States Air Force.

c. High School Apprenticeship Program (HSAP): (1) to stimulate among high school students broader involvement in science and engineering careers of interest to the United States Air Force, (2) to establish individual working relationships between students and active researchers, and (3) to strengthen the nation's efforts to recruit and sustain careers in science and engineering.

To achieve the stated objectives, Research & Development Laboratories (RDL) supports AFOSR in the recruitment process, coordination with laboratories of the selection process, in the administration of participants, and in the publication of an annual report on the SRP. Calendar year 1992 was the second year in which RDL administered the SFRP, GSRP and HSAP and the first year of RDL administration of the RIP.

2. RECRUITING

A 40-page brochure was used to explain the Summer Research Program to potential faculty members and graduate students. Copies were mailed to science and engineering departments and to research grant offices at accredited four-year colleges, universities and technical institutes. It was requested that recipients distribute the brochure among all faculty members and graduate students, thus informing them of the program and of the arrival of the brochure. Copies of the brochures were further provided to AFOSR and participating United States Air Force laboratories. Finally, brochures were mailed to individual applicants who called or wrote requesting copies.

The recruitment of potential applicants at Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) was conducted through mailings of brochures as well as through visits to the following 10 HBCUs and meetings with HBCU administrators, faculty members, and graduate students:

Bowie State University	Bowie, MD
Coppin State College	Baltimore, MD
Fayetteville State University	Fayetteville, NC
Howard University	Washington, D.C.
Morgan State University	Baltimore, MD
North Carolina A&T University	Greensboro, NC
North Carolina Central University	Durham, NC
University of Maryland Eastern Shore	Princess Anne, MD
University of the District of Columbia	Washington, D.C.
Winston-Salem State University	Winston-Salem, NC

Advertisements for the SRP were published in four professional journals: Black Issues in Higher Education, Chemical & Engineering News, IEEE Spectrum, and Physics Today.

Brochures describing the HSAP were mailed to approximately 180 high schools principals' and guidance counselors' offices within commuting distances of participating United States Air Force laboratories. AFOSR and participating United States Air Force laboratories were also provided brochures. Independent of RDL, Wright Laboratory's Armament Directorate at Eglin Air Force Base, Florida conducts its own high school recruitment and selection programs using RDL-provided HSAP brochures. High school students selected to serve at the Armament Directorate serve eleven weeks as opposed to the eight weeks normally worked by high school students at all other locations.

3. SELECTION

For the 1992 Summer Research Program, AFOSR opened up eligibility to faculty members who were permanent residents. Previously, all SRP participants were required to be United States citizens. In 1992, 193 permanent-resident faculty members applied, and 25 of those (13%) were selected.

Total faculty member applications increased from 505 in 1991 to 719 for the 1992 program. Graduate student applications increased from 251 last year to 286 in 1992. In 1991, 632 high school students applied, while 643 applied in 1992. The 1992 SRP saw continued growth in the number of faculty members and high school students selected. Fewer graduate students were selected in 1992 (121) than in 1991 (142) despite 1992's higher level of applicants. The laboratories funded fewer graduate students with laboratory funds in 1992, probably reflecting the budget situation with cuts in the defense budget. The total number of SRP selectees in all three categories; however, continues to rise, as revealed in Table 1.

Table 1: SRP Selection History

YEAR	SFRP	GSRP	HSAP	TOTAL
1979	70	---	---	70
1980	87	---	---	87
1981	87	---	---	87
1982	91	17	---	108
1983	101	53	---	154
1984	152	84	---	236
1985	154	92	---	246
1986	158	100	42	300
1987	159	101	73	333
1988	153	107	101	361
1989	168	102	103	373
1990	165	121	132	418
1991	170	142	132	444
1992	185	121	159	464

AFOSR originally allocated 150 basic faculty member, 100 graduate student, and 125 high school slots among the laboratories as shown in Table 2.

Table 2: AFOSR Allocation of Slots

USAF LABORATORIES	SFRP	GSRP	HSAP
AEDC	4	4	10
AFCEL	7	1	9
ARMSTRONG	35	25	24
FRANK J. SEILER	6	4	--
PHILLIPS	30	21	24
ROME	22	14	14
WILFORD HALL	1	2	--
WRIGHT	45	29	44
TOTAL	150	100	125

Note: Arnold Engineering Development Center (AEDC)
Air Force Civil Engineering Laboratory (AFCEL)
Wilford Hall USAF Medical Center

4. HISTORICALLY BLACK COLLEGES & UNIVERSITIES / MINORITY INSTITUTIONS (HBCU/MIs)

Seventy-two Historically Black Colleges & Universities (HBCU) and Minority Institution (MI) faculty members applied to the SRP in 1992 and thirteen were selected. Nine 1992 SRP HBCU/MI graduate students applied and five were selected. Table 3 depicts the number of HBCU/MI selectees at each laboratory by category.

Table 3: Total HBCU/MI Participants

USAF LABORATORIES	1992 SFRP	1992 GSRP
AEDC	1	--
AFCEL	--	1
ARMSTRONG	5	2
FRANK J. SEILER	--	--
PHILLIPS	3	2
ROME	2	--
WILFORD HALL	--	--
WRIGHT	2	--
TOTAL	13	5

5. 1992 SRP FUNDING SOURCES

Funding sources for the 1992 SRP were: the AFOSR - provided slots for the basic contract; laboratory funds; AFOSR funds remaining from the previous year; special funds made available to the AFOSR program office to use for candidates from HBCUs and MIs; and -- in the case of high school students working on environmental research -- funding made available from the Air Force Office of Scientific Research. Funding sources by category for the 1992 SRP selected participants are shown in Table 4.

Table 4: 1992 SRP Funding Categories

1992 SUMMER RESEARCH PROGRAM FUNDING CATEGORY	1992 SFRP	1992 GSRP	1992 HSAP
BASIC ALLOCATION BY AFOSR	150	100	125
USAF LABORATORIES	16	13	7
SLOTS ADDED BY AFOSR (LEFTOVER FUNDS)	6	3	16
HBCU/MI BY AFOSR (SPECIAL FUNDS)	13	5	---
AFOSR ADDITIONAL HSAP - ENVIRONMENTAL	---	---	11
TOTAL	185	121	159

Note: Twenty-eight faculty member selectees and nine graduate student selectees declined, including four HBCU/MI selectees.

6. RESEARCH ADMINISTRATION

In 1992, for the first time, selected faculty associates and graduate students of the 1992 SRP were allowed to specify a variable number of work weeks to be spent at the laboratories. In past years, all tours were 10 weeks. In 1992, SRP continuous work weeks were between 8 and 12 weeks. The average tour length selected by faculty members was 10.6 weeks; graduate students' average period was 11 weeks. Four faculty members and two graduate students extended their tours (from 10 to 12 weeks) after they had completed over half their original tour. Several other associates and students requested extensions; however, lack of funding availability precluded approval of their extension requests.

RDL provided each 1992 SRP selectee with an eight-page procedural brochure explaining the administration of the program and a four-page instruction pamphlet for preparation and submission of the required final report.

Faculty members and graduate students were administered as "consultant employees" of RDL during their research tours. Thus, RDL did not provide tax withholding, insurance, unemployment compensation withholding, etc., for associates and students. However, high school selectees were administered as RDL's employees, and the extra payroll costs resulted in slightly higher costs for high school selectees in 1992 versus 1991.

Faculty member selectees were encouraged to make a pre-research-tour orientation visit to their chosen United States Air Force laboratory. The costs of that visit were reimbursed. In 1992, 102 SFRPs exercised this privilege.

All faculty associate and graduate student researchers who lived more than 50 miles from their laboratories were reimbursed for expenses (i.e., for their to/from trip, privately owned automobile mileage at ($0.25) per mile). A rental-car's cost is not an authorized reimbursable expense during the research tour.

Financial compensation for associates at the laboratory consisted of a weekly stipend and (for associates serving more than 50 miles from their homes) a daily expense allowance. The 1992 rates (four percent higher than in 1991) were:

Faculty Stipend:	$718/week
Faculty Expense:	$49/day
Graduate students with master's stipend:	$442/week
Graduate students with bachelor's stipend:	$380/week
Graduate student expense:	$36/day

High school students were paid $5/hour for first-time participants ($5.40 for first-time participants at Wright Laboratory's Armament Directorate) and $6/hour for students in their second or subsequent SRP tour.

Associates submitted biweekly vouchers countersigned by their laboratory research monitor, and RDL issued checks so as to arrive in associates' hands two weeks later.

Each associate was required to submit an end-of-tour report (maximum of 20 pages) describing the research accomplished during their tours. (Graduate students working jointly with a faculty member associate were required to submit only a copy of the abstract of the joint paper.) The abstracts from each report are grouped alphabetically by laboratory in appendices to the Management Volume. The reports themselves are contained in other volumes as shown here:

LABORATORY	VOLUME
AEDC	6, 11
AFCEL	6, 11
Armstrong	2, 7
Frank J. Seiler	6, 11
Phillips	3, 8
Rome	4, 9
Wilford Hall	6, 11
Wright	5, 10

7. PROGRAM STATISTICS

The following is a summary of the data found in Appendices A through G.

a. Academic Levels of SFRP Associates

The SFRP associates were at the standard levels of Assistant Professor (69), Associate Professor (61), Chairman (1), Professor (45), Research Associate (3), Research Engineer (2), Research Professor (2), and Research Scientist (2).

b. Total SRP Applications

A total of 1,642 applications (529 SFRP, 165 GSRP and 483 HSAP) were received during the 1992 Summer Research Program. There were 1,131 non-selectees, 46 declining selectees and 185 selectees.

c. Degrees Held by SFRP and GSRP Associates

SFRP associates consisted of 179 PhDs; 6 had masters degrees. GSRP associates consisted of 9 BAs, 60 BSs, 5 MAs, 1 MD, 45 MSs, and 1 PhD.

d. Colleges/Universities of Associates

SFRP and GSRP selected associates came from 105 different universities or colleges.

e. List of States Represented

Applications were received from all 50 states plus Washington, DC; Puerto Rico, and Ontario, Canada. SFRP associates represented 44 states including Puerto Rico. GSRP associates represented 29 states including Puerto Rico.

f. 1992 SRP Evaluations

A total of 101 GSRP, 148 SFRP, 147 HSAP and 39 U.S. Air Force laboratory focal points evaluations were received for statistical processing. The summary statistics of the 1992 SRP data is grouped using the graph method relative to the evaluation's questions. The rating scales of the evaluation are represented by NR (No Responses) and 1 (lowest) through 5 (highest). The majority of the participating responders rated the overall assessment of the SRP with a 5 rating. In addition, responders collectively described the strong points of the program as:

a. Opportunity for research collaboration and exchange of ideas exchange with government researchers and collegiate faculty members.

b. Enhancement of research skills

c. Excellent opportunity to know AFOSR/nation's interests.

d. Opportunity for follow-on research proposals.

Each selected 1992 SRP research associate and his or her Air Force laboratory focal point was required to submit an end-of-tour questionnaire. The results of those questionnaires are contained in Appendices A through C.

Appendices D through G contains the names and limited other data on associates, and Appendices H through J contain the final report abstracts.

8. AIR FORCE LABORATORIES ABBREVIATIONS

Abbreviation	Laboratories/Center/Division
AAMRL	Armstrong Aerospace Medical Research laboratory
AEDC	Arnold Engineering Development Center
ASTRO	Astronautic Laboratory
ATL	Armament Laboratory
AVION	Avionics Laboratory
ESC	Engineering and Services Center
ETL	Electronic Technology Laboratory

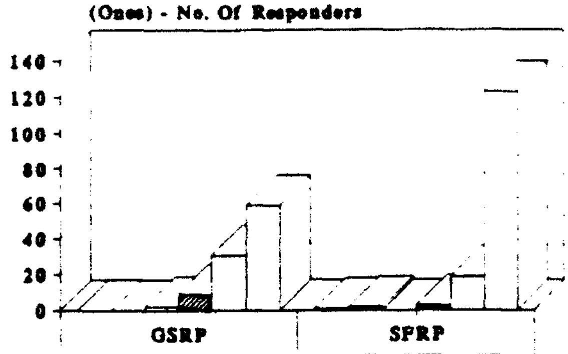
FDL	Flight Dynamics Laboratory
FJSRL	Frank J. Seiler Research Laboratory
GEO	Geophysics Laboratory
LHFD	Human Resources Laboratory: Logistics & Human Factors Division
MAT	Materials Laboratory
MPD	Human Resources Laboratories: Manpower and Personnel Division
OEHL	Occupational and Environmental Health Laboratory
OTD	Human Resources Laboratories: Operations Training Division
PROP	Aero Propulsion and Power Laboratory
RADC	Rome Air Development Center (at Griffiss AFB)
RADCH	Rome Air Development Center (at Hanscom AFB)
SAM	School of Aerospace Medicine
TSD	Human Resources Laboratory: Training System Division
WHMC	Wilford Hall USAF Medical Center
WL	Weapons Laboratory

APPENDIX A:

RESULTS OF SFRP AND GSRP

PARTICIPANT QUESTIONNAIRES

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

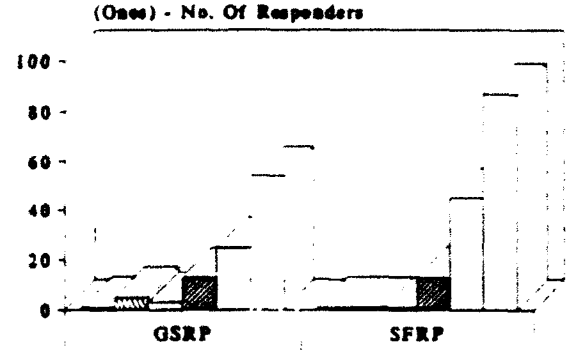


	GSRP	SFRP
NR	0	1
1	0	2
2	2	0
3	9	3
4	31	19
5	59	123

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

1. Match of lab research to your field of interest.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

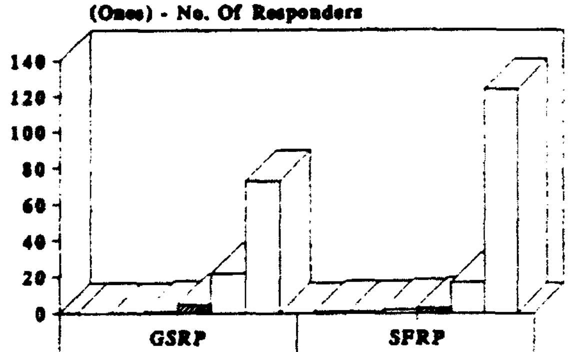


	GSRP	SFRP
NR	1	1
1	5	1
2	3	1
3	13	13
4	25	45
5	54	87

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

2. Your influence on selection of topic.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

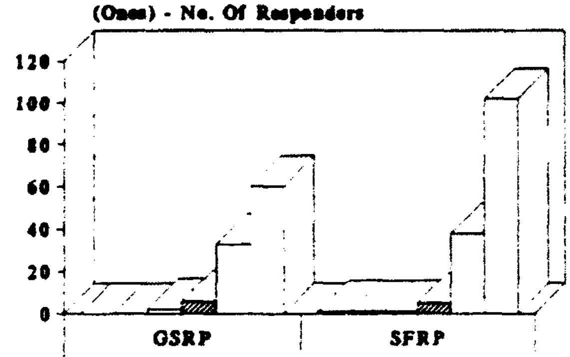


	GSRP	SFRP
NR	0	1
1	0	1
2	1	2
3	5	3
4	22	17
5	73	124

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

3. Working relationship with focal point.
(NR - No Response)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

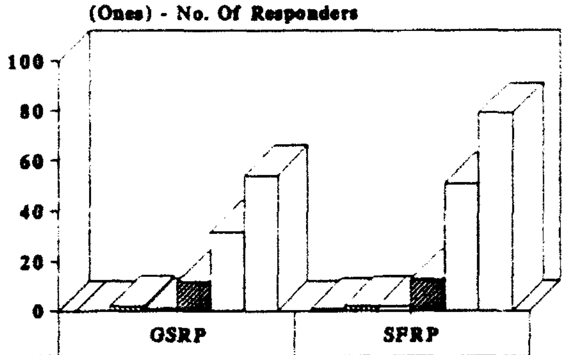


	GSRP	SFRP
NR	0	1
1	0	1
2	2	1
3	6	5
4	33	38
5	60	102

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

4. Technically challenging work.
(NR - No Response)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

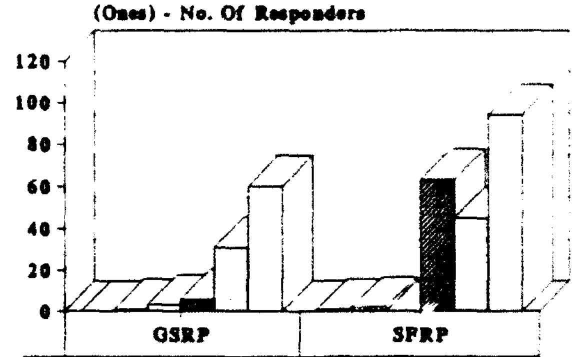


	GSRP	SFRP
NR	0	1
1	2	2
2	1	2
3	12	13
4	32	51
5	54	79

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

5. Enhancement of your academic qualifications.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

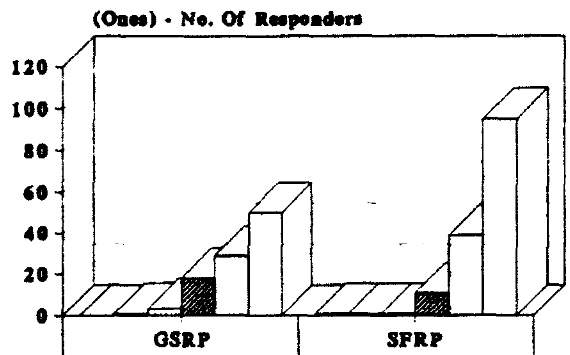


	GSRP	SFRP
NR	0	1
1	1	2
2	3	0
3	6	63
4	31	45
5	60	94

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

6. Enhancement of your research qualifications.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

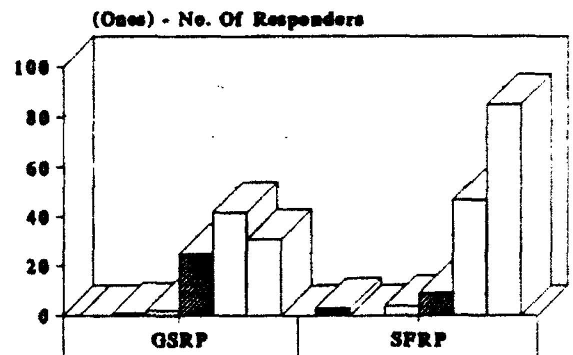


	GSRP	SFRP
NR	0	1
1	1	1
2	3	1
3	18	11
4	29	39
5	50	95

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

7. Stimulating professional associations.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

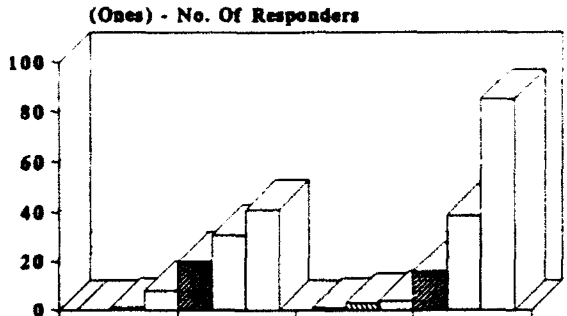


	GSRP	SFRP
NR	0	3
1	1	0
2	2	4
3	25	9
4	42	47
5	31	85

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

8. Contribution to USAF/national interests.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

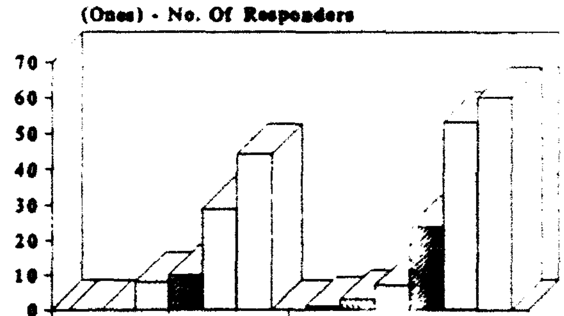


	GSRP	SFRP
NR	0	1
1	1	3
2	8	4
3	20	16
4	31	39
5	41	85

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

9. Lab readiness for you: focal point, task.

1992 AFOSR SUMMER RESE.RC. PROGRAM
GSRP & SFRP EVALUA.I..S

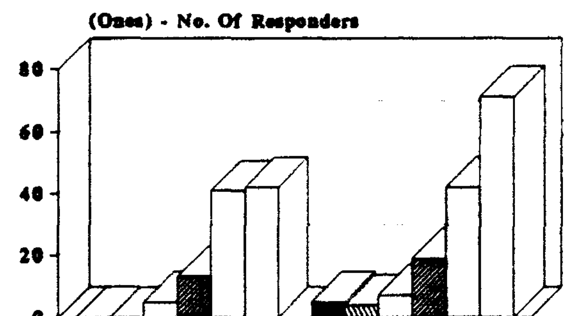


	GSRP	SFRP
NR	0	1
1	0	3
2	8	7
3	10	24
4	29	53
5	44	60

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

10. Lab readiness for you: equip, supplies.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

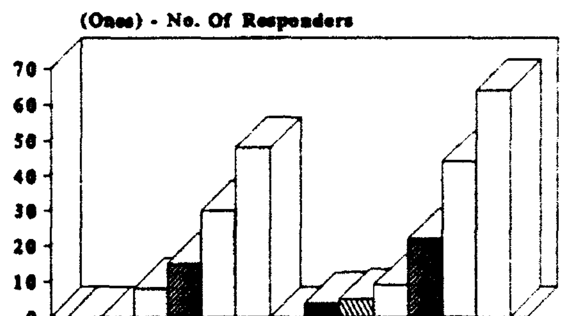


	GSRP	SFRP
NR	0	5
1	0	4
2	5	7
3	13	19
4	41	42
5	42	71

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

11. Lab computing equipment: technical capabilities.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS



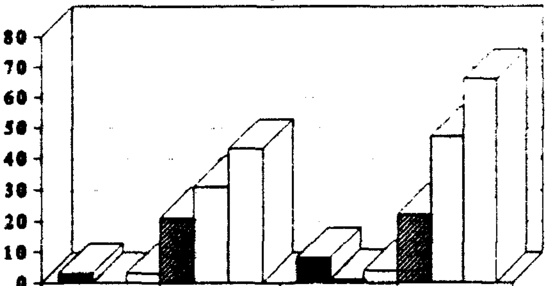
	GSRP	SFRP
NR	0	4
1	0	5
2	8	9
3	15	22
4	30	44
5	48	64

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

12. Lab computing equipment: *availability*.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



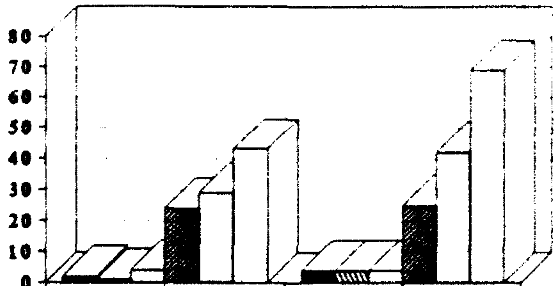
	GSRP	SFRP
NR	3	8
1	0	1
2	3	4
3	21	22
4	31	47
5	43	66

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

13. Other lab equipment: capabilities/availability.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



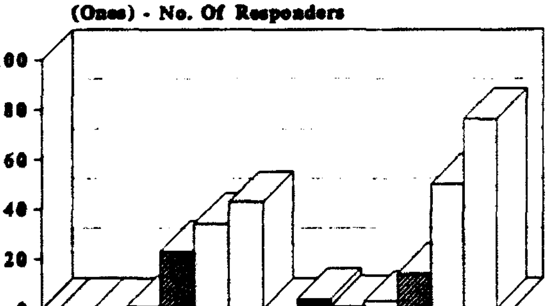
	GSRP	SFRP
NR	2	4
1	1	4
2	4	4
3	24	25
4	29	42
5	43	69

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

14. Lab library services.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



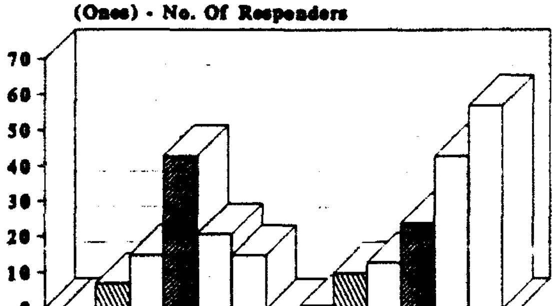
	GSRP	SFRP
NR	0	4
1	0	1
2	1	3
3	23	14
4	34	50
5	43	76

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

15. Lab research and administrative support.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders

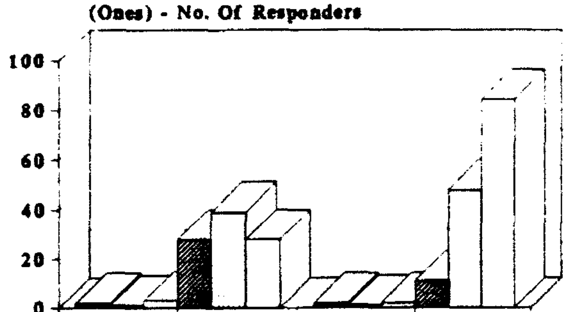


	GSRP	SFRP
NR	0	1
1	7	10
2	15	13
3	43	24
4	21	43
5	15	57

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

16. Opportunities to meet other SRP associates.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

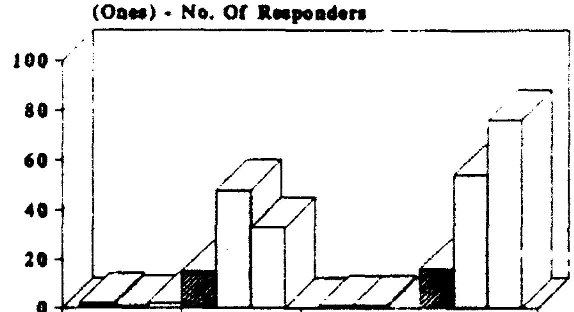


	GSRP	SFRP
NR	2	2
1	1	1
2	3	2
3	28	11
4	39	48
5	28	84

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

17. Adequacy of RDL's advertising/recruiting brochure.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

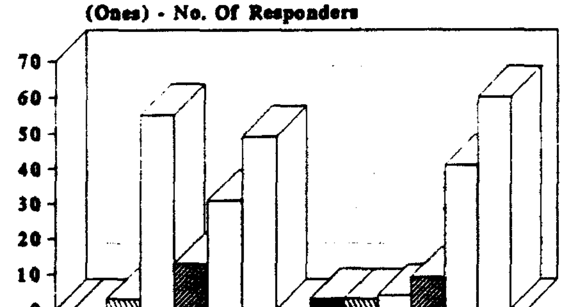


	GSRP	SFRP
NR	2	1
1	1	1
2	2	0
3	15	16
4	48	54
5	33	76

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

18. Adequacy of RDL's procedural & admin brochures.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

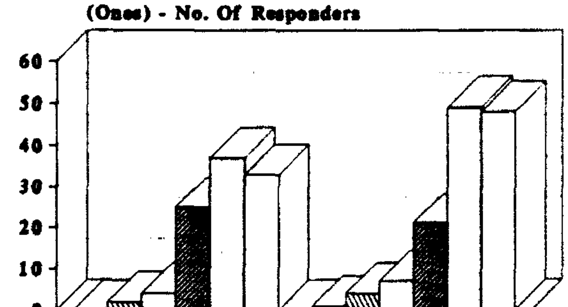


	GSRP	SFRP
NR	0	3
1	3	3
2	55	4
3	13	9
4	31	41
5	49	60

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

19. Responsiveness of RDL's communications.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS



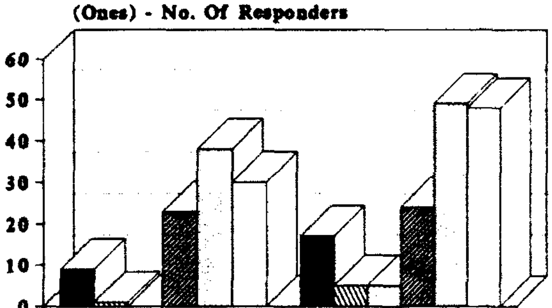
	GSRP	SFRP
NR	0	1
1	2	4
2	4	7
3	25	21
4	37	49
5	33	48

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

20. Overall payment procedures.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



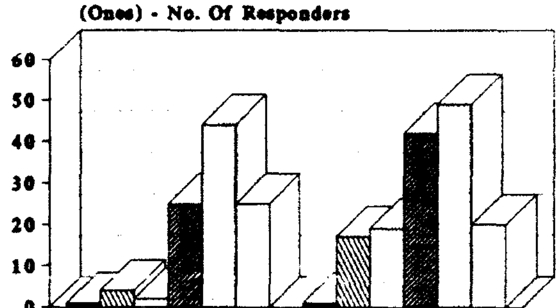
	GSRP	SFRP
NR	9	17
1	1	5
2	0	5
3	23	24
4	38	49
5	30	48

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

21. Amount of travel reimbursement.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



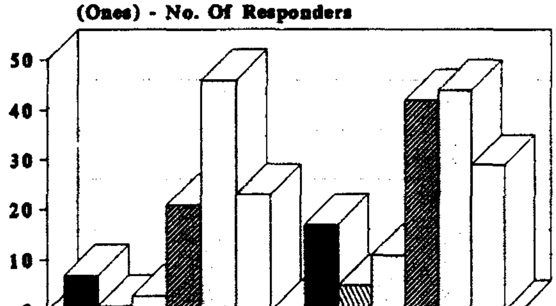
	GSRP	SFRP
NR	1	1
1	4	17
2	2	19
3	25	42
4	44	49
5	25	20

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

22. Amount of regular pay.

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders



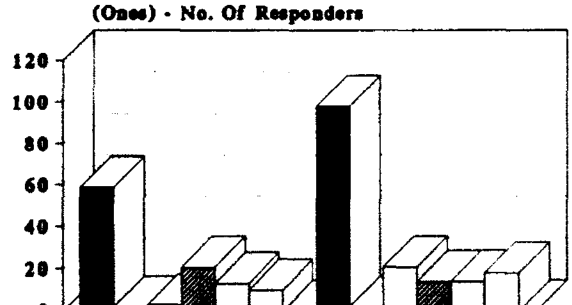
	GSRP	SFRP
NR	7	17
1	1	5
2	3	11
3	21	42
4	46	44
5	23	29

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

23. Amount of daily expense allowance.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

(Ones) - No. Of Responders

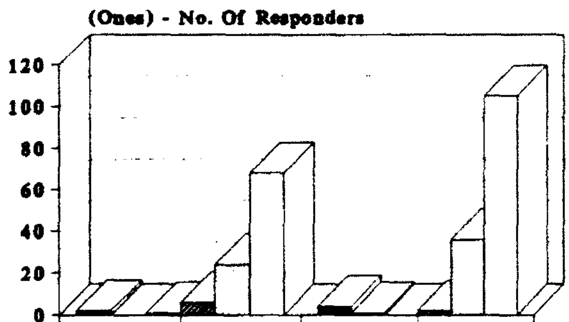


	GSRP	SFRP
NR	59	98
1	2	2
2	3	21
3	21	14
4	13	14
5	10	18

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

24. Security clearance procedures.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

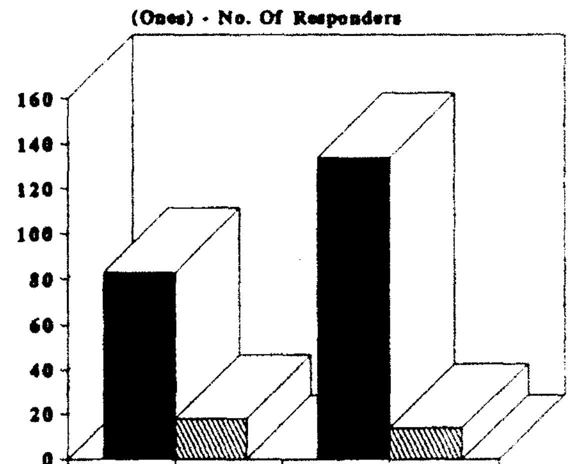


	GSRP	SFRP
NR	2	4
1	0	1
2	1	0
3	6	2
4	24	36
5	68	105

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

25. Overall assessment of SRP value to you.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

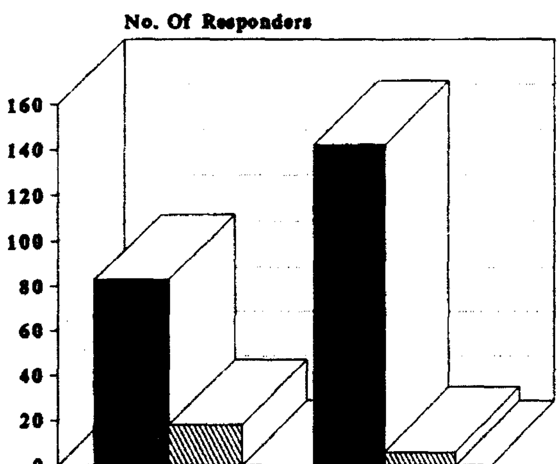


	GSRP	SFRP
YES	83	134
NO	18	14

YES NO

26. Would you apply again next year?

1992 AFOSR SUMMER RESEARCH PROGRAM
GSRP & SFRP EVALUATIONS

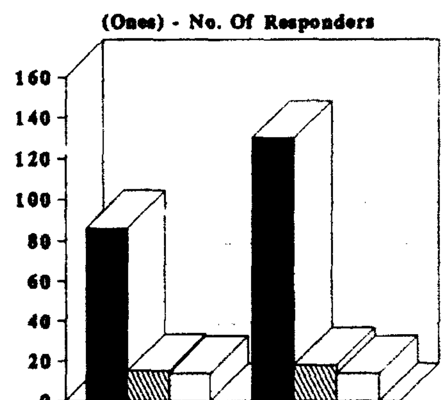


	GSRP	SFRP
YES	83	142
NO	18	6

YES NO

27. Will you continue this or related research?

1992 AFOSR SUMMER RESEARCH PROGR
GSRP & SFRP EVALUATIONS



	GSRP	SFRP
YES	86	130
NO	15	18
Desired # Weeks	14	14

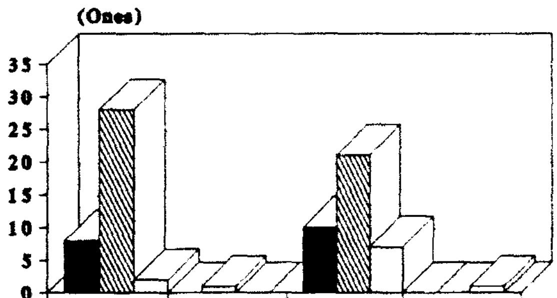
YES NO
Desired # Weeks

29. Was length satisfactory? If no, desired length?

APPENDIX B:

RESULTS OF LABORATORY FOCAL POINT QUESTIONNAIRES

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



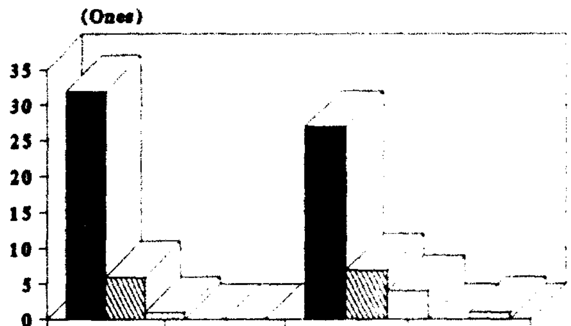
	ALLOCATED 1992SFRP	PREFERRED 1993SFRP
NR	8	10
1	28	21
2	2	7
3	0	0
4	1	0
8	0	1

(SFRP W/FOCAL POINT)

No. SFRP
NR 1 2 3 4 8

1a. Number of associates working directly with Focal Point.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



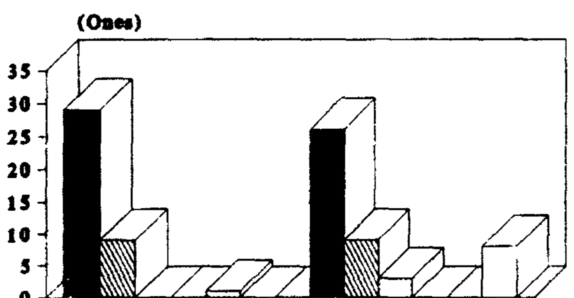
	ALLOCATED 1992SFRP	PREFERRED 1993SFRP
0	32	27
1	6	7
2	1	4
3	0	0
4	0	1

(GSRP W/SUMMER FACULTY)

No. GSRP W/SFRP
0 1 2 3 4

1b. Number of associates working directly with Focal Point.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



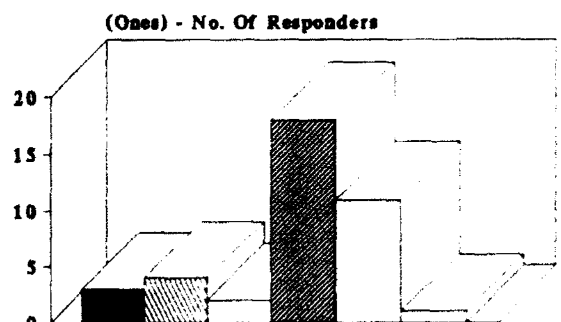
	ALLOCATED 1992SFRP	PREFERRED 1993SFRP
0	29	26
1	9	9
2	0	3
3	0	0
4	1	0
8	0	8

(GSRP W/FOCAL POINTS)

No. GSRP W/FOCAL PT.
0 1 2 3 4 8

1c. Number of associates working directly with Focal Point.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



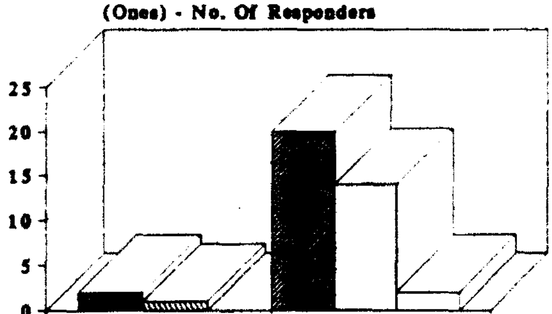
	LAB FOCAL POINT
NR	3
1	4
2	2
3	18
4	11
5	1

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

2. Time avaliable to evaluate applications.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



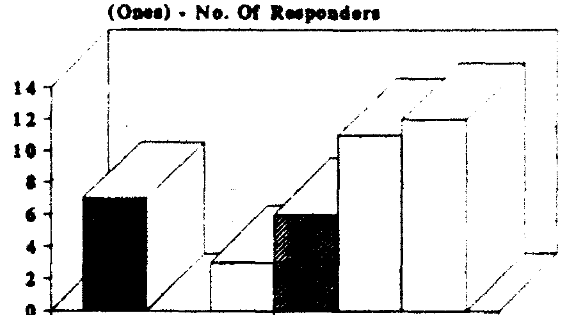
	LAB FOCAL POINT
NR	2
1	1
2	0
3	20
4	14
5	2

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

3. Adequacy of applications for selection purposes.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



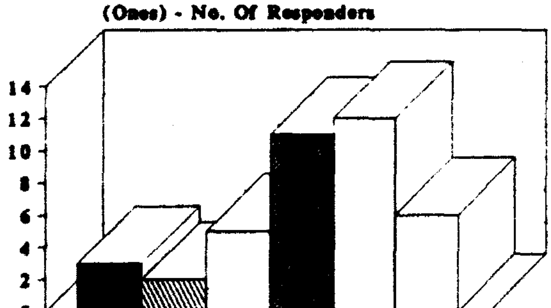
	LAB FOCAL POINT
NR	7
1	0
2	3
3	6
4	11
5	12

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

4. Value of SFRP orientation trips.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



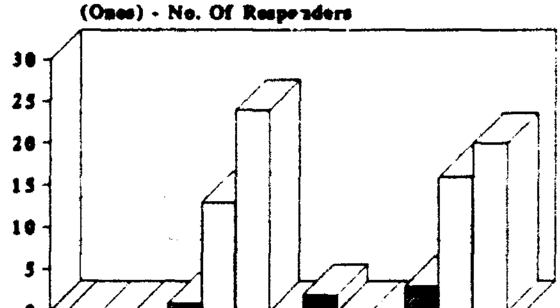
	LAB FOCAL POINT
NR	3
1	2
2	5
3	11
4	12
5	6

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

5. Length of research tour (8-12 weeks).

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders

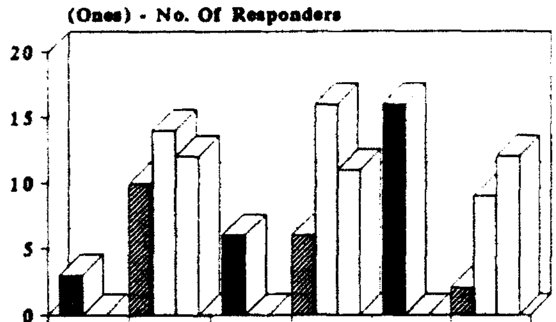


	LABORATORY	A.F/GOV'T
NR	0	2
1	0	0
2	0	0
3	1	3
4	13	16
5	24	20

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

6. Benefits of associates' work at Lab & Gov't.
(NR - No Responders)

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

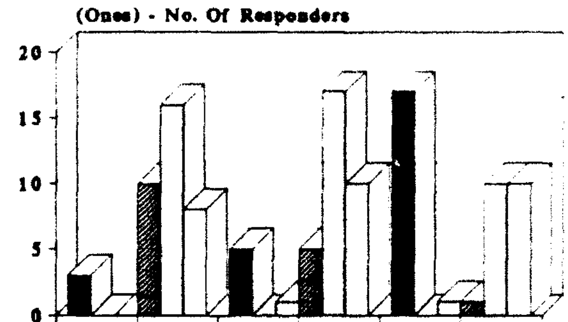


	Lab & Staff	SFRP	GSRP
NR	3	6	16
1	0	0	0
2	0	0	0
3	10	6	2
4	14	16	9
5	12	11	12

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

7. Enhancement of research qualifications for:

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

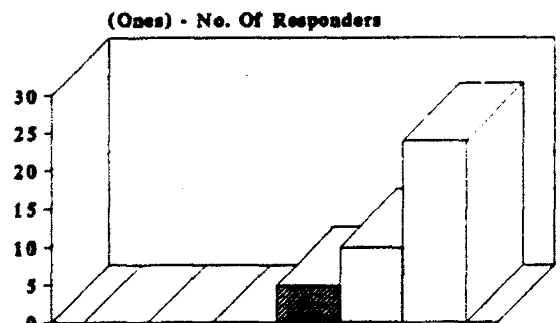


	Lab & Staff	SFRP	GSRP
NR	3	5	17
1	0	0	0
2	0	1	1
3	10	5	1
4	16	17	10
5	8	10	10

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

8. Enhancement of subject matter knowledge for:

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

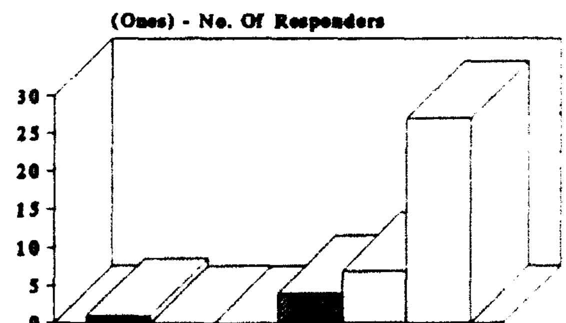


	LAB FOCAL POINTS
NR	0
1	0
2	0
3	5
4	10
5	24

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

9. Value of AF/University scientific links.
(NR - No Responders)

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



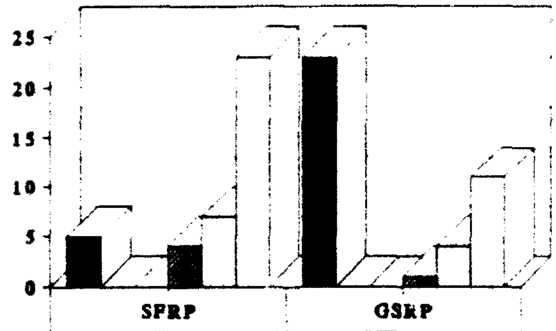
	LAB FOCAL POINTS
NR	1
1	0
2	0
3	4
4	7
5	27

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

10. Potential of future collaboration.
(NR - No. Of Responders)

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



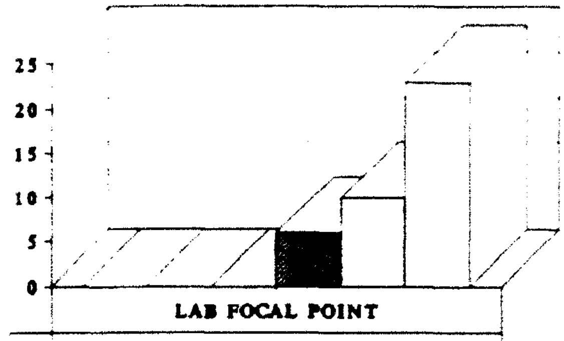
	SFRP	GSRP
NR	5	23
1	0	0
2	0	0
3	4	1
4	7	4
5	23	11

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

11. Your working relationship with SFRP & GSRP.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



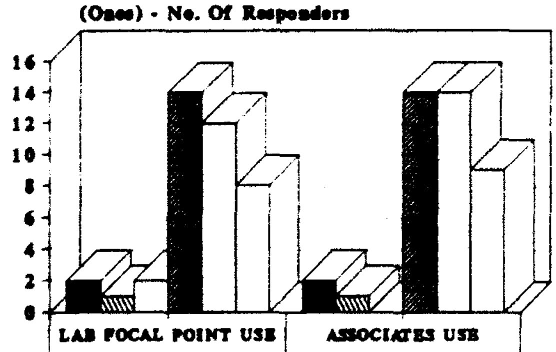
	LAB FOCAL POINT
NR	0
1	0
2	0
3	6
4	10
5	23

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

12. Expenditure of your time a worthwhile investment.

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders



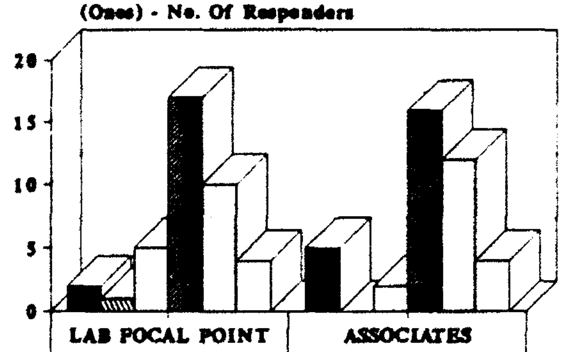
	LAB FOCAL POINT USE	ASSOCIATES USE
NR	2	2
1	1	1
2	2	0
3	14	14
4	12	14
5	8	9

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

13. Quality of program literature for:

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS

(Ones) - No. Of Responders

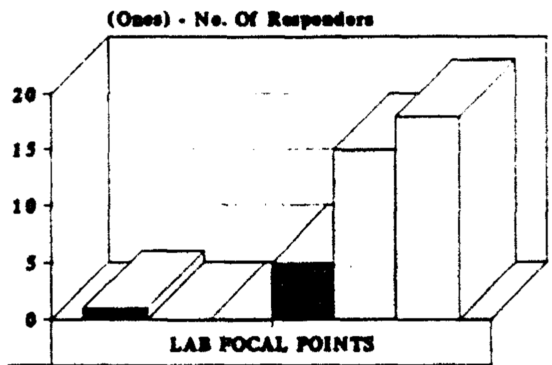


	LAB FOCAL POINT	ASSOCIATES
NR	2	5
1	1	0
2	5	2
3	17	16
4	10	12
5	4	4

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

14. Quality of RDL communication with:

1992 AFOSR SUMMER RESEARCH PROGRAM
LAB FOCAL POINT EVALUATIONS



NR	1
1	0
2	0
3	5
4	15
5	18

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

15. Overall assessment of Summer Research Program.
(NR - No Responders)

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

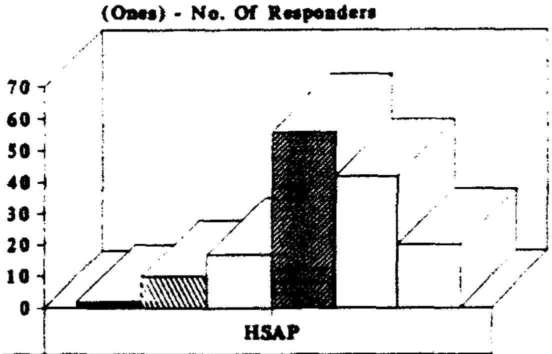
APPENDIX C:

RESULTS OF HIGH SCHOOL APPRENTICESHIP PROGRAM

PARTICIPANT QUESTIONNAIRES

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



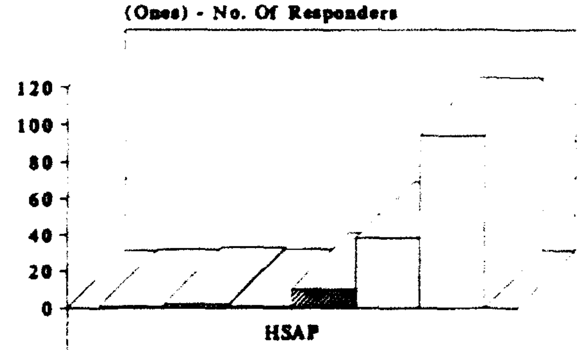
	HSAP
NR	2
1	10
2	17
3	56
4	42
5	20

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

1. Your influence on selection of topic/type of work.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



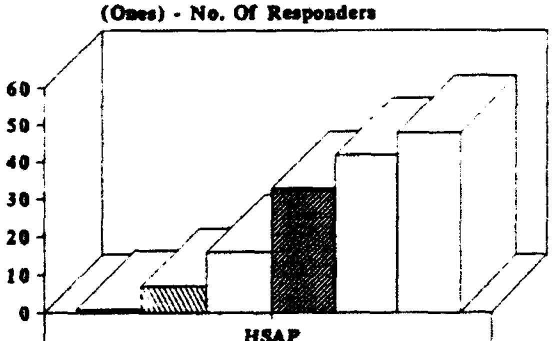
	HSAP
NR	1
1	2
2	1
3	10
4	38
5	94

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

2. Working relationship with mentor/lab scientists.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



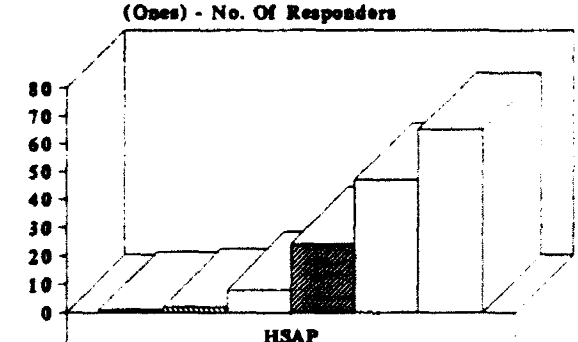
	HSAP
NR	1
1	7
2	16
3	33
4	42
5	48

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

3. Lab readiness for you: mentor, task, work plan.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



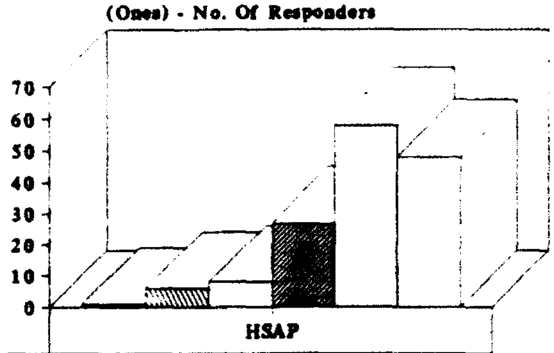
	HSAP
NR	1
1	2
2	8
3	24
4	47
5	65

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

4. Lab readiness for you: equipment, supplies.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



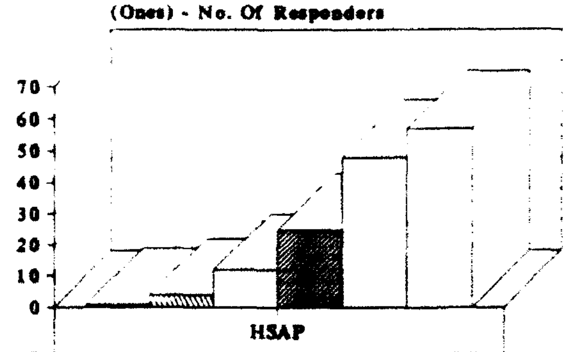
	HSAP
NR	1
1	6
2	8
3	27
4	58
5	48

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

5. Technically challenging work.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



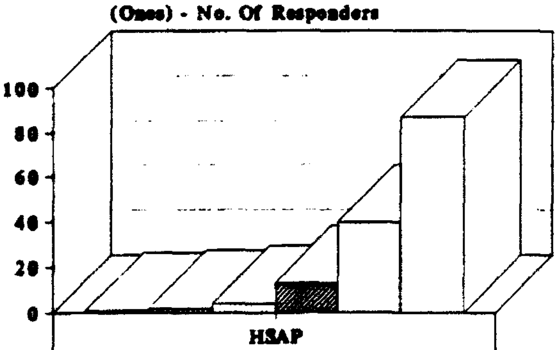
	HSAP
NR	1
1	4
2	12
3	25
4	48
5	57

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

6. Increased interest in science/math.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



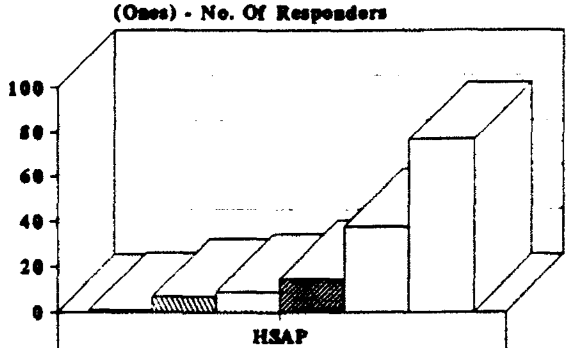
	HSAP
NR	1
1	2
2	4
3	13
4	40
5	87

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

7. Enhancement of your academic qualifications.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



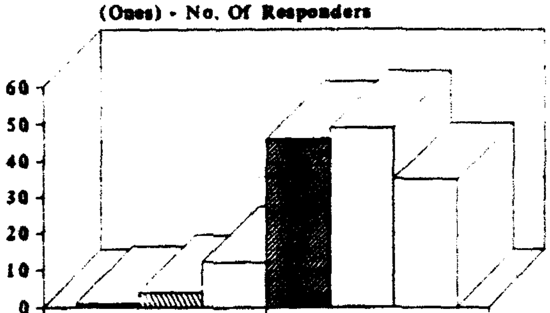
	HSAP
NR	1
1	7
2	9
3	15
4	38
5	77

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

8. Enhancement of your research qualifications.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



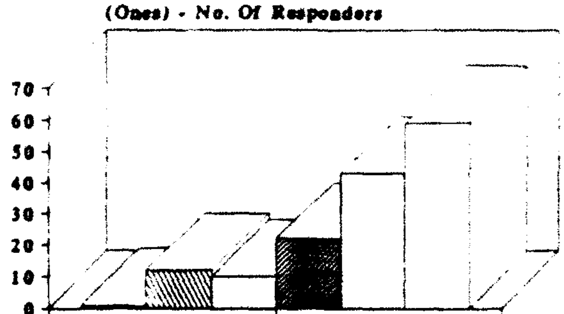
	HSAP
NR	1
1	4
2	12
3	46
4	49
5	35

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

9. Influence on your career.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



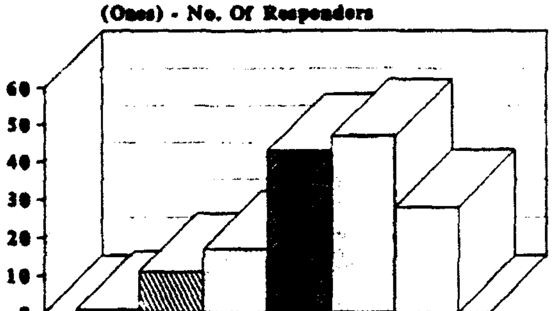
	HSAP
NR	1
1	12
2	10
3	22
4	43
5	59

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

10. Performance of hands-on research.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



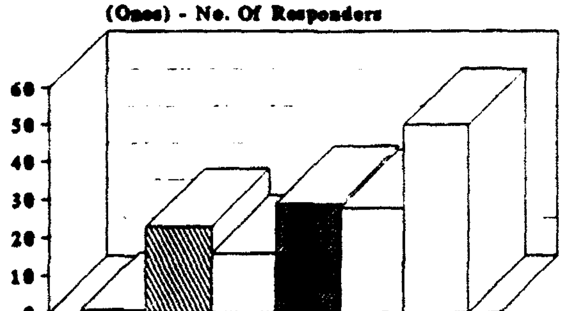
	HSAP
NR	1
1	11
2	17
3	43
4	47
5	28

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

11. Contribution to USAF/national interests.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



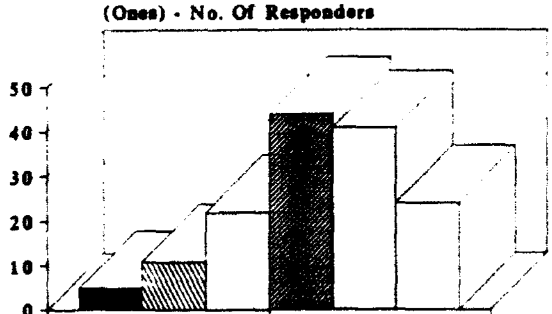
	HSAP
NR	1
1	23
2	16
3	29
4	28
5	50

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

12. Opportunities to meet other HSAP associates.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



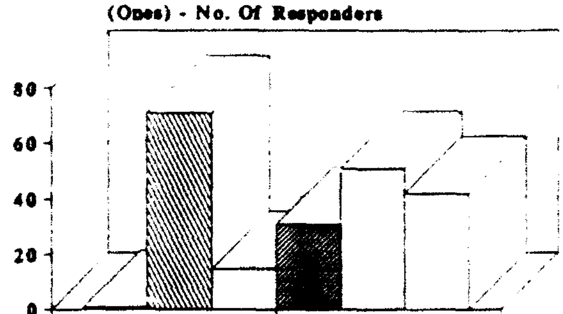
	HSAP
NR	5
1	11
2	22
3	44
4	41
5	24

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

13. Adequacy of RDL's advertising brochure.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



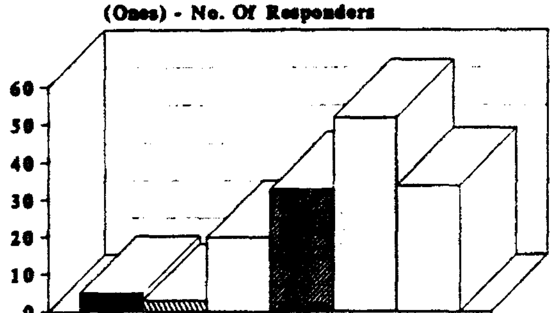
	HSAP
NR	1
1	71
2	15
3	31
4	51
5	42

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

14. Adequacy of RDL's procedural & admin brochure.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



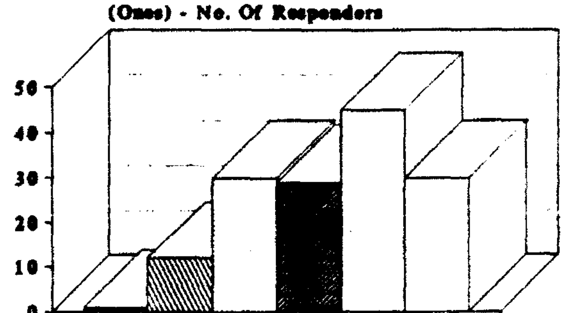
	HSAP
NR	5
1	3
2	20
3	33
4	52
5	34

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

15. Responsiveness of RDL's communications.
(NR - No Response)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



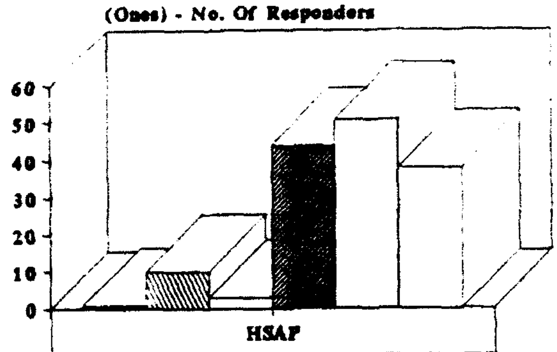
	HSAP
NR	1
1	12
2	30
3	29
4	45
5	30

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

16. Pay procedures.
(NR - No Response)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



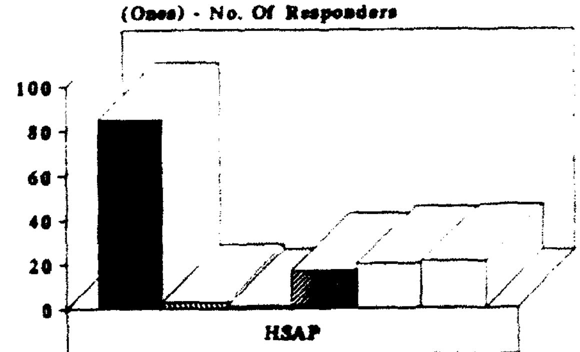
	HSAP
NR	1
1	10
2	3
3	44
4	51
5	38

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

17. Amount of pay.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



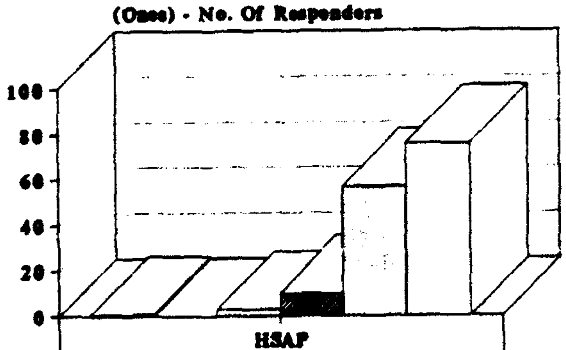
	HSAP
NR	85
1	3
2	1
3	17
4	20
5	21

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

18. Security clearance procedures.

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders



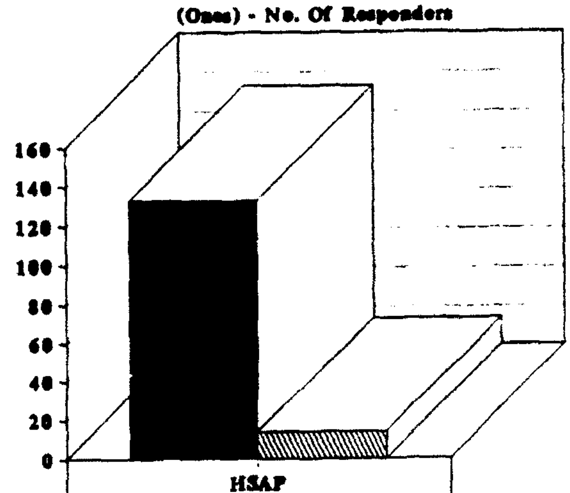
	HSAP
NR	1
1	0
2	3
3	10
4	57
5	76

Rating 1 (L) - 5 (H)
NR 1 2 3 4 5

19. Overall assessment of HSAP value to you.
(NR - No Responses)

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS

(Ones) - No. Of Responders

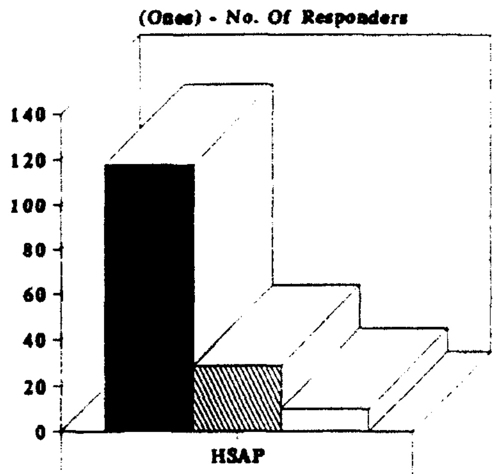


	HSAP
YES	133
NO	14

YES NO

20. Would you apply again next year?

1992 AFOSR SUMMER RESEARCH PROGRAM
HSAP EVALUATIONS



	HSAP
YES	118
NO	29
# WEEKS	10

29. Was length satisfactory? If no, desired length?

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

APPENDIX D:

SFRP PARTICIPANT DATA

NAME/ADDRESS	DEGREE, SPECIALTY, LAB ASSIGNMENT
Ben A. Abbott Research Instructor Dept of Electrical Engineering Vanderbilt University Nashville, TN 37235	DEGREE: MS SPECIALTY: Electrical Engineering LABORATORY: AEDC/SvT
Thomas E. Alberts Asst Professor Dept of Mechanical Engineering Old Dominion University Norfolk, VA 23529-0247	DEGREE: PhD SPECIALTY: Mechanical Engineering LABORATORY: FJSRL/NA
Richard A. Anderson Professor Dept of Physics University of Missouri-Rolla Rolla, MO 65401	DEGREE: PhD SPECIALTY: Physics LABORATORY: PL/LIMI
Brian M. Argrow Asst Professor Dept of Aero & Mech Eng University of Oklahoma Norman, OK 73019-0601	DEGREE: PhD SPECIALTY: Aerospace Engineering LABORATORY: WL/FIMM
Xavier J. Avula Professor Dept of Mech & Aero Engnrg University of Missouri-Rolla Rolla, MO 65401	DEGREE: PhD SPECIALTY: Engineering Mechanics LABORATORY: AL/AOC
Abdul A. Awwal Asst Professor Dept of Comp Sci & Engrng Wright State University Dayton, OH 45435	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: WL/AARA
Stephan B. Bach Asst Professor Dept of Div of Earth & Phy Sci University of Texas at San Antonio San Antonio, TX 78249-0663	DEGREE: PhD SPECIALTY: Physical Chemistry LABORATORY: AL/OEB
Sivasubramanya N. Balakrishnan Assoc Professor Dept of Mech & Aero Eng University of Missouri-Rolla Rolla, MO 65401	DEGREE: PhD SPECIALTY: Aerospace Engineering LABORATORY: WL/MNAG

Margaret W. Batschelet Asst Professor Dept of English/Philosophy University of Texas at San Antonio San Antonio, TX 78249-0640	DEGREE: SPECIALTY: LABORATORY:	PhD English AL/HRTI
Joseph R. Baumgarten Professor Dept of Mechanical Engineering Iowa State University Ames, IA 50013	DEGREE: SPECIALTY: LABORATORY:	PhD Mechanical Engineering PL/VTSS
Jean-Pierre R. Bayard Asst Professor Dept of Elec & Electronic Eng California State University/Sacramento Sacramento, CA 95819-6019	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical & Comp Engrg RL/ERAA
Larry A. Beardsley Asst Professor Dept of Math Physics & Com Sci Savannah State College Savannah, GA 31404	DEGREE: SPECIALTY: LABORATORY:	MS Mathematics AL/CFBV
B T. Beck Assoc Professor Dept of Mechanical Engineering Kansas State University Manhattan, KS 66506	DEGREE: SPECIALTY: LABORATORY:	PhD Mechanical Engineering FJSRL/NA
Raymond D. Bellem Assoc Professor Dept of Elec Engnrg/Comp Sci Embry Riddle Aeronautical University Prescott, AZ 86301	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering PL/WST
Prabir . Bhattacharya Assoc Professor Dept of Computer Science University of Nebraska-Lincoln Lincoln, NE 68588-0115	DEGREE: SPECIALTY: LABORATORY:	PhD Mathematics WL/AARA
Csaba A. Biegl Asst Professor Dept of Electrical Engineering Vanderbilt University Nashville, TN 37235	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering AEDC/SvT

Albert W. Biggs
Professor
Dept of Electrical Engineering
University of Alabama in Huntsville
Huntsville, AL 35802

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: PL/WSR

Victor . Birman
Assoc Professor
Dept of Engineering Ed. Center
University of Missouri-Rolla
St. Louis, MO 63121

DEGREE: PhD
SPECIALTY: Aeronautical Engineering
LABORATORY: WL/FIBE

James K. Boger
Asst Professor
Dept of Electronic Engineering
Oregon Institute of Technology
Klamath Falls, OR 97601-8801

DEGREE: MS
SPECIALTY: Physics
LABORATORY: PL/LIMI

Michael A. Breen
Asst Professor
Dept of Mathematics
Tennessee Technological University
Cookeville, TN 38505

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: WL/AART

Theodore J. Burkey
Assoc Professor
Dept of Chemistry
Memphis State University
Memphis, TN 38152

DEGREE: PhD
SPECIALTY: Physical Organic Chem
LABORATORY: WL/MN

Robert J. Burkholder
Research Associate
Dept of Electrical Engineering
Ohio State University
Columbus, OH 43210

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AARA

Eugene E. Callens
Assoc. Professor
Dept of Mech & Ind Engineering
Louisiana Tech University
Ruston, LA 71272-0046

DEGREE: PhD
SPECIALTY: Aerospace Engineering
LABORATORY: WL/MNMW

Gene O. Carlisle
Professor
Dept of Chemistry
West Texas State University
Canyon, TX 79016

DEGREE: PhD
SPECIALTY: Inorganic Chemistry
LABORATORY: PL/LITN

Gregory P. Carman
Research Scientist
Dept of Engrg Sci & Mechanics
Virginia Polytechnic Inst and State Univ
Blacksburg, VA 24601

DEGREE: PhD
SPECIALTY: Engineering Mechanics
LABORATORY: WL/FIBE

William R. Carper
Professor
Dept of Chemistry
Wichita State University
Wichita, KS 67208

DEGREE: PhD
SPECIALTY: Physical Chemistry
LABORATORY: FJSRL/CD

Gary T. Chapman
Professor
Dept of Mechanical Engineering
University of California, Berkeley
Berkeley, CA 94720

DEGREE: PhD
SPECIALTY: Aeronautics/Astronautics
LABORATORY: WL/MNAA

Pinyuen . Chen
Assoc Professor
Dept of Mathematics
Syracuse University
Syracuse, NY 13244-1150

DEGREE: PhD
SPECIALTY: Mathematical Statistics
LABORATORY: RL/IRRE

Chien-In H. Chen
Asst Professor
Dept of Electrical Engineering
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELED

Jer-Sen . Chen
Asst Professor
Dept of Computer Sci Engnrg
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Computer Vision
LABORATORY: AL/CFBV

Joe G. Chow
Asst Professor
Dept of Mech and Aero Engrng
Clarkson University
Potsdam, NY 13676

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: WL/FIVR

Thomas M. Christensen
Asst Professor
Dept of Physics
University of Colorado at Colorado Springs
Colorado Springs, CO 80933

DEGREE: PhD
SPECIALTY: Applied Physics
LABORATORY: FJSRL/NP

Douglas A. Christensen
Professor
Dept of Electrical Engineering
University of Utah
Salt Lake City, UT 84121

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: PL/LIMI

Maryalice . Citera
Asst Professor
Dept of Psychology
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Indust/Organ Psychology
LABORATORY: AL/CFHD

Stephen H. Cobb
Asst Professor
Dept of Physics
Murray State University
Murray, KY 42071

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: AEDC/SvT

Sneed B. Collard
Professor
Dept of Biology
University of West Florida
Pensacola, FL 32514

DEGREE: PhD
SPECIALTY: Biology
LABORATORY: AFCEL/RAV

Steven H. Collicott
Asst Professor
Dept of Aero & Astro
Purdue University
West Lafayette, IN 47907-1282

DEGREE: PhD
SPECIALTY: Aeronautics
LABORATORY: WL/FIMN

John W. Connolly
Professor
Dept of Chemistry
University of Missouri-Kansas City
Kansas City, MO 64110-2499

DEGREE: PhD
SPECIALTY: Chemistry
LABORATORY: WL/MLBP

Nancy J. Cooke
Asst Professor
Dept of Psychology
Rice University
Houston, TX 77251

DEGREE: PhD
SPECIALTY: Psychology
LABORATORY: AL/HRMJC

Michael L. Daley
Assoc Professor
Dept of Electrical Engineering
Memphis State University
Memphis, TN 38152

DEGREE: PhD
SPECIALTY: Electrical Engineer
LABORATORY: WHMC/SGHMN

Asesh K. Das
Asst Professor
Dept of Statistics & Comp Sci
West Virginia University
Morgantown, WV 26506

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: AL/HRG

Kent M. Daum
Assoc Professor
Dept of Optometry
University of Alabama-Birmingham
Birmingham, AL 35294-0010

DEGREE: PhD
SPECIALTY: Physiological Optics
LABORATORY: AL/HRA

Jennifer L. Davidson
Asst Professor
Dept of Elec Eng & Comp Eng
Iowa State University
Ames, IA 50011

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: WL/MNGS

Joanne E. DeGroat
Asst Professor
Dept of Electrical Engineering
Ohio State University
Columbus, OH 43210-1272

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAAT

Subramaniam . Deivanayagam
Professor
Dept of Industrial Engrng/Mfg
Tennessee Technological University
Cookeville, TN 38505

DEGREE: PhD
SPECIALTY: Industrial Engineering
LABORATORY: AL/HRGA

Mark A. Dietenberger
Assoc Professor
Structural Integrity Division
University of Dayton Research Institute
Dayton, OH 45469-0120

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: WL/POTC

David A. Dolson
Asst Professor
Dept of Chemistry
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Chemistry
LABORATORY: WL/POOC

James F. Driscoll
Assoc Professor
Dept of Aerospace Engineering
University of Michigan
Ann Arbor, MI 49109

DEGREE: PhD
SPECIALTY: Aerospace & Mechanical
LABORATORY: WL/POSF

Walter . Drost-Hansen Professor Dept of Chemistry University of Miami Coral Gables, FL 33124	DEGREE: PhD SPECIALTY: Chemistry LABORATORY: WHMC/SGS
Bradley D. Duncan Asst Professor Dept of Electrical Engineering University of Dayton Dayton, OH 45469-0226	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: WL/AARI
John C. Duncan Asst Professor Dept of Aerospace Eng Tech Kent State University Kent, OH 44242	DEGREE: MS SPECIALTY: Techology LABORATORY: AL/CFHT
John E. Ebel Assoc Professor Dept of Geology & Geophysics Boston College Chestnut Hill, MA 02167	DEGREE: PhD SPECIALTY: Geophysics LABORATORY: PL/GPE
David M. Elliott Assoc Professor Dept of Engineering Arkansas Technological University Russellville, AR 72801	DEGREE: PhD SPECIALTY: Engineering LABORATORY: PL/RKCP
John E. Erdei Asst Professor Dept of Physics University of Dayton Dayton, OH 45469	DEGREE: PhD SPECIALTY: Physics LABORATORY: AL/CFHP
Jamie S. Ervin Asst Professor Dept of Mech & Aero Engnrng University of Dayton Dayton, OH 45469-0210	DEGREE: PhD SPECIALTY: Mechanical Engineering LABORATORY: WL/POTC
Daniel A. Erwin Asst Professor Dept of Aerospace Engineering University of Southern California Los Angeles, CA 90089-1191	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: PL/RKFE

Daniel L. Ewert Asst Professor Dept of Electrical Engineering North Dakota State University Fargo, ND 58105	DEGREE: SPECIALTY: LABORATORY:	PhD Physiology AL/AOC
Barry L. Farmer Professor Dept of Materials Science University of Virginia Charlottesville, VA 22903-2442	DEGREE: SPECIALTY: LABORATORY:	PhD Materials Science WL/MLPJ
George T. Flowers Asst Professor Dept of Mechanical Engineering Auburn University Auburn University, AL 36849-5341	DEGREE: SPECIALTY: LABORATORY:	PhD Mechanical Engineering WL/FIBR
Tekum . Fonong Assoc Professor Dept of Chemistry Hampton University Hampton, VA 23668	DEGREE: SPECIALTY: LABORATORY:	PhD Analytical Chemistry AL/AOE
Simon Y. Foo Asst Professor Dept of Electrical Engineering Florida State University Tallahassee, FL 32306	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering WL/MNMF
Richard L. Fork Professor Dept of Physics Rensselaer Polytechnic Institute Troy, NY 12180	DEGREE: SPECIALTY: LABORATORY:	PhD Physics RL/OCPA
Jeffrey F. Friedman Assoc Professor Dept of Physics Univ of Puerto Rico, Mayaguez Mayaquez, PR 00708	DEGREE: SPECIALTY: LABORATORY:	PhD Physics PL/GPI
Daniel L. Fuller Professor Dept of Chemistry/Physics Nicholls State University Thibodaux, LA 70310	DEGREE: SPECIALTY: LABORATORY:	PhD Chemistry PL/RLKCP

Rex E. Gantenbein Assoc Professor Dept of Computer Science University of Wyoming Laramie, WY 82071-3682	DEGREE: SPECIALTY: LABORATORY:	PhD Computer Science RL/C3AB
Larry E. Gerdom Asst Professor Dept of Natural Science Mobile College Mobile, AL 36663-0220	DEGREE: SPECIALTY: LABORATORY:	PhD Inorganic Chemistry AFCEL/RAVC
Bernard S. Gerstman Assoc Professor Dept of Physics Florida International University Miami, FL 33199	DEGREE: SPECIALTY: LABORATORY:	PhD Physics AL/OED
Vincent P. Giannamore Asst Professor Dept of Chemistry Xavier University of Louisiana New Orleans, LA 70125	DEGREE: SPECIALTY: LABORATORY:	PhD Organic Chemistry PL/RKCP
Gary G. Gimmestad Research Scientist Electro-Optics Laboratory Georgia Institute of Technology Atlanta, GA 30332	DEGREE: SPECIALTY: LABORATORY:	PhD Physics PL/LITE
Richard D. Gould Asst Professor Dept of Mech & Aero Engrng North Carolina State University Raleigh, NC 27695-7910	DEGREE: SPECIALTY: LABORATORY:	PhD Mechanical Engineering WL/POPT
Gary M. Graham Assoc Professor Dept of Mechanical Engineering Ohio University Athens, OH 45701	DEGREE: SPECIALTY: LABORATORY:	PhD Mechanical Engineering WL/FIGC
Susan T. Graul Research Associate Dept of Chemistry University of California/Santa Barbara Santa Barbara, CA 93106	DEGREE: SPECIALTY: LABORATORY:	PhD Chemistry PL/WSSI

Donald D. Gray
Assoc Professr
Dept of Civil Engineering
West Virginia University
Morgantown, WV 26506-6101

DEGREE: PhD
SPECIALTY: Fluid Dynamics
LABORATORY: AFCL/RAVC

Elmer A. Grubbs
Asst Professor
Dept of Electrical Engineering
New Mexico Highlands University
Las Vegas, NM 87701

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAAF-3

Surendra K. Gupta
Assoc Professor
Dept of Mechanical Engineering
Rochester Institute of Technology
Rochester, NY 14623

DEGREE: PhD
SPECIALTY: Materials Science
LABORATORY: RL/ERDR

Pushpa L. Gupta
Professor
Dept of Mathematics
University of Maine
Orono, ME 04469

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: AL/AOE

Ramesh C. Gupta
Professor
Dept of Mathematics
University of Maine
Orono, ME 04469

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: AL/OED

Ian W. Hall
Assoc Professor
Dept of Mechanical Engineering
University of Delaware
Newark, DE 19716

DEGREE: PhD
SPECIALTY: Metallurgy
LABORATORY: WL/MLLM

Charles E. Hall
Asst Professor
Dept of Mech & Aero Engrng
North Carolina State University
Raleigh, NC 27695-7910

DEGREE: PhD
SPECIALTY: Aero & Astro Engnrg
LABORATORY: WL/FIOP

Paul O. Hedman
Professor
Dept of Chemical Engineering
Brigham Young University
Provo, UT 84602

DEGREE: PhD
SPECIALTY: Chemical Engineering
LABORATORY: WL/POSF

Richard A. Hengst
Assoc Professor
Dept of Biological Sciences
Purdue University North Central
Westville, IN 46391

DEGREE: PhD
SPECIALTY: Environmental Physiology
LABORATORY: AL/CFT

Robert R. Henry
Professor
Dept of Elec/Comp Engineering
University of Southwestern Louisiana
Lafayette, LA 70504-3890

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: RL/C3D

James M. Henson
Asst Professor
Dept of Electrical Engineering
University of Nevada-Reno
Reno, NV 89557-0153

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: PL/WSA

DeLayne R. Hudspeth
Assoc Professor
Dept of Curriculum & Instr
University of Texas at Austin
Austin, TX 78712

DEGREE: PhD
SPECIALTY: Education
LABORATORY: AL/HRTC

David . Hui
Assoc Professor
Dept of Mech Engineering
University of New Orleans
New Orleans, LA 70065

DEGREE: PhD
SPECIALTY: Aerospace Engineering
LABORATORY: WL/FIVS

Mayer . Humi
Professor
Dept of Mathematical Sciences
Worcester Polytechnic Institute
Worcester, MA 01609-2280

DEGREE: PhD
SPECIALTY: Applied Mathematics
LABORATORY: PL/GPA

Hua Kuo . Hwang
Assoc Professor
Dept of Elec & Comp Eng
California State Polytechnic University
Pomona, CA 91768

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: RL/C3BB

Mario . Innocenti
Assoc Professor
Dept of Aerospace Engineering
Auburn University
Auburn, AL 36849-5338

DEGREE: PhD
SPECIALTY: Aero/Astro Engineering
LABORATORY: WL/MNA

Jack S. Jean
Asst Professor
Dept of Comp Sci & Engineering
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAAT-1

Ismail I. Jouny
Asst Professor
Dept of Electrical Engineering
Lafayette College
Easton, PA 18042

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AARM

Khosrow . Kaikhah
Chairman
Dept of Computer Science
Huston-Tillotson College
Austin, TX 78702

DEGREE: PhD
SPECIALTY: Computer Engineer
LABORATORY: RL/C3CA

Amir . Karimi
Assoc Professor
Division of Engineering
University of Texas at San Antonio
San Antonio, TX 78249-0665

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: PL/VTPT

Autar . Kaw
Asst Professor
Dept of Mechanical Engineering
University of South Florida
Tampa, FL 33620-5350

DEGREE: PhD
SPECIALTY: Engineering Mechanics
LABORATORY: WL/MLBM

Catherine H. Ketchum
Instructor
Dept of Pathology
University of Alabama at Birmingham
Birmingham, AL 35294

DEGREE: PhD
SPECIALTY: Pathology
LABORATORY: AL/AOH

Arkady . Kheyfets
Asst Professor
Dept of Mathematics
North Carolina State University
Raleigh, NC 27695-8205

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/CA

Charles J. Kibert
Assoc Professor
Dept of Building Construction
University of Florida
Gainesville, FL 32611

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: AFCEL/RACF

Kenneth R. Kimble
Assoc Professor
Dept of Mathematics
University of Tennessee Space Institute
Tullahoma, TN 37388

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: AEDC/SvT

Arthur J. Koblasz
Assoc Professor
School of Civil Engineering
Georgia Institute of Technology
Atlanta, GA 30332

DEGREE: PhD
SPECIALTY: Engineering
LABORATORY: AL/AOC

Antti J. Koivo
Professor
Dept of Electrical Engineering
Purdue University
W. Lafayette, IN 47907

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: AL/CFBS

Demitris A. Kouris
Asst Professor
Dept of Mech & Aero Engnrg
Arizona State University
Tempe, AZ 85287-6106

DEGREE: PhD
SPECIALTY: Applied Mechanics
LABORATORY: WL/MLLN

Tribikram . Kundu
Assoc Professor
Dept of Civil & Mech Engrg
University of Arizona
Tucson, AZ 85719

DEGREE: PhD
SPECIALTY: Solid Mechanics
LABORATORY: WL/MLLP

Spencer S. Kuo
Professor
Dept of Electrical Engineering
Polytechnic University of New York
Farmingdale, NY 11735

DEGREE: PhD
SPECIALTY: Electrophysics
LABORATORY: PL/GPI

Lura D. Lange
Asst Professor
Dept of Chemistry
Central Missouri State University
Warrensburg, MO 64093-5055

DEGREE: PhD
SPECIALTY: Inorganic Chemistry
LABORATORY: PL/RKFE

William F. Lawless
Asst Professor
Dept of Psychology
Paine College
Augusta, GA 30910

DEGREE: PhD
SPECIALTY: Psychology
LABORATORY: AL/HRA

Byung-Lip L. Lee
Assoc Professor
Dept of Engrng Science/Mechani
Pennsylvania State University
University Park, PA 16802

DEGREE: PhD
SPECIALTY: Material Science & Engrng
LABORATORY: WL/FIVM

Juin J. Liou
Assoc Professor
Dept of Electrical Engineering
University of Central Florida
Orlando, FL 32816

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELRD

Shy-Sheng P. Liou
Asst Professor
Division of Engineering
San Francisco State University
San Francisco, CA 94132

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/POOC-1

Christopher C. Lu
Assoc Professor
Dept of Chem/Mat Engineering
University of Dayton
Dayton, OH 45469

DEGREE: PhD
SPECIALTY: Chemical Engineering
LABORATORY: WL/POSL

Lewis M. Lutton
Assoc Professor
Dept of Biology
Mercyhurst College
Erie, PA 16546

DEGREE: PhD
SPECIALTY: Environmental Physiology
LABORATORY: AL/CFTO

Paul K. Maciejewski
Asst Professor
Dept of Mechanical Engineering
University of Pittsburgh
Pittsburgh, PA 15261

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: WL/POTC

Robert G. Main
Professor
Dept of Communication Design
California State University, Chico
Chico, CA 95929-0504

DEGREE: PhD
SPECIALTY: Educational Technology
LABORATORY: AL/HRTC

Valipuram S. Manoranjan
Asst Professor
Dept of Pure & Applied Math
Washington State University
Pullman, WA 99164-3113

DEGREE: PhD
SPECIALTY: Numerical Analysis
LABORATORY: AFCEL/RAVC

Arvind S. Marathay
ʕ ofessor
Optical Sciences Center
University of Arizona
Tucson, AZ 85721

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/GPO

Charlesworth R. Martin
Assoc Professor
Dept of Physics/Engineering
Norfolk State University
Norfolk, VA 23504

DEGREE: PhD
SPECIALTY: Civil Engineering
LABORATORY: WL/MNGA

Thomas M. Miller
Professor
Dept of Physics & Astronomy
University of Oklahoma
Norman, OK 73019

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/GPO

Joseph B. Milstein
Assoc Professor
Dept of Electrical Engineering
University of Massacnusetts-Lowell
Lowell, MA 01854

DEGREE: PhD
SPECIALTY: Chemistry
LABORATORY: RL/ERXE

Evelyn H. Monsay
Assoc Professor
Dept of Physics
Le Moyne College
Syracuse, NY 13214

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: RL/C.ᵓC

William C. Moor
Assoc Professor
Dept of Indus & Mgt Sys Eng
Arizona State University
Tempe, AZ 85287-5906

DEGREE: PhD
SPECIALTY: Industrial Engineering
LABORATORY: AL/HRA

Carlyle E. Moore
Assoc Professor
Dept of Physics
Morehouse College
Atlanta, GA 30314

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: AEDC/Cal

Benjamin E. Mulligan
Professor
Dept of Psychology
University of Georgia
Athens, GA 30602

DEGREE: PhD
SPECIALTY: Psychology
LABORATORY: AL/OED

Richard D. Murphy
Professor
Dept of Physics
University of Missouri-Kansas City
Kansas City, MO 64110

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/WSP

Krishna . Naishadham
Asst Professor
Dept of Electrical Engineering
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELMT

David A. Nelson
Assoc Professor
Dept of Mechanical Engineering
Michigan Technological University
Houghton, MI 49931

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: AL/CFTO

Michael S. Nilan
Assoc Professor
School of Information Studies
Syracuse University
Syracuse, NY 13244-4100

DEGREE: PhD
SPECIALTY: Communications
LABORATORY: RL/C3AA

Olin P. Norton
Research Engineer
Diag Inst & Analysis Lab
Mississippi State University
Mississippi State, MS 39762

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: AEDC/SvT

John L. Orehotsky
Professor
Dept of Engineering & Physics
Wilkes University
Wilkes-Barre, PA 18766

DEGREE: PhD
SPECIALTY: Solid State Science
LABORATORY: RL/ERXO

Ronnie E. Owens
Asst Professor
Dept of Elec & Comp Engnrg
Clemson University
Clemson, SC 29634-0915

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: RL/EROC

Ravindra . Pandey
Asst Professor
Dept of Physics
Michigan Technological University
Houghton, MI 49931

DEGREE: PhD
SPECIALTY: Solid State Theory
LABORATORY: FJSRL/NC

Allen S. Parrish Asst Professor Dept of Computer Science University of Alabama Tuscaloosa, AL 35487-0290	DEGREE: PhD SPECIALTY: Computer Science LABORATORY: RL/C3CB
Carolyn J. Pesthy Research Associate Dept of Science University of Texas at San Antonio San Antonio, TX 78217	DEGREE: PhD SPECIALTY: Curriculum & Instuction LABORATORY: AL/HRTI
Randolph S. Peterson Assoc Professor Dept of Physics University of the South Sewanee, TN 37375-1000	DEGREE: PhD SPECIALTY: Atomic Physics LABORATORY: AEDC/SvT
Edward H. Piepmeier Asst Professor Dept of Pharmaceutics University of South Carolina Columbia, SC 29208	DEGREE: PhD SPECIALTY: Pharmaceutics LABORATORY: AL/AOH
Bernard J. Piersma Professor Dept of Chemistry Houghton College Houghton, NY 14744	DEGREE: PhD SPECIALTY: Physical Chemistry LABORATORY: FJSRL/CD
Aubrey B. Poore Professor Dept of Mathematics Colorado State University Ft. Collins, CO 80523	DEGREE: PhD SPECIALTY: Applied Mathematics LABORATORY: RL/OCTS
Mary J. Potasek Resch Professor Dept of Applied Physics Columbia University New York, NY 10027	DEGREE: PhD SPECIALTY: Applied Physics LABORATORY: WL/MLPO
Vishwanath . Prasad Assoc Professor Dept of Mechanical Engineering Columbia University New York, NY 10027	DEGREE: PhD SPECIALTY: Mechanical Engineering LABORATORY: RL/ERXE

Rupasiri P. Purasinghe
Assoc Professor
Dept of Civil Engineering
California State University at Los Angeles
Los Angeles, CA 90032-8151

DEGREE: PhD
SPECIALTY: Structural Engineering
LABORATORY: PL/RKAS

Salahuddin . Qazi
Assoc Professor
Dept of Elec/Photonics Eng
SUNY Institute of Technology
Utica, NY 13504

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: RL/OCPA

Carey M. Rappaport
Asst Professor
Dept of Elec & Comp Engnrg
Northeastern University
Boston, MA 02115

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: RL/ERAA

Krishnaswamy . Ravi-Chandar
Assoc Professor
Dept of Mechanical Eng
University of Houston
Houston, TX 77204-4792

DEGREE: PhD
SPECIALTY: Aeronautics
LABORATORY: PL/RKCP

Kenneth F. Reardon
Asst Professor
Dept of Agri & Chemical Engnrg
Colorado State University
Ft. Collins, CO 80523

DEGREE: PhD
SPECIALTY: Chemical Engineering
LABORATORY: AFCEL/RAVC

David B. Reynolds
Assoc Professor
Dept of Biomed & Hum Fact Eng
Wright State University
Dayton, OH 45435-0001

DEGREE: PhD
SPECIALTY: Biomedical Engineering
LABORATORY: AL/CFBV

Richard M. Roberds
Professor
Dept of Engineering & Mechanic
University of Tennessee Space Institute
Tullahoma, TN 37388

DEGREE: PhD
SPECIALTY: Nuclear Engineering
LABORATORY: AEDC/Cal

Donald K. Robinson
Assoc Professor
Dept of Chemistry
Xavier University
New Orleans, LA 70125

DEGREE: PhD
SPECIALTY: Chemistry
LABORATORY: AL/OEDR

Armando A. Rodriguez Asst Professor Dept of Electrical Engineering Arizona State University Tempe, AZ 85287-5706	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: WL/MNAG
Larry A. Roe Asst Professor Dept of Mechanical Engineering Virginia Polytechnic Institute Blacksburg, VA 24061-0238	DEGREE: PhD SPECIALTY: Mechanical Engineering LABORATORY: WL/POPT
John P. Rohrbaugh Research Eng Elec Envr Effects Lab Georgia Tech Research Institute Atlanta, GA 30332	DEGREE: MS SPECIALTY: Electrical Engineering LABORATORY: RL/ERPT
Jorge L. Romeu Asst Professor Dept of Mathematics State University of New York Cortland, NY 13045	DEGREE: PhD SPECIALTY: IE & OR (?) LABORATORY: RL/OCTM
Thaddeus A. Roppel Asst Professor Dept of Electrical Engineering Auburn University Auburn, AL 36849-5201	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: WL/MNSI
Christopher A. Rotz Assoc Professor Dept of Manu Eng & Eng Tech Brigham Young University Provo, UT 84602	DEGREE: PhD SPECIALTY: Mechanical Engineering LABORATORY: PL/VTSC
Mary A. Roznowski Asst Professor Dept of Psychology Ohio State University Columbus, OH 43210-1222	DEGREE: PhD SPECIALTY: Psychology LABORATORY: AL/HRM
Walter E. Rudzinski Professor Dept of Chemistry Southwest Texas State University San Marcos, TX 78666	DEGREE: PhD SPECIALTY: Chemistry LABORATORY: AL/OEA

Robert G. Sargent
Professor
Dept of College of Engineering
Syracuse University
Syracuse, NY 13244

DEGREE: PhD
SPECIALTY: Engineering
LABORATORY: RL/XPX

Robert E. Schlegel
Assoc Professor
School of Industrial Engnrg
University of Oklahoma
Norman, OK 73019

DEGREE: PhD
SPECIALTY: Industrial Engineering
LABORATORY: AL/CFTO

William P. Schonberg
Assoc Professor
Dept of Mechanical Engineering
University of Alabama in Huntsville
Hunstville, AL 35899

DEGREE: PhD
SPECIALTY: Civil Engineering
LABORATORY: WL/MNSA

Martin . Schwartz
Professor
Dept of Chemistry
University of North Texas
Denton, TX 76203

DEGREE: PhD
SPECIALTY: Physical Chemistry
LABORATORY: WL/MLBT

Edward J. Seykora
Professor
Dept of Physics
East Carolina University
Greenville, NC 27858-4353

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/GPS

Arnab K. Shaw
Asst Professor
Dept of Electrical Engineering
Wright State University
Dayton, OH 45435

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAWP-1

Larry R. Sherman
Assoc Professor
Dept of Chemistry
University of Scranton
Scranton, PA 18510-4626

DEGREE: PhD
SPECIALTY: Analytical Chemistry
LABORATORY: AL/OEA

Jon H. Shively
Professor
Dept of Industrial & Civil Eng
California State University at Northridge
Northridge, CA 91330

DEGREE: PhD
SPECIALTY: Metallurgy
LABORATORY: PL/VTS

Alan M. Silberberg
Professor
Dept of Psychology
American University
Washington, DC 20016-8062

DEGREE: PhD
SPECIALTY: Experimental Psychology
LABORATORY: AL/OEDR

Robert R. Snapp
Asst Professor
Dept of Electrical Engineering
University of Vermont
Burlington, VT 05405

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: RL/IRA

Janusz A. Starzyk
Professor
Dept of Elec & Comp Engrg
Ohio University
Athens, OH 45701

DEGREE: PhD
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAAT-1

Johanna S. Stenzel
Assoc Professor
Dept of Arts & Sciences
University of Houston-Victoria
Victoria, TX 77901

DEGREE: PhD
SPECIALTY: Mathematics
LABORATORY: PL/LIMI

Stanley D. Stephenson
Assoc Professor
Dept of Computer Info Systems
Southwest Texas State University
San Marcos, TX 78666

DEGREE: PhD
SPECIALTY: Social Psychology
LABORATORY: AL/HRTC

Richard D. Swope
Professor
Dept of Engineering Science
Trinity University
San Antonio, TX 78212

DEGREE: PhD
SPECIALTY: Mechanical Engineering
LABORATORY: AL/AOC

Arjun . Tan
Professor
Dept of Physics
Alabama A & M University
Normal, AL 35762

DEGREE: PhD
SPECIALTY: Physics
LABORATORY: PL/WSSD

Lois E. Tetrick
Assoc Professor
Dept of Psychology
Wayne State University
Detroit, MI 48202

DEGREE: PhD
SPECIALTY: Psychology
LABORATORY: AL/HRM

Jeffrey D. Tew Asst Professor Dept of Indust & Systems Eng Virginia Polytechnic University Blacksburg, VA 24061	DEGREE: SPECIALTY: LABORATORY:	PhD Operations Research RL/IRAE
Richard H. Tipping Professor Dept of Physics & Astronomy University of Alabama Tuscaloosa, AL 35486	DEGREE: SPECIALTY: LABORATORY:	PhD Physics PL/GPO
Stephen A. Truhon Asst Professor Dept of Social Sciences Winston-Salem State University Winston-Salem, NC 27110	DEGREE: SPECIALTY: LABORATORY:	PhD Psychology AL/HRM
Robert J. Turnbull Professor Dept of Elec/Comp Engineering University of Illinois Urbana, IL 61801	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering PL?RKFT
Theresa P. Tuthill Asst Professor Dept of Elec Engr University of Dayton Dayton, OH 45469-0226	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering WL/MLLP
Ramasubramanian . Venkatasubraman Asst Professor Dept of Electrical Engineering University of Nevada, Las Vegas Las Vegas, NV 89154-4026	DEGREE: SPECIALTY: LABORATORY:	PhD Electrical Engineering WL/MLPO
George E. Veyera Asst Professor Dept of Civil/Environ Engrng University of Rhode Island Kingston, RI 02881	DEGREE: SPECIALTY: LABORATORY:	PhD Civil Engineering AFCEL/RACS
Guttalu R. Viswanath Professor Dept of Math & Comp Science South Carolina State College Orangeburg, SC 29117	DEGREE: SPECIALTY: LABORATORY:	PhD Mathematics RL/IRDS

Brian S. Vogt Professor Dept of Chemistry Bob Jones University Greenville, SC 29614	DEGREE: PhD SPECIALTY: Analytical Chemistry LABORATORY: AFCEL/RAVW
Xingwu . Wang Asst Professor Dept of Electrical Engineering Alfred University Alfred, NY 14802	DEGREE: PhD SPECIALTY: Physics LABORATORY: AFCEL/RACO
Philip D. Whitefield Assoc Professor Dept of Chemistry University of Missouri-Rolla Roll<, MO 65401	DEGREE: PhD SPECIALTY: Chemistry LABORATORY: PL/LIDB
Colin W. Wightman Asst Professor Dept of Electrical Engineering New Mexico Institute of Mining & Tech. Socorro, NM 87801	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: RL/IRAA
Peter K. Willett Asst Professor Dept of Elec & Sys Engineering University of Connecticut Storrs, CT 06269	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: RL/OCTM
Carla C. Williams Asst Professor Dept of Physics & Engineering Fort Lewis College Durango, CO 81301	DEGREE: PhD SPECIALTY: Electrical Engineering LABORATORY: PL/VTET
Robert F. Willson Assoc Professor Dept of Physics & Engineering Tufts University Medford, MA 02155	DEGREE: PhD SPECIALTY: Physics LABORATORY: PL/GPS
Michael L. Womack Assoc Professor Dept of Natural Science Macon College Macon, GA 31297	DEGREE: PhD SPECIALTY: Biology LABORATORY: AL/OEM

APPENDIX E:

GSRP PARTICIPANT DATA

NAME/ADDRESS	DEGREE, SPECIALTY, LAB ASSIGNMENT
Terri L. Alexander University of Central Florida Ctr for Elect-Opt & Laser/EE Orlando, FL 32816	DEGREE: BS SPECIALTY: Electrical Engineering LABORATORY: WL/MNSI
Theodore A. Bapty Vanderbilt University Dept of Electrical Engineering Nashville, TN 37235	DEGREE: MS SPECIALTY: Electrical Engineering LABORATORY: AEDC/SvT
William M. Barnett University of Missouri-Rolla Dept of Chemistry Rolla, MO 65401	DEGREE: MS SPECIALTY: Chemistry LABORATORY: PL/LIDB
Melani M. Barreto University of Puerto Rico (R.U.M.) Dept of Physics Mayaguez/PR, 00681	DEGREE: BS SPECIALTY: Physics LABORATORY: PL/GPI
Rodney L. Bates University of Mississippi Dept of Mathematics University, MS 38677	DEGREE: MS SPECIALTY: Mathematics LABORATORY: PL/WSAT
Mary A. Beals Worcester Polytechnic Institute Dept of Mathematical Sciences Worcester, MA 01609-2280	DEGREE: BS SPECIALTY: Mathematics LABORATORY: PL/GPI
Vernon T. Bechel University of South Florida Dept of Mechanical Engineering Tampa, FL 33620-5350	DEGREE: BS SPECIALTY: Mechanical Engineering LABORATORY: WL/MLBM
Lance H. Benedict North Carolina State University Dept of Mech/Aerospace Engrng Raleigh, NC 27695-7910	DEGREE: MS SPECIALTY: Aerospace Engineering LABORATORY: WL/POPT
Paul K. Berg Kansas State University Dept of Mechanical Engineering Manhattan, KS 66506	DEGREE: BS SPECIALTY: Mechanical Engineering LABORATORY: FJSRL/NA
Jennifer L. Blume Texas Tech University Dept of Psychology (Exper) Lubbock, TX 79409	DEGREE: BA SPECIALTY: Psychology LABORATORY: AL/CFT

Benjamin F. Bohren University of North Carolina at Charlotte Dept of Computer Science Charlotte, NC 28223	DEGREE: SPECIALTY: LABORATORY:	BS Computer Science WL/AAAI
Elaine M. Brunsman University of Dayton Dept of Physics Dayton, OH 45469-2311	DEGREE: SPECIALTY: LABORATORY:	BS Physics AL/CFHW
Russell P. Burton Kent State University Dept of Sociology Kent, OH 44242	DEGREE: SPECIALTY: LABORATORY:	MA Sociology AL/AOEP
Thomas C. Byron University of Florida Dept of Aero Eng/Mech & Eng Gainesville, FL 32611-2031	DEGREE: SPECIALTY: LABORATORY:	MS Engineering Science WL/MNMW
Julio L. Camacho University of Miami, Coral Gables Dept of Chemistry Coral Gables, FL 33124-0431	DEGREE: SPECIALTY: LABORATORY:	BS Chemistry WHMC/SGS
Michael T. Carter Texas A & M University Dept of Aerospace Engineerring College Station, TX 77843-3141	DEGREE: SPECIALTY: LABORATORY:	BA Aerospace Engineering PL/VTS
Charity A. Carter Stevens Institute of Technology Dept of Electrical Engineering Hoboken, NJ 07030	DEGREE: SPECIALTY: LABORATORY:	MS Electrical Engineering RL/OCPA
Brian L. Carter Memphis State University Dept of Electrical Engineering Memphis, TN 38152	DEGREE: SPECIALTY: LABORATORY:	BS Electrical Engineering WHMC/SGHSN
Paul J. Chandonnet University of Mass at Lowell Dept of Electrical Engineering Lowell, MA 01854	DEGREE: SPECIALTY: LABORATORY:	MS Electrical Engineering RL/ERXE
Jed S. Cohen Trinity University Dept of Biology San Antonio, TX 78212	DEGREE: SPECIALTY: LABORATORY:	BA Biology AL/OEDR

Nathan G. Coit
University of Colorado
Dept of Physics
Colorado Springs, CO 80933-7150

DEGREE: BS
SPECIALTY: Physics
LABORATORY: FJSRL/NP

Ahmet A. Coker
Wright State University
Dept of Computer Sci & Eng
Dayton, OH 45435

DEGREE: MS
SPECIALTY: Computer Engineering
LABORATORY: WL/AAAT-1

James W. Collins
University of Georgia
Dept of Psychology
Athens, GA 30602

DEGREE: MS
SPECIALTY: Physiological Psychology
LABORATORY: AL/OEDR

Jeffrey S. Dalton
University of Missouri - Rolla
Dept of Electrical Engineering
Rolla, MO 65401

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: WL/MNAG

David N. Dickter
Ohio State University
Dept of Psychology
Columbus, OH 43210-1222

DEGREE: BA
SPECIALTY: Psychology
LABORATORY: AL/HRM

Ronald L. Dilsavor
Ohio State University
Dept of Electrical Engineering
Columbus, OH 43210

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: WL/AARA

Robert F. Diskin
University of Scranton
Dept of Chemistry
Scranton, PA 18510

DEGREE: BS
SPECIALTY: Biology
LABORATORY: AL/OEA

Itiel E. Dror
Harvard University
Dept of Psychology
Cambridge, MA 02138

DEGREE: MA
SPECIALTY: Cognitive Science
LABORATORY: AL/HRA

Travis V. DuBois
Old Dominion University
Dept of Mec Eng & Mechanics
Norfolk, VA 23529

DEGREE: MS
SPECIALTY: Mechanical Engineering
LABORATORY: FJSRL/NA

Alfred D. Ducharme
University of Central Florida
Ctr for Elect-Opt & Laser/EE
Orlando, FL 32816

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: WL/MNGI

Paul S. Erdman
University of Iowa
Dept of Physics and Astronomy
Iowa City, IA 52242

DEGREE: MS
SPECIALTY: Physics
LABORATORY: PL/RKFE

William E. Faller
University of Colorado, Boulder
Dept of Aerospace Eng Sciences
Boulder, CO 80309-0429

DEGREE: MS
SPECIALTY: Aerospace Engineering
LABORATORY: FJSRL/NA

John D. Farquhar
University of Georgia
Dept of Instructional Tech
Athens, GA 30602

DEGREE: MS
SPECIALTY: Instructional Design
LABORATORY: AL/HRT

Jennifer M. Ferst
Virgina Polytechnic Inst & State Univ
Dept of Mech/Science Engrng
Blacksburg, VA 24061

DEGREE: BS
SPECIALTY: Mechanical Engineering
LABORATORY: AL/CFBV

Michelle A. Fitzurka
Catholic University of America
Dept of Physics
Washington, DC 20064

DEGREE: MS
SPECIALTY: Physics
LABORATORY: AL/OEDA

William R. Fletcher
Howard University
Dept of Mathematics
Washington, DC 20059

DEGREE: MA
SPECIALTY: Administration
LABORATORY: AL/AOE

David E. Frink
University of Cincinnati
Aero Eng & Eng Mech
Cincinnati, OH 45221

DEGREE: BS
SPECIALTY: Aerospace Engineering
LABORATORY: WL/MLLP

Christopher A. Fuchs
University of North Carolina/Chapel Hill
Dept of Physics
Chapel Hills, NC 27599-3255

DEGREE: BS
SPECIALTY: Physics
LABORATORY: PL/CA

Christopher A. Fuligni
University of Florida
Dept of Electrical Engineering
Gainesville, FL 32611

DEGREE: BS
SPECIALTY: Materials Science
LABORATORY: PL/LIDA

Lindy . Fung
Ohio State University
Dept of Electrical Engineering
Columbus, OH 43210

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAAT

Gary L. Gallia
University of Scranton
Dept of Biology
Scranton, PA 18510

DEGREE: BS
SPECIALTY: Biology
LABORATORY: AL/AOEL

Robert J. Geierman
University of Tennessee Space Institute
Dept of Aeronautical Engnrgr
Tullahoma, TN 37388

DEGREE: BS
SPECIALTY: Mechanical Engineering
LABORATORY: AEDC/SvT

Ann P. Gillman
Eastern Kentucky University
Dept of Chemistry
Richmond, KY 40475

DEGREE: BS
SPECIALTY: Biology/Chemistry
LABORATORY: WL/POSF

Robert `. Gorsegner
University of Alabama at Tuscaloosa
Dept of Electrical Engineering
Tuscaloosa, AL 35487

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: RL/IRRE

Lawrence R. Gottlob
Arizona State University
Dept of Psychology
Tempe, AZ 85287-1104

DEGREE: BS
SPECIALTY: Business
LABORATORY: AL/HRA

Michael C. Governale
Utah State University
Dept of Physics
Logan, UT 84322-4415

DEGREE: BS
SPECIALTY: Physics
LABORATORY: PL/WSM

John A. Greenfield
University of New Mexico
Dept of Elec/Comp Engineering
Albuquerque, NM 87131

DEGREE: MS
SPECIALTY: Computer Engineering
LABORATORY: PL/VTET

Steven E. Griffin
University of Texas at San Antonio
Division of Engineering
San Antonio, TX 78249-0665

DEGREE: BS
SPECIALTY: Mechanical Engineering
LABORATORY: PL/VTPT

Diane E. Hageman
University of Cincinnati
Dept of Aero Eng/Eng Mechanics
Cincinnati, OH 45221

DEGREE: BS
SPECIALTY: Aerospace Engineering
LABORATORY: WL/MLBM

Carl R. Herman
SUNY at Binghamton
Dept of Electrical Engineering
Binghamton, NY 13903

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: RL/C3BA

Benjamin W. Hoe
Polytechnic University
Dept of Electrical Engineering
Brooklyn, NY 11226

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: RL/C3DA

Rod J. Hughes
Bowling Green State University
Dept of Psychology
Bowling Green, OH 43403

DEGREE: MA
SPECIALTY: Experimental Psychology
LABORATORY: AL/CFT

Andrew P. Johnston
University of Missouri-Rolla
Dept of Mech & Aero Engineer
Rolla, MO 65401

DEGREE: BS
SPECIALTY: Aerospace Engineering
LABORATORY: WL/FIOP

Mhanjit S. Jolly
Massachusetts Institute of Technology
Dept of Aero/Astronautics
Cambridge, MA 02139

DEGREE: BS
SPECIALTY: Aeronautical Engineering
LABORATORY: PL/RKAS

Patricia P. Jones
University of Michigan
Dept of Educational Studies
Ann Arbor, MI 48109-1259

DEGREE: MS
SPECIALTY: Computer Science
LABORATORY: AL/HRTC

Daniel P. Katz
Harvard University
Div of Applied Sci & Physics
Cambridge, MA 02138

DEGREE: MS
SPECIALTY: Applied Physics
LABORATORY: RL/EROP

Timothy S. Keen
University of Florida
Dept of Const Managemen
Gainesville, FL 32611

DEGREE: BS
SPECIALTY: Business Administration
LABORATORY: AFCEL

Daniel B. Kim
University of Cincinnati
Dept of Aerospace Engineering
Cincinnati, OH 45219

DEGREE: BS
SPECIALTY: Aerospace Engineering
LABORATORY: WL/MNAA

Mark E. Kithcart
North Carolina A & T State University
Dept of Mechanical Engineering
Greensboro, NC 27411

DEGREE: BS
SPECIALTY: Mechanical Engineering
LABORATORY: AFCEL/RACO

Kenneth E. Krause
Washington
Dept of Electrical Engineering
St. Louis, MO 63130-4899

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: RL/ERC

Robert C. Kundich University of Tennessee/Mem Hlth Sci Ctr Dept of Biomedical Engineering Memphis, TN 38163	DEGREE: SPECIALTY: LABORATORY:	MA Sport Sciences AL/CFT
Kurt W. Kunzler University of Utah Dept of Electrical Engineering Salt Lake City, UT 84112	DEGREE: SPECIALTY: LABORATORY:	BS Electrical Engineering PL/LITE
William S. Kvasnak Clarkson University Dept of Mechanical Engineering Potsdam, NY 13699	DEGREE: SPECIALTY: LABORATORY:	MS Mechanical Engineering AEDC/MS600
John T. Lair University of New Orleans Dept of Mechanical Engineering New Orleans, LA 70148	DEGREE: SPECIALTY: LABORATORY:	BS Industrial Design WL/FIOP
Richard D. Lankes Syracuse University School of Information Studies Syracuse, NY 13244-4100	DEGREE: SPECIALTY: LABORATORY:	BA Selected Studies RL/C3AA
Robert J. Leiweke Ohio State University Dept of Aero & Astro Eng Columbus, OH 43210	DEGREE: SPECIALTY: LABORATORY:	BS Aeronautical Engineering PL/WSP
Darron D. Lockett Clark Atlanta University Dept of Physics Atlanta, GA 30314	DEGREE: SPECIALTY: LABORATORY:	BA Physics PL/LITN
Timothy M. Magee University of Colorado School of Business Boulder, CO 80309-0419	DEGREE: SPECIALTY: LABORATORY:	BS Mathematics & Chem Eng PL/RKFE
Shawn H. Mahloch Arizona State University Dept of Electrical Engineering Tempe, AZ 85287	DEGREE: SPECIALTY: LABORATORY:	BS Electrical Engineering WL/FIOP
Dallas J. Marks University of Cincinnati Dept of Elec & Computer Eng Cincinnati, OH 45221	DEGREE: SPECIALTY: LABORATORY:	BS Electrical Engineering WL/AAA-2

Richard A. Marschall
University of Tennessee Space Institute
Dept of Engineering Sci & Mech
Tullahoma, TN 37388-8897

DEGREE: MS
SPECIALTY: Mechanical & Aero Eng
LABORATORY: AEDC/SvT

Francis H. Maurais
Worcester Polytechnic Institute
Dept of Applied Mathematics
Worcester, MA 01609

DEGREE: BS
SPECIALTY: Mathematics
LABORATORY: PL/GPA

J. Scott . McMurtry
Louisiana Tech University
Dept of Mechanical Engineering
Ruston, LA 71272-0046

DEGREE: MS
SPECIALTY: Mechanical Engineering
LABORATORY: WL/MNMW

Jane M. Messerschmitt
Polytechnic University
Dept of Electrical Engineering
Farmingdale, NY 11735

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: PL/WSP

Trevor E. Meyer
Iowa State University
Dept of Electric/Computer Eng
Ames, IA 50011

DEGREE: MS
SPECIALTY: Computer Engineering
LABORATORY: WL/MNGS

Scott H. Mills
University of Oklahoma
Dept of Psychology
Norman, OK 73019

DEGREE: MS
SPECIALTY: Psychology
LABORATORY: AL/CFHW

Michael S. Moore
Vanderbilt University
Dept of Electrical Engineering
Nashville, TN 37235

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: AEDC/SvT

Michael P. Moses
Purdue University
Dept of Aero & Astro
West Lafayette, IN 47907

DEGREE: MS
SPECIALTY: Space Science
LABORATORY: PL/RKC

Hung S. Nguyen
North Dakota State University
Dept of Elect/Electronic Eng
Fargo, ND 58105

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: WL/POOC-1

Steven V. Nunes
California State University, Chico
Dept of Electrical Engineering
Chico, CA 95929

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: WL/AAWP-1

Todd W. Nuteson
Wright State University
Dept of Electrical Engineering
Dayton, OH J45435

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELM

R. F. O'Bleness
Wright State University
Dept of Electrical Engineering
Datyon, OH 45435

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELE

Heather R. Panek
University of Scranton
Dept of Biology
Scranton, PA 18510

DEGREE: BS
SPECIALTY: Biology
LABORATORY: AL/CFT

Andrew D. Paulson
Boston College
Dept of Geophysics
Chestnut Hill, MA 02167

DEGREE: BS
SPECIALTY: Physics
LABORATORY: PL/GPE

Joseph A. Pellettiere
Case Western Reserve University
Dept of Biomedical Engineering
Cleveland, OH 44106

DEGREE: BS
SPECIALTY: Biomedical Engineering
LABORATORY: AL/CFTO

Joseph M. Petroziello
University of Scranton
Dept of Biology
Scranton, PA 18510-4699

DEGREE: BS
SPECIALTY: Biology
LABORATORY: AL/AOEL

Jeffrey A. Pobst
University of Southern California
Dept of Aerospace Engineering
Los Angeles, CA 90089-1191

DEGREE: MS
SPECIALTY: Aerospace Engineering
LABORATORY: PL/RKFE

Randall H. Pursley
Georgia Institute of Technology
Dept of Electromagnetics
Atlanta, GA 30332

DEGREE: BS
SPECIALTY: Electrical Engineering
LABORATORY: RL/ERPT

Edward L. Riegelsberger
Ohio State University
Dept of Electrical Engineering
Columbus, OH 43210

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: AL/CFBA

Blair H. Rollin
University of Tennessee Space Institute
Dept of Mathematics
Tullahoma, TN 37388

DEGREE: BS
SPECIALTY: Mathematics
LABORATORY: AEDC/CAL

David W. Rose New York University Dept of Mathematics New York, NY 10012	DEGREE: SPECIALTY: LABORATORY:	BS Mathematics PL/GPS
Anna L. Rowe Rice University Dept of Psychology Houston, TX 77251	DEGREE: SPECIALTY: LABORATORY:	MS Experimental Psychology AL/HRM
Mohammed A. Samad University of New Orleans Dept of Mechanical Engineering New Orleans, LA 70148	DEGREE: SPECIALTY: LABORATORY:	BS Mechanical Engineering WL/FIOP
Daniel E. Schatt University of Tennessee Space Institute Dept of Aerospace Engineering Tullahoma, TN 37388	DEGREE: SPECIALTY: LABORATORY:	BS Aerospace Engineering AEDC/CAL
John . Schilling University of Southern California Dept of Aerospace Engineering Los Angeles, CA 90089	DEGREE: SPECIALTY: LABORATORY:	MS Aerospace Engineering PL/RKFE
Jonathan A. Selvaraj Wright State University Dept of Psychology Dayton, OH 45435	DEGREE: SPECIALTY: LABORATORY:	BA Psychology AL/CFHI
Pamela A. Shaw Wichita State University Dept of Chemistry Wichita, KS 67208	DEGREE: SPECIALTY: LABORATORY:	BS Chemistry FJSRL/NE
Randa L. Shehab University of Oklahoma Dept of Industrial Engineering Normen, OK 73019	DEGREE: SPECIALTY: LABORATORY:	MS Industrial Engineering AL/CFT
David L. Sims University of Cincinnati Dept of Elec & Sci Engineering Cincinnati, OH 45221-0030	DEGREE: SPECIALTY: LABORATORY:	MD Computer Science RL/C3AB
Robert W. Slater University of Cincinnati Dept of Mech/Ind/Nuclear Eng Cincinnati, OH 45221	DEGREE: SPECIALTY: LABORATORY:	MS Mechanical Engineering WL/FIOP

Waleed W. Smari
Syracuse University
Dept of Electric/Computer Eng
Syracuse, NY 13244-1240

DEGREE: MS
SPECIALTY: Computer Engineering
LABORATORY: RL/C3AB

Frank C. Smeeks
Meharry Medical College
Dept of Physiology
Nashville, TN 37208

DEGREE: MS
SPECIALTY: Chemistry
LABORATORY: AL/AOC

Jeffrey A. Smith
Pennsylvania State University
Dept of Engrng Sci & Mechanics
University Park, PA 16802

DEGREE: BS
SPECIALTY: Engineering Science
LABORATORY: WL/FIOP

Edward P. Socci
University of Virginia
Dept of Material Science & Eng
Charlottesville, VA 22903-2442

DEGREE: BS
SPECIALTY: Applied Science in Engin.
LABORATORY: WL/MLPJ

Brian D. Staveley
University of New Mexico
Dept of Mechanical Engineering
Albuquerque, NM 87131

DEGREE: BS
SPECIALTY: Mechanical Engineering
LABORATORY: PL/LIMS

Jose . Suarez
Florida Institute of Technology
Dept of Space Systems
Melbourne, FL 32901

DEGREE: BS
SPECIALTY: Space Sciences
LABORATORY: PL/WSSD

Shady H. Suleiman
Ohio State University
Dept of Electrical Engineering
Columbus, OH 43210

DEGREE: MS
SPECIALTY: Electrical Engineering
LABORATORY: WL/ELOT

Thomas J. Thompson
Iowa State University
Dept of Mechanical Engineering
Ames, IA 50011

DEGREE: MS
SPECIALTY: Mechanical Engineering
LABORATORY: PL/VTS

Kimberly A. Trick
University of Dayton
Dept of Chem & Mat Engineering
Dayton, OH 45469-0240

DEGREE: MS
SPECIALTY: Chemical Engineering
LABORATORY: WL/MLBC

Rose M. Vecchione
University of Dayton
Dept of Chemical Engineering
Dayton, OH 45469-0246

DEGREE: BS
SPECIALTY: Chemical Engineering
LABORATORY: WL/MLIM

Paul H. Vitt University of Missouri-Rolla Dept of Mech/Aero Engineering Rolla, MO 65401	DEGREE: SPECIALTY: LABORATORY:	BS Aerospace Engineering AEDC/SvT
Lawrence L. Vo San Francisco State University Dept of Electrical Engineering San Francisco, CA 94132	DEGREE: SPECIALTY: LABORATORY:	BS Electrical Engineering WL/POOC-1
David L. Warren Brigham Young University Dept of Chemical Engineering Provo, UT 84602	DEGREE: SPECIALTY: LABORATORY:	BS Mechanical Engineering WL/POSF
Michael A. Weaver Georgia Institute of Technology Dept of Aerospace Engineering Atlanta, GA 30332	DEGREE: SPECIALTY: LABORATORY:	MS Aerospace Engineering AEDC/CAL
Sean A. Webb Brigham Young University Dept of Mfg Tech & Engnrg Tech Provo, UT 84602	DEGREE: SPECIALTY: LABORATORY:	BS Manufacturing Engineering PL/VTSC
Charles T. Widener University of Syracuse Dept of Electrical Engineering Syracuse, NY 13244-1140	DEGREE: SPECIALTY: LABORATORY:	MS Electrical Engineering RL/OCDS
John J. Widholm American University Dept of Psychology Washington, DC 20016-8062	DEGREE: SPECIALTY: LABORATORY:	BA Psychology AL/OEDR
Lorraine C. Williams University of California at Riverside Dept of Psychology Riverside, CA 92521	DEGREE: SPECIALTY: LABORATORY:	PhD Psychology AL/AOCN
Andrew S. Wilson California State University Dept of Communication Design Chico, CA 95929	DEGREE: SPECIALTY: LABORATORY:	BA English AL/HRTC
Michael A. Zeimer Virginia Polytechnic Inst & State Univ Dept of Ind & Sys Eng Blacksburg, VA 24061-0118	DEGREE: SPECIALTY: LABORATORY:	BS Ind Eng & Op Rsrch RL/IRAE

APPENDIX F:

HSAP PARTICIPANT DATA

NAME/HIGH SCHOOL/ADDRESS	GRADE, LAB ASSIGNMENT
Lori L. Anderson Centerville High School Centerville, OH 45459	GRADE: 12 LABORATORY: WL/AA
Stephen A. Antonson Rome Catholic High School Rome, NY 13440	GRADE: 11 LABORATORY: RL/IR
Eric A. Apfel Choctawhatchee High School Fort Walton Beach, FL 32547	GRADE: 12 LABORATORY: WL/MN
Katherine M. Arnold Robert E. Lee High School San Antonio, TX 78231	GRADE: 11 LABORATORY: AL/OE
Esteban R. Arredondo George W. Brackenridge High School San Antonio, TX 78210	GRADE: 12 LABORATORY: AL/OE
Matthew J. Bauder Sauquoit Valley Central High School Clayville, NY 13322-9504	GRADE: 11 LABORATORY: RL/IR
Jennifer R. Bautista Fort Walton Beach High School Fort Walton Beach, FL 32547	GRADE: 10 LABORATORY: WL/MN
Sara E. Berty Carroll High School Beavercreek, OH 45440	GRADE: 10 LABORATORY: AL/OE
Michele A. Bielby Camden Central High School Blossvale, NY 13308	GRADE: 11 LABORATORY: RL/C3
William B. Blanchard Laurel Hill School Laurel Hill, FL 32567	GRADE: 11 LABORATORY: WL/MN
J. Stacey . Bond Centerville High School Centerville, OH 45458	GRADE: 12 LABORATORY: WL/EL
Ryan B. Bond Tullahoma High School Tullahoma, TN 37388	GRADE: 10 LABORATORY: AEDC

Leah E. Brown Samuel Clemens High School Schertz, TX 78154	GRADE: 10 LABORATORY:	 AL/OE
Christopher A. Browning Albuquerque High School Albuquerque, NM 87118	GRADE: 12 LABORATORY:	 PL/LI
Melanie . Carr Arlington High School Arlington, MA 02174	GRADE: 11 LABORATORY:	 PL/GP
Carmen . Casares Providence High School San Antonio, TX 78237	GRADE: 11 LABORATORY:	 AL/AO
Deborah A. Case Archbishop Alter High School Spring Valley, OH 45370	GRADE: 11 LABORATORY:	 AL/HR
Helen H. Chou Centerville High School Centerville, OH 45429	GRADE: 12 LABORATORY:	 WL/EL
Claudius W. Christmas Wayne High School Huber Heights, OH 45424	GRADE: 11 LABORATORY:	 WL/FI
Kara L. Ciomperlik East Central High School St. Hedwig, TX 78152	GRADE: 10 LABORATORY:	 AL/OE
Kyle R. Conway Albuquerque High School Kirtland AFB, NM 87118	GRADE: 09 LABORATORY:	 PL/SC
Theresa J. Cook Niceville High School Niceville, FL 32578	GRADE: 10 LABORATORY:	 WL/MN
Yvonne M. Corrales George W. Brackenridge High School San Antonio, TX 78203	GRADE: 11 LABORATORY:	 AL/OE
Steven F. Cortner Shelbyville Central High School Normandy, TN 37360	GRADE: 12 LABORATORY:	 AEDC
Jeffrey P. Cutler Lincoln-Sudbury Regional High School Sudbury, MA 01776	GRADE: 12 LABORATORY:	 PL/GP

Gerald E. Dalley
Beavercreek High School
Beavercreek, OH 45430-1148

GRADE: 11
LABORATORY: WL/FI

Anthony W. Davis
Sandia High School
Albuquerque, NM 87110

GRADE: 11
LABORATORY: PL/WS

Elizabeth C. Day
Beavercreek High School
Beavercreek, OH 45434-5737

GRADE: 12
LABORATORY: WL/PO

Maria A. De la Cruz
Providence High School
San Antonio, TX 78207

GRADE: 11
LABORATORY: AL/OE

Michael P. Decker
Sauquoit Valley Central High School
Sauquoit, NY 13456

GRADE: 11
LABORATORY: RL/ER

Lesha . Denega
Niceville High School
Niceville, FL 32578

GRADE: 12
LABORATORY: WL/MN

Lisa E. Dillho f
Archbishop Alter High School
Dayton, OH 45429

GRADE: 10
LABORATORY: AL/CF

Christopher R. Dodsworth
Northmont Senior High School
Englewood, OH 45322

GRADE: 11
LABORATORY: WL/EL

Philip C. Dorsch
Bay High School
Panama City, FL 32405

GRADE: 11
LABORATORY: AFCEL/RA

Catherine E. Downey
Lincoln-Sudbury Regional High School
Lincoln, MA 01773

GRADE: 11
LABORATORY: PL/GP

Brandon J. Ellena
Tehachapi High School
Tehachapi, CA 93561

GRADE: 11
LABORATORY: PL/XP

Mark R. Eslinger
Judson High School
San Antonio, TX 78244

GRADE: 11
LABORATORY: AL/OE

Blake D. Ethridge
La Cueva High School
Albuquerque, NM 87122-1816

GRADE: 11
LABORATORY: PL/LI

Christine . Fern McCollum High School San Antonio, TX 78221	GRADE: 11 LABORATORY:	 AL/AO
David J. Finch Colonel White High School Dayton, OH 45406	GRADE: 11 LABORATORY:	 AL/OE
Erik R. Fleming Eldorado High School Albuquerque, NM 87111	GRADE: 12 LABORATORY:	 PL/LI
Corey D. Fogleman A. Crawford Mosley High School Lynn Haven, FL 32444	GRADE: 12 LABORATORY:	 AFCEL/RA
Angela D. Foth A. Crawford Mosley High School Panama City, FL 32404-8809	GRADE: 10 LABORATORY:	 AFCEL/RA
Thomas J. Fraites, Jr Niceville High School Niceville, FL 32578	GRADE: 12 LABORATORY:	 WL/MN
Kimberly A. Frank Archbishop Alter High School Dayton, OH 45429	GRADE: 12 LABORATORY:	 WL/PO
Amy L. Gallagher Rutherford High School Panama City, FL 32404	GRADE: 11 LABORATORY:	 AFCEL
Stephanie J. Garcia Oliver W. Holmes High School San Antonio, TX 78251	GRADE: 11 LABORATORY:	 AL/CF
Michael D. Gavornik Theodore Roosevelt High School San Antonio, TX 78239-2152	GRADE: 12 LABORATORY:	 AL/OE
Andrew J. Gerrard Holland Patent Central School Holland Patent, NY 13354	GRADE: 12 LABORATORY:	 RL/OC
Genetta K. Gibson Tullahoma High School Tullahoma, TN 37388	GRADE: 12 LABORATORY:	 AEDC
Mark W. Giles Bay High School Panama City, FL 32405-2033	GRADE: 10 LABORATORY:	 AFCEL/RA

Erin L. Glaser
Kettering Fairmont High School
Kettering, OH 45409

GRADE: 12
LABORATORY: WL/PO

Todd C. Gleason
Rome Free Academy
Lee Center, NY 13363

GRADE: 12
LABORATORY: RL/ER

Jennifer C. Gonzales
Harlandale High School
San Antonio, TX 78214

GRADE: 10
LABORATORY: AL/OE

Daniel R. Grayson
Choctawhatchee School
Fort Walton Beach, FL 32547

GRADE: 12
LABORATORY: WL/MN

Margaret J. Hahn
Beavercreek High School
Beavercreek, OH 45431

GRADE: 11
LABORATORY: AL/CF

Venus-Vict W. Hammack
Lowell High School
Lowell, MA 01852-2106

GRADE: 10
LABORATORY: RL/ER

Amy L. Hancock
Roy High School
Roy, UT 84067

GRADE: 11
LABORATORY: WL/PO

Eileen M. Harrington
Arlington High School
Arlington, MA 02174

GRADE: 12
LABORATORY: RL/ER

Deanna . Harrison
Walton High School
Defuniak Springs, FL 32433

GRADE: 11
LABORATORY: WL/MN

Steven R. Hart
West Carrollton Senior High School
Dayton, OH 45418

GRADE: 12
LABORATORY: WL/FI

David B. Hartsock
Bellbrook High School
Dayton, OH 45440

GRADE: 11
LABORATORY: WL/PO

Richard C. Hartzer
A. Crawford Mosley High School
Lynn Haven, FL 32444

GRADE: 12
LABORATORY: AFCEL/RA

Eric W. Haseltine
Rutherford High School
Panama City, FL 32404

GRADE: 12
LABORATORY: AFCEL/RA

Bryan R. Havel George W. Brackenridge High School San Antonio, TX 78212	GRADE: LABORATORY:	11 AL/HR
Jeff R. Hay Sandia High School Albuquerque, NM 87110	GRADE: LABORATORY:	11 PL/VT
Marsha G. Henke Alamo Heights High School San Antonio, TX 78212	GRADE: LABORATORY:	11 AL/CF
Laura L. Hill Franklin County High School Winchester, TN 37398	GRADE: LABORATORY:	12 AEDC
Heather B. Hopwood Tullahoma High School Normandy, TN 37360	GRADE: LABORATORY:	11 AEDC
Chad D. Houghton Choctawhatchee School Fort Walton Beach, FL 32547	GRADE: LABORATORY:	12 WL/MN
DeLesley S. Hutchins Albuquerque High School Albuquerque, NM 87110	GRADE: LABORATORY:	9 PL/SC
Mindee A. Jeffery Quartz Hill High School Lancaster, CA 93534	GRADE: LABORATORY:	11 PL/RK
John . Kahrs Niceville High School Niceville, FL 32578	GRADE: LABORATORY:	12 WL/MN
Brad L. Karmiol Albuquerque Academy Albuquerque, NM 87111	GRADE: LABORATORY:	11 PL/WS
Daniel A. Kelley Beavercreek High School Beavercreek, OH 45431-2666	GRADE: LABORATORY:	12 WL/AA
Vandana . Khurma Beavercreek High School Beavercreek, OH 45434-5852	GRADE: LABORATORY:	12 AL/OE
Jennifer M. Kim Beavercreek High School Beavercreek, OH 45434	GRADE: LABORATORY:	12 AL/CF

Jason A. Kitchen Niceville High School Niceville, FL 32579	GRADE: 12 LABORATORY:	 WL/MN
Alexandra N. Kitty Good Counsel High School Chicago, IL 60630	GRADE: 10 LABORATORY:	 PL/RK
Barry J. Koestler Beavercreek High School Beavercreek, OH 45430	GRADE: 12 LABORATORY:	 WL/AA
Jason D. Kowalczyk Whitesboro High School Marcy, NY 13403-2917	GRADE: 12 LABORATORY:	 RL/C3
Peter G. Kozlowski Centerville High School Centerville, OH 45458	GRADE: 11 LABORATORY:	 WL/ML
Daniel J. Kramer Carroll High School Dayton, OH 45440	GRADE: 12 LABORATORY:	 WL/FI
Erik J. Krause Valley High School Corrales, NM 87048	GRADE: 11 LABORATORY:	 PL/VT
Robert L. Kuhn Rutherford High SChool Panama City, FL 32404	GRADE: 11 LABORATORY:	 AFCEL/RA
Joel E. Kulesa Archbishop Alter High School Bellbrook, OH 45305	GRADE: 11 LABORATORY:	 WL/PO
Benjamin A. Kuperman Beavercreek High School Beavercreek, OH 45440-3340	GRADE: 11 LABORATORY:	 AL/HR
Frank A. Lasley Winchester High School Winchester, MA 01890	GRADE: 12 LABORATORY:	 PL/GP
Richard I. Lee Coffee County Central High School Manchester, TN 37355	GRADE: 12 LABORATORY:	 AEDC
Allen L. Lefkovitz Dayton Christian High School Englewood, OH 45322	GRADE: 12 LABORATORY:	 WL/AA

Natasha A. Lindsay Rutherford High School Panama City, FL 32404	GRADE: 12 LABORATORY:	 AFCEL
Jason E. Lindsey Niceville High School Niceville, FL 32578	GRADE: 12 LABORATORY:	 WL/MN
David M. Lineberry Coffee County Central High School Manchester, TN 37355	GRADE: 12 LABORATORY:	 AEDC
Raymond A. Liuzzi Notre Dame High School Whitesboro, NY 13492	GRADE: 12 LABORATORY:	 RL/C3
Raul L. Lopez South San Antonio High School San Antonio, TX 78224	GRADE: 11 LABORATORY:	 AL/OE
April M. Lopez Harlandale High School San Antonio, TX 78211	GRADE: 10 LABORATORY:	 AL/OE
Brad M. Lormand Rosamond High School Mojave, CA 93501	GRADE: 11 LABORATORY:	 PL/RK
Matthew W. Losey Paraclete High School Lancaster, CA 93535	GRADE: 12 LABORATORY:	 PL/RK
Andrew T. Malone Kettering Fairmont High School Kettering, OH 45409	GRADE: 12 LABORATORY:	 AL/OE
Chris R. Marlow Franklin County High School Tullahoma, TN 37388	GRADE: 11 LABORATORY:	 AEDC
Ryan M. Mason Coffee County Central High School Manchester, TN 37355	GRADE: 12 LABORATORY:	 AEDC
Daran . Mason Crestview High School Crestview, FL 32536	GRADE: 12 LABORATORY:	 WL/MN
Suzanne J. Matthews Del Norte High School Albuquerque, NM 87110	GRADE: 11 LABORATORY:	 PL/VT

Sean A. Menge Adirondack High School Boonville, NY 13309	GRADE: 11 LABORATORY: RL/C3
Virginia A. Miksch Incarnate Word High School San Antonio, TX 78223	GRADE: 11 LABORATORY: AL/CF
Brent A. Miller Bay High School Panama City, FL 32405	GRADE: 11 LABORATORY: AFCEL/RA
Diane M. Monaghan Paraclete High School Palmdale, CA 93551	GRADE: 12 LABORATORY: PL/SX
Elliott . Moore Fort Walton Beach High School Fort Walton Beach, FL 32548	GRADE: 11 LABORATORY: WL/MN
Rebecca C. Mortis Incarnate Word High School San Antonio, TX 78227	GRADE: 11 LABORATORY: AL/HR
Robert B. Murray Beavercreek High School Beavercreek, OH 45385	GRADE: 12 LABORATORY: WL/EL
Michael S. Nancarrow Beavercreek High School Beavercreek, OH 45431	GRADE: 12 LABORATORY: AL/CF
Thomas M. Owsley Archbishop Alter High School Dayton, OH 45449	GRADE: 12 LABORATORY: WL/FI
Maria C. Pacheco Oakwood High School Dayton, OH 45419	GRADE: 12 LABORATORY: WL/FI
Michael J. Panara Rome Free Academy Rome, NY 13440	GRADE: 10 LABORATORY: RL/C3
Anne E. Pletl Notre Dame High School Marcy, NY 13403	GRADE: 10 LABORATORY: RL/C3
Eric J. Powers Beavercreek High School Beavercreek, OH 45434	GRADE: 12 LABORATORY: WL/AA

Tracy R. Reed GRADE: 11
Tehachapi High School LABORATORY: PL/RK
Tehachapi, CA 93561

Randi L. Reynosa GRADE: 11
Health Careers High School LABORATORY: AL/OE
San Antonio, TX 78224

Anthony . Richards GRADE: 9
Bedford High School LABORATORY: RL/ER
Hanscom AFB, MA 01731

Melvin K. Richardson GRADE: 12
Tempe High School LABORATORY: WL/AA
Tempe, AZ 85282

Robert J. Roche GRADE: 11
John Jay High School LABORATORY: AL/AO
San Antonio, TX 78245

Stephanie A. Rodriguez GRADE: 12
South San Antonio High School LABORATORY: AL/CF
San Antonio, TX 78211

David . Rosenbaum GRADE: 11
Niceville High School LABORATORY: WL/MN
Niceville, FL 32578

Jeffrey M. Roth GRADE: 12
Lincoln-Sudbury Regional High School LABORATORY: PL/GP
Sudbury, MA 01776

Kimberly D. Royalty GRADE: 11
Colonel White High School LABORATORY: WL/FI
Dayton, OH 45404

Eugene C. Salerno GRADE: 12
Oneida Senior High School LABORATORY: RL/C3
Oneida, NY 13421

Carol A. Salinas GRADE: 11
Incarnate Word High School LABORATORY: AL/CF
San Antonio, TX 78242

Paul A. Salinas GRADE: 11
William Howard Taft High School LABORATORY: AL/CF
San Antonio, TX 78268-1882

Timothy C. Sanchez-Brown GRADE: 12
Valley High School LABORATORY: PL/WS
Corrales, NM 87048

Sarah E. Schanding East Central High School San Antonio, TX 78222	GRADE: 10 LABORATORY: AL/CF
Dennis W. Scott, Jr. Niceville High School Niceville, FL 32578	GRADE: 12 LABORATORY: WL/MN
Andrew G. Sega Oriskany Central High School Oriskany, NY 13424	GRADE: 11 LABORATORY: RL/C3
Tiffany M. Selmon John H. Patterson High School Dayton, OH 45406	GRADE: 10 LABORATORY: WL/ML
Joe C. Senus Rome Free Academy Rome, NY 13440	GRADE: 11 LABORATORY: RL/IR
Jonathan D. Servaites Centerville High School Centerville, OH 45459	GRADE: 11 LABORATORY: WL/FI
Michael A. Shaffer Graham High School St. Paris, OH 43072	GRADE: 12 LABORATORY: WL/EL
Max A. Shapiro Phillips Academy Georgetown, MA 01833	GRADE: 11 LABORATORY: RL/ER
John D. Silva McCollum High School San Antonio, TX 78221	GRADE: 11 LABORATORY: AL/OE
Ryan Q. Simon Springfield North High School Springfield, OH 45504	GRADE: 09 LABORATORY: AL/OE
Adam W. Smith Phillips Academy Andover, MA 01810	GRADE: 11 LABORATORY: PL/GP
Jill A. Solscheid Centerville High School Centerville, OH 45459	GRADE: 11 LABORATORY: AL/OE
David J. Spry Tippecanoe High School Tipp City, OH 45371	GRADE: 11 LABORATORY: WL/PO

Elizabeth A. Stoehr Centerville High School Centerville, OH 45458	GRADE: 12 LABORATORY:	AL/OE
Michael S. Strickland A. Crawford Mosley High School Lynn Haven, FL 32444	GRADE: 11 LABORATORY:	AFCEL/RA
Jeffrey R. Strickland A. Crawford Mosley High School Lynn Haven, FL 32444	GRADE: 10 LABORATORY:	AFCEL/RA
David C. Summey Mosley High School Panama City, FL 32405	GRADE: 12 LABORATORY:	AFCEL/RA
Robert N. Tarr La Cueva Albuquerque, NM 87122	GRADE: 10 LABORATORY:	PL/SC
Kimberly M. Thompson George W. Brackenridge High School San Antonio, TX 78210	GRADE: 11 LABORATORY:	AL/HR
Christina . Trossbach Choctawhatchee High School Shalimar, FL 32579	GRADE: 11 LABORATORY:	WL/MN
Christopher J. Troyer Winston Churchill High School San Antonio, TX 78259	GRADE: 12 LABORATORY:	AL/CF
Darcie . Tutin Niceville High School Niceville, FL 32578	GRADE: 11 LABORATORY:	WL/MN
William J. Walsh Braintree High School Braintree, MA 02184	GRADE: 10 LABORATORY:	RL/ER
Sara K. Waterman Tullahoma High School Estill Springs, TN 37330	GRADE: 11 LABORATORY:	AEDC
David L. Watson Kettering Fairmont High School Kettering, OH 45440-2412	GRADE: 11 LABORATORY:	WL/AA
Suzanne G. Weidner East Central High School San Antonio, TX 78263	GRADE: 10 LABORATORY:	AL/OE

Matthew J. Wick Albuquerque Academy Albuquerque, NM 87111	GRADE: 11 LABORATORY: PL/WS
Jeffrey A. Yerian West Carrollton Senior High School West Carrollton, OH 45449	GRADE: 12 LABORATORY: WL/ML
James E. Youngblood Crestview High School Crestview, FL 32536	GRADE: 12 LABORATORY: WL/MN
Amy L. Zimmerman Carroll High School Beavercreek, OH 45431	GRADE: 11 LABORATORY: AL/CF

APPENDIX G:

OVERALL SRP STATISTICS

1992 SUMMER RESEARCH PROGRAM
ACADEMIC ANALYSIS
AFOSR/RDL

1992 SRP ANALYSIS BY CANDIDATES

PARTICIPANT	NON-SELECTEE	DECLINING SELECTEE	SELECTEE	TOTAL
1992 SFRP	501 (54-HBCU/MI)	28 (3-HBCU/MI)	185 (13-HBCU/MI)	714
1992 GSRP	156 (3-HBCU/MI)	9 (1-HBCU/MI)	121 (5-HBCU/MI)	286
1992 HSAP	474	9	159	642
TOTAL	1,131	46	465	1,642

1992 SRP ANALYSIS BY PARTICIPATING ACADEMIC INSTITUTIONS

PARTICIPANT	NON-HBCU/MI	HBCU/MI
1992 SFRP	119	13
1992 GSRP	73	5

Note: 1992 HSAP Institutions totaled 80

APPENDIX H:

SFRP REPORT ABSTRACTS

ARMSTRONG LABORATORY

MATHEMATICAL MODELING OF THE HUMAN CARDIOVASCULAR SYSTEM UNDER ACCELERATION: ANALYSIS OF THE ARTERIAL BLOOD FLOW USING THE THICK-WALL MODEL

Xavier J. R. Avula
Professor
Department of Mechanical and Aerospace Engineering
and Engineering Mechanics
University of Missouri-Rolla

Abstract

Recently developed high performance aircraft would expose the human body to acceleration injury if appropriate life-supporting devices are not incorporated in their design. The cardiovascular system, being central to the maintenance of homeostasis, is adversely affected by sustained accelerations produced during the operation of these aircraft. To aid in the construction of the needed life-support systems, and to understand the response of the cardiovascular system in the adverse environment of high-speed aircraft maneuvers, mathematical models of the cardiovascular sytem are highly desirable. In this study, the proposed model consists of a thick-walled, highly deformable elastic tube in which the blood flow is described by linearized Navier-Stokes equations. The governing equations, which are coupled nonlinear partial differential equations, were solved by the fourth-order Runge-Kutta numerical scheme. The thick-wall model predicts higher pressures in comparison with the earlier results of the thin-wall model. Further study involving the model of the entire circulation system with realistic tissue properties, and using the finite element method is proposed to develop a comprehensive mathematical model for better understanding.

GC/MS PROTOCOLS FOR EPA METHOD 1625

Stephan B.H. Bach
Assistant Professor
Division of Earth and Physical Sciences
University of Texas at San Antonio

Abstract

A Finnigan 5100 GC/MS is set-up to operate EPA Method 1625. The tuning parameters for the instrument had to be optimized after restarting the instrument. Application of the quantitation software available with the 5100 to operate EPA Method 1625 is undertaken. A short description for troubleshooting various instrumental problems encountered while making the instrument and the software operational are described.

AN INTELLIGENT TUTOR FOR SENTENCE COMBINING

Margaret W. Batschelet
Assistant Professor
Division of English, Classics, and Philosophy
University of Texas at San Antonio

Abstract

Sentence combining has become a well established technique for teaching grammar, syntax, and some forms of punctuation. Using sentence combining, students practice producing syntactically complex sentences by adding to, deleting, and rearranging simple "kernel sentences." Research on sentence combining by Frank O'Hare and others has established that students who have sentence combining practice produce more syntactically mature sentences as well as better written compositions. Some work has been done on using computers for sentence combining, but only one sentence combining program has been written: a drill-and-practice program for Apple II computers. The R-WISE tutor,a tutoring system aimed at improving the reading and writing skills of high school freshmen, includes a sentence combining module as part of its editing tools. The sentence combining and reduction module allows students to revise clusters of sentences within their drafts which need to be either combined or broken into more than one sentence. Students can work with their sentences or go through a set of exercises designed to improve their sentence combining and reducing skills. Some tutoring is provided, based in part on the number of sentence clusters or run-ons remaining after the module is completed and on student performance on the exercises.

Articulated Total Body Model Dynamics
Verification and Demonstration Simulations

by

Larry A. Beardsley

Abstract

The Armstrong Laboratory at Wright-Patterson Air Force Base, Ohio utilizes a program called DYNAMAN, written by General Engineering and Systems Analysis Company (GESAC) for the purpose of performing predictive simulations of human body dynamics resulting from various external force applications. The DYNAMAN program runs on a PC based computer and uses the Articulated Total Body (ATB) model program code for the dynamics simulations. Although the ATB model code was developed to study human body dynamics, the program can be used to simulate general coupled rigid body dynamics. The present study examined some of the basic mechanisms in the model to validate their respc .gainst closed form mathematical solutions. Particular emphasis was placed on studing elastic and energy absorbing impacts and it was found the simulation results agreed very closely with the closed form mathematical solutions.

A STUDY OF THE EFFECTS OF LOW UPDATE RATE ON VISUAL DISPLAYS

Jer-Sen Chen

Assistant Professor

Department of Computer Science and Engineering

Wright State University

Abstract

This report contains a study on the effect of low and incompatible update rate to a 60 Hz refresh visual display and propose solutions to remove the undesired artifacts. Since the contrast sensitivity of human eyes drops significantly above 60 Hz, visual display devices usually operate at 60 Hz refresh rate. If the refresh rate is low, for instance at 30 Hz, the undesired flickering artifact will be detected by human visual perception. Due to limitation of technology, even though we are exploring very high definition video signals it is just impossible to achieve the 60 Hz requirement. Simple remedies to the problem of lower update rate, such as to display the same frame multiple times or to blank out the non-updated frames will introduce undesired artifacts of multiple images or flickering. This report proposes approaches to alleviate the problem by either an algorithmic scheme to interpolate the missing frames or by a field sequential scheme on binocular displays. A spatially interpolative scheme, though computationally efficient, is not a solution to generating the missing frames. A temporally interpolative scheme should be employed to generate the correct frames though it is computationally extensive and sometimes not feasible for real time applications. The binocular field sequential approach provides an alternative to solving the problem of low update rate, though the temporal integration behavior of binocular perception is yet to be further studied.

Development of a Research Paradigm to Study Collaboration in Multidisciplinary Design Teams

Maryalice Citera
Assistant Professor
Department of Psychology
Wright State University

Jonathan A. Selvaraj
Graduate Research Assistant
Department of Psychology
Wright State University

Abstract

The purpose of this research project was to develop a research paradigm to investigate the collaborative process of design in multidisciplinary teams. Two phases of task development are described. The initial phase involved identifying a design problem that could be used to create the experimental task. The problem selected was the design of a navigation system for an automobile. The second phase involved collecting knowledge about the problem to make the task as realistic and interesting as possible. Knowledge was collected from design experts using a concept mapping technique. The results highlighted many tradeoffs and design issues that could be integrated into an experimental task. Future steps necessary for producing the design paradigm are described.

AN APPROACH TO ON-LINE ASSESSMENT AND DIAGNOSIS OF STUDENT TROUBLESHOOTING KNOWLEDGE

Nancy J. Cooke
Assistant Professor
and
Anna L. Rowe
Graduate Student
Department of Psychology
Rice University

Abstract

Intelligent tutors have the potential to enhance training in avionics troubleshooting by giving students more experience with specific problems. Part of their success will be associated with their ability to assess and diagnose the students' knowledge in order to direct pedagogical interventions. The goal of the research program described here is to develop a methodology for assessment and diagnosis of student knowledge of fault diagnosis in complex systems. Along with this broad goal, the methodology should: (1) target system knowledge, (2) provide rich representations of this knowledge useful for diagnosis, (3) be appropriate for real-world complex domains like avionics troubleshooting, and (4) enable assessment and diagnosis to be carried out on-line. In order to meet these requirements a general plan for mapping student actions onto system knowledge is proposed and research from one part of this plan is presented. Results from a Pathfinder analysis on action sequences indicate that action patterns can be meaningfully distinguished for high and low performers and that the patterns reveal specific targets for intervention. Short- and long-term contributions of this work are also discussed.

INTELLIGENT DECISION MAKING WITH QUALITATIVE REASONING

Asesh Das
Department of Statistics and Computer Science
West Virginia University
Morgantown, WV 26506

Abstract

A class of common sense reasoning, called qualitative physics has been treated, where, physical systems being subjected to deep reasoning studies on their behavioral pattern, can focus one dimensional qualitative laws free from mathematical intricacies, but sufficient to describe their mainstream behaviors with discrete real numbers. The nature of decision making with tools using qualitative physics in an uncertain environment has been discussed. It is stressed that the notion of generic task structures play a dominant role in design/diagnostics with qualitative reasoning. This idea has been extended to decision making in robot-automated operations, where, planning and decision making can be done by constructing partially ordered bases consisting composite pairs of geometric descriptions of a subject and the corresponding generic task structure. The theory has been illustrated with a simple example.

EFFECTS OF FEEDBACK DELAY ON TRACKING

Kent M. Daum, O.D., Ph.D.
Associate Professor
School and Department of Optometry
The University of Alabama at Birmingham

ABSTRACT

All flight simulators have delays in both the presentation and the use of information. In the fiber-optic helmet-mounted display (FOHMD), these delays are associated partly with the detection and measurement of eye position. In currently used simulators that measure head and eye position, the presentation delay in response to an eye movement has been measured at 90 to 140 ms. In addition to these delays, the human oculomotor system also has an inherent delay of about 150 ms. A large body of literature has shown that humans can track predictable stimuli with very small errors as long as the stimuli are within certain limits of amplitude, frequency and bandwidth. Most evidence suggests that the ability to track these targets is a result of an element within the feedback control system that predicts target motion and acts to eliminate delays which would otherwise drastically interfere with tracking and task performance. Although there has been substantial study of many of these factors, there has been little work aimed at assessing the effects of alterations of the amount of delay on tracking performance. This lack of information is critical in assessing tracking tasks with an additional delay such as is necessarily found in a simulator. It is also critical in determining simulator fidelity for any task involving eye movements. The objective of this project was to study the effects of feedback delay on tracking performance. We studied five subjects (mean age: 30.4 yrs; range: 21 to 40 yrs.). The subjects tracked a small green dot on a CRT while attempting to keep a laser spot (indicating their eye position) superimposed on the stimulus. The laser spot marked eye position with or without an additional delay. We examined the effects of feedback delays ranging from 0 to 225 ms. on sinusoidal motion (5 frequencies: 0.1 to 1.0 Hz.) and an unpredictable smooth stimulus with a bandwidth of 0.00 to 0.95 Hz. Each waveform and frequency was repeated 3 times. Both the mean number of saccades per second and the mean amplitude of the saccades increased as a function of the frequency being tracked and as a function of delay. Saccades generated while tracking the random smooth pursuit waveform occurred frequently (relative to the other waveform) and, as expected, were not affected by the presence of a feedback delay. The amplitude of saccades for this waveform fell about in the middle of the other frequencies, suggesting that the frequency composition of the random stimulus was well matched to the sinusoidal stimuli. These data suggest that the addition of modest delays (on the order of 75 ms.) result in significantly poorer tracking. They further imply that delays involving eye movements in the construction of flight simulators should be minimized. Further study is necessary to define the capabilities of the oculomotor system in dealing with such delays and in defining the parameters precisely responsible for the detrimental tracking effects.

Hand Torque Strength for Small Fasteners

S. Deivanayagam
Professor of Industrial Engineering
Tennessee Technological University

Abstract

This report describes an experimental investigation on the hand torque strength capabilities of persons for tightening and loosening small fasteners such as wing-nuts, keys and Allen screws. During the typical maintenance activities of modern systems the technician often is required to perform such tasks. This study used 14 males and 14 females as subjects and each subject performed 72 test exertions under simulated task conditions in the laboratory. The results will be useful as a data base for computerized human models such as CREW CHIEF and DEPTH for modeling ergonomic capabilities of persons.

DESIGN AND MODIFICATION OF A THREAT SITE/EMITTER LAYDOWN DATABASE AND THREAT EMITTER PARAMETERS DATABASE FOR THE ADVANCED DEFENSIVE MISSION PLANNING SYSTEM AND B1-B/B-2 ENGINEERING RESEARCH SIMULATORS

John C. Duncan
Assistant Professor
Aerospace Engineering Technology
Kent State University

ABSTRACT

The primary goal of the Advanced Defensive Mission Planning System (ADMPS) is to allow rapid Mission Generation - integrating terrain information, routes, and threats - by a non-expert Mission Planner. The ADMPS should provide a realistic and accurate model of threat/site laydown using current doctrine, strategy and practices. At the same time, each threat model should simulate realistic threat emitter characteristics and operation. Together, the digitized terrain database, threat site laydown and emitter simulation should provide a realistic simulated electronic warfare environment that can be used in various Defensive System simulations. Once fully implemented, the ADMPS will be able to easily and quickly provide total mission scenarios - including training and EWO missions - for use in studies in various aircraft simulations.

Fractal and Multifractal Aspects of an Electroencephalogram

John E. Erdei
Associate Professor
and
Elaine M. Brunsman
Department of Physics
University of Dayton

ABSTRACT

The tools of fractal analysis have been used in an attempt to better understand the relationship between dynamical systems analysis and cognitive task assessment. The main thrust of the research has been to determine both the fractal and multifractal scaling behavior of an electroencephalogram (EEG), and to determine if this scaling behavior is sensitive to tasks being carried out by a subject. Universal features of the EEG have been examined by comparing the scaling behavior for 5 subjects, each of which performed the same tasks. The results were compared with known results for random noise, in an effort to determine the amount of randomness in the signal. Upon determination of the details of the scaling behavior of the EEG, the sensitivity of this behavior to cognitive task was examined by comparing EEG recorded under 12 different task conditions. Four 30 second EEG segments taken from a single 3 minute record were examined, and the scaling behavior for each segment was averaged to produce a single result for the given task. Scaling exponents and the multifractal spectrum was computed for each subject under all task conditions. Although the determination of the scaling exponents and the multifractal spectrum was successful, association of these characteristics with particular tasks yielded ambiguous results. A great deal of the ambiguity stems from the lack of stationarity of the signal, since the scaling behavior is not uniform from one section of the EEG to another.

TERMINAL ARTERIOLAR DENSITY, TOTAL PERIPHERAL RESISTANCE AND OPTIMAL VENTRICULO-ARTERIAL COUPLING

Daniel L. Ewert
Assistant Professor
Department of Electrical Engineering
North Dakota State University

Abstract

Three main areas were studied. These were 1) a proof-of-concept experiment to characterize the coronary artery pressure and flow relation as a function of occluded terminal arterioles in goat myocardium; 2) development of a mathematical technique to estimate total peripheral resistance (TPR) during unsteady conditions in a high $+G_z$ state and 3) a mathematical description to determine optimal ventriculo-arterial coupling based on the principle of maximum external work transfer.

The proof-of-concept experiment was performed and approximately 42 million, nonradioactive 15 μm microspheres were injected into the left ventricle myocardium. The relationship between coronary pressure and flow was a decreasing nonlinear function of occluded terminal arterioles.

Two equations were developed which predicted arterial capacitance and total peripheral resistance during transient $+G_z$ episodes. In addition it is possible to estimate the volume of blood that pools in the venous system during high $+G_z$ states.

An equation was developed which estimated the optimum ratio of arterial elastance to left ventricle elastance for maximum external work transfer from heart (left ventricle) to the arterial system.

TSH AND FREE T_4 TESTING IN LIEU OF TRADITIONAL "LONG" THYROID PROFILES

Tekum Fonong
Associate Professor
Department of Chemistry
Hampton University

Abstract

A laboratory test protocol consisting of the measurement of *sensitive* TSH (sTSH) and free thyroxine (FT_4) in human serum was evaluated as a possible replacement for the traditional "long" thyroid profile for assessing thyroid dysfunctional states. The traditional "long" thyroid profile consists of the measurement of serum TSH, total thyroxine (TT_4), triiodothyronine uptake (T_3U), and a calculated free thyroxine index (FTI). The traditional "long" thyroid profile is presently offered to clients by the Epidemiology Research Division of Armstrong Laboratory, Brooks Air Force Base, San Antonio Texas. In this study, sTSH and FT_4 were measured in serum specimens from 89 patients previously evaluated for possible thyroid disorder at the Department of Endocrinology, Wilford Hall USAF Medical Center, Lackland AFB, San Antonio, TX. The sTSH and FT_4 test results were found to be in support of the clinical diagnoses in the patient groups studied and they were in good agreement with results from the "long" thyroid profile. Two recommendations are made from these findings: (i) that the sTSH and FT_4 combination be provided as the first line test protocol for the laboratory diagnosis of thyroid dysfunction and (ii) that the Epidemiology Research Division of Armstrong Laboratory offer the sTSH and FT_4 test protocol to clients in place of the "long" thyroid profile. There are benefits to the laboratory for implementing a sTSH and FT_4 protocol - the sTSH and FT_4 combination provides increased diagnostic sensitivity compared to conventional RIA methods; the sTSH assay evaluated in this study can clearly distinguish euthyroid from hyperthyroid patients; the chemiluminometric endpoint of the sTSH and FT_4 assays avoids the need for radioisotopes with their potential health and disposal problems; and the reduced number of initial tests using the sTSH and FT_4 protocol is a definite cost-effective strategy for the laboratory.

A THEORETICAL AND COMPUTATIONAL MODEL OF LASER INDUCED RETINAL DAMAGE

Bernard S. Gerstman
Associate Professor
Department of Physics
Florida International University

Abstract

Laser induced retinal damage was studied from a theoretical standpoint. A computational model was developed to simulate and understand the underlying physical mechanisms leading to damage. The model permits the varying of the density of the melanin granules which are responsible for the high absorptivity of visible radiation in the retinal pigment epithelium, the location of the primary absorption site leading to damage. The model also permits the varying of the input laser pulse characteristics, thus allowing a systematic computational investigation of the effects of different laser characteristics and the subjects' retinal anatomical differences on damage mechanisms. A retinal thermal profile as a function of position and time is computed for a given laser pulse and melanin density. The laser induced temperature rise can then be used in a preliminary thermodynamic model of the damage process that was also developed. This model takes into account both damage and repair mechanisms and supplements the single term Arrhenius damage integral, which is shown to be inadequate. In, addition the "nanosecond discrepancy" is shown not to exist.

ESTIMATION OF DIOXIN HALF-LIFE IN THE AIR FORCE HEALTH STUDY

Pushpa L. Gupta

Professor

Department of Mathematics

University of Maine

ABSTRACT

In this project the estimation of half-life of 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD) in humans is studied by examining the mixed effects model with repeated measurements studied by Michalek et. al. (1992). In the case of two measurements and a single covariate, analytical expression for the restricted maximum likelihood estimators of the parameters and their variance-covariance matrix are derived. The results are then extended to the general case with arbitrary number of measurements and covariates. The purpose of this investigation is to compare the efficiencies of the estimator of half-life thus obtained and the estimator of half-life obtained by using the unconditional model (full model) introduced by Gupta (1990, 1991). This will enable the Air Force scientists to select an appropriate method for estimating the half-life.

SURVIVAL ANALYSES OF RADIATED ANIMALS
INCORPORATING COMPETING RISKS AND COVARIATES

Ramesh C. Gupta
Professor
Department of Mathematics
University of Maine

Abstract

The effects of radiation, taking into account the cause of death (cancer or heart disease) along with the covariates such as sex, age, type of exposure, dose, are examined. A general log linear hazard model approach is studied. The model estimates the cause specific hazard rates, assuming piecewise exponential distribution and exhibits the survival function for each of the covariate groups and the probability of death due to each cause. A data set called "Delayed Bio-Effects Colony", of radiated animals, is analyzed and some conclusions are drawn.

THERMAL STRESS IN SEVEN TYPES OF CHEMICAL DEFENSE ENSEMBLES DURING MODERATE EXERCISE IN HOT ENVIRONMENTS

Richard A. Hengst
Associate Professor
Department of Biological Sciences
Purdue University North Central

Abstract

Data collected from experiments conducted in 1991 were organized into a technical report format. This report covers exposure tolerance and physical effects of thermal stress on subjects performing mild exercise in desert conditions when wearing seven different chemical defense ensembles. Subjects walked at 3 mi h^{-1} in ambient conditions of 40°C and 20% RH until rectal temperature increased 1.5°C above starting values. Ensembles tested included the BDO with BDU, BDO without BDU, UK with BDU, Gore-Tex with PJ-7, MLFS, CWU-77P, and PJ-7. The performances of these ensembles were compared with BDU results. Three garments, the PJ-7, MLFS, and CWU-77P performed within 94% of the trial exposure of the BDU and all three performed significantly better than other garments tested. CDEs with longer trial lengths had lower mean skin temperatures, lower heart rates, lower heat storage rates and slower rates of rectal temperature increase. The significantly longer times and lower thermal stress characteristic of better performing ensembles correlate well with higher percentage sweat evaporation values with consequent improvement in heat dissipation.

The Potential of Electronic
Teams for Distance Education

DeLayne Hudspeth
Associate Professor
Area of Instructional Technology
College of Education
The University of Texas
Austin, Texas

Abstract

The potential use of collaborative electronic networks was investigated as a means to involve and motivate distant learners, provide a cooperative base of learning and interaction and provide an environment for learning in a society where the half life of knowledge shortens and the distinction between work and learning blurs. Literature from a number of disciplines was reviewed and suggests considerable potential for electronic support of geographically separate persons who might function as electronically supported learning teams (E/L-teams). It is recommended that costs and benefits of existing services such as telephone bridges and groupware be explored to empirically determine the pro's and con's of electronically supported teams.

EVALUATION OF GLUCOSE MONITORING DEVICES FOR USE IN HYPERBARIC CHAMBERS

Catherine H. Ketchum, Ph.D., NRCC
Instructor
Department of Pathology
Division of Laboratory Medicine
University of Alabama at Birmingham

Abstract

Significant decreases in whole blood glucose (WBG) levels have been noted in diabetic patients undergoing hyperbaric oxygen therapy thus making accurate monitoring of WBG's within a hyperbaric chamber critical to patient care. Five WBG monitoring instruments were evaluated to determine what effects, if any, increasing the partial pressure of oxygen by increasing chamber pressure from 1.0 to 2.4 atmospheres absolute (ATA) would have on instrument performance. Reagent strips exposed to chamber conditions for 30 dives showed no adverse effects in precision or stability. Using whole blood samples ranging from 25 to 250 mg glucose/dl, we found that the hyperbaric environment did have a significant effect on accuracy and did affect the precision of one instrument. All glucose results obtained with the Glucometer M+ were increased significantly, as were those less than 100 mg/dl with the ExacTech pen. All results were decreased significantly with the HemoCue and the Companion 2. Although significant decreases were noted with concentrations greater than 150 mg/dl, the OneTouch II was not affected in the hypoglycemic range.

A NEW PROTOCOL FOR STUDYING CAROTID BARORECEPTOR FUNCTION

Arthur J. Koblasz
Associate Professor
School of Civil Engineering
Georgia Institute of Technology

Abstract

A new protocol was evaluated for characterizing carotid baroreceptor function in baboons. Three male baboons were anesthetized with Ketamine (30mg IM) followed by periodic doses of a-Chloralose (50mg/kg IV, plus maintenance doses of 20mg/hr). Pancuronium Bromide (.1mg/kg IV) was also given to each animal to reduce muscle activity. The right carotid sinus was isolated by ligating all incoming and outgoing vessels approximately 1 cm above and below the sinus. A small catheter was inserted into the carotid sinus, along with a 2-French Millar (single-tipped) pressure transducer. A Skinner three-way hydraulic valve (Type B14) was used to switch the catheter between two reservoirs of warmed physiological saline solution, which were positioned at different heights above the carotid sinus.

This apparatus allowed the pressure in the carotid sinus to be quickly shifted between two different levels, creating both pulse and step changes in pressure. Since the carotid sinus was completely isolated, the pressure shifts occurred nearly instantaneously with no significant flow of saline into the sinus.

A STUDY ON TELEOPERATED SYSTEM CONTAINING AN EXOSKELETON

A.J. Koivo
Professor
School of Electrical Engineering
Purdue University

Abstract

A teleoperated system consisting of a human operator, an exoskeleton (leader-master), a robotic manipulator (follower-slave) and environment is studied. The kinematics of the exoskeleton are first studied by assigning the coordinate frames by following the Denavit-Hartenberg (D-H) guidelines. Then the kinematic relations are developed, including the forward kinematic equations and the Jacobian matrix, the transpose of which relates the joint torques to the generalized force (force and torque) acting on the end-effector. Since the joint shafts are driven by a cable (wire) system, the torques of the motors are next calculated in terms of the joint torques. Thus, the kinematic relations for the exoskeleton are determined.

Then, the entire teleoperated system is considered. This system with the exoskeleton is currently being designed and constructed in the Laboratory on Human Sensors, Feedback and Telerobotics. The use of two-port networks to study the behavior of teleoperated systems was reviewed. The ideal response of the teleoperated system is defined as the steady-state response in which (i) the velocities of the leader (master) and follower (slave) are the same and (ii) the (generalized) forces exerted by the follower on the environment and by the leader (master) on the exoskeleton are equal. The conditions for the ideal response are presented in terms of the two-port network model which is used to model the behavior of the teleoperated system.

The effect of the time delay in the system is discussed. A recommendation for the control architecture of the teleoperated system is then presented.

A composite person-factor measure for selecting fighter pilots

W.F. LAWLESS
Assistant Professor
Departments of Mathematics and Psychology
Paine College

Abstract

The research activities completed this summer were designed to find the factors that would identify the top fighter pilot candidates for the United States Air Force. A comprehensive literature search was completed which led to the initial person factors of expertise and history. In parallel, working with Mike Houck, UDRI, and Wayne Waag, HRA, scales to measure fighter pilot situation awareness were crafted with a format redesigned for optical scanning data collection. Other scales written by the author included a wingman interdependence scale, a revision of a background scale, assistance with a peer evaluation scale, and a post-SA SimTest scale. A theory was constructed based on the literature review and the author's dissertation, the SAAC-engagements data base analyzed for the combined selection person factors, a chapter for a report written, an outline of a journal article planned, a proposal for the 1992 Fall SA SimTest engagements written, and a paper written to present to the Aerospace Medical Association. Additionally, initial plans were made to analyze a second data base for other articles, and later this Fall for the analysis of a third data base for the construction of an ANN enemy pilot.

LOCAL ADMINISTRATION OF EXCITATORY AMINO ACID ANTAGONISTS ATTENUATES LIGHT-INDUCED PHASE SHIFTS AND *C-FOS* EXPRESSION IN THE HAMSTER SUPRACHIASMATIC NUCLEI

L. M. Lutton*, B. Buckley and M. A. Rea
Associate Professor
Department of Biology
Mercyhurst College

Abstract

The effects of local administration of excitatory amino acid antagonists on light-induced phase shifts of the circadian activity rhythm and on light-induced c-fos expression in the SCN were determined. Syrian hamsters, stereotaxically fitted with guide cannulas, received 300 nl injections of CNQX, MK-801 or vehicle in the SCN area 5 min prior to a 10 min, 20 lux light exposure. Injection of either 1mM CNQX or MK-801 resulted in a 77% reversible inhibition of light-induced phase advances (CNQX=12$\pm$7 min; MK801=12$\pm$5 min; veh=52$\pm$9 min; $p<0.05$). The effect of CNQX was dose related, while MK-801 was equally effective at the lowest dose tested (0.01mM). 1 mM MK-801 at CT13 resulted in a 71% inhibition of light-induced phase delays (vehicle=-51$\pm$6 min; MK-801=-15$\pm$5 min; $p<0.05$), but 1 mM CNQX failed to significantly do so (-39$\pm$10 min). Injection of MK-801 alone was without effect at CT18 or CT13, but CNQX alone at CT13, but not CT18, appeared to cause a significant phase delay (-20$\pm$6 min).

Light exposure at CT18 resulted in a characteristic c-fos expression in the SCN. Local administration of 1 mM CNQX and MK-801 reduced the number of Fos-immunoreactive cells by about 32% and 44%, respectively: (CNQX=643$\pm$135; MK-801=533$\pm$ 143; vehicle=951$\pm$79; $p<0.05$). These results indicate that both NMDA and non-NMDA receptors in the SCN mediate light-induced phase shifts and Fos expression and they provide evidence that this Fos expression represents a necessary event in the photic entrainment of the SCN circadian pacemaker.

Collaborative Instructional Development Environment:
A Stage for the AIDA

Robert G. Main, Ph.D.
and
Andrew S. Wilson, M.A.
Department of Communication Design
California State University, Chico

Abstract

Computer-based media production tools have matured sufficiently to enable the Air Force to readily provide very powerful curriculum materials development tools based on the existing Workstation III or IV. However, providing instructional designers and developers with a multimedia development workstation is not equivalent to providing them the power to use them well. While an Automated Instructional Design Advisor will certainly aid designers and developers in choosing appropriate media to solve instructional problems, provision of such powerful media production tools will require a commitment within the Air Force to provide technical and creative support. Only this will ensure effective, motivational media design.

An examination of matured computer-based media production technology was undertaken and a group of ISD experts was impaneled to discern which available tools hold the most promise and value for instructional design. This study presents the findings of the Delphi panel as well as considering the impact of providing such tools to designers and developers. We make the recommendation that implementation of a computer-mediated communication system be concurrent with the emplacement of computer-based media production tools to create a collaborative instructional development environment that will improve media creativity and dynamism especially with respect to computer-based training. In addition, such a system will provide for centralized archiving of reusable and repurposed media, effective formative and summative evaluation, increased collaboration between instructional designers, developers, subject matter experts and media production experts, thus increasing instructional quality, employee productivity and job satisfaction.

A METHOD FOR COMPARISON OF ALTERNATIVE MULTISHIP AIRCRAFT SIMULATION SYSTEMS UTILIZING BENEFIT ESTIMATION

William C. Moor
Associate Professor
Department of Industrial and Management Systems Engineering
Arizona State University

Abstract

This study improves and refines a benefits model developed in previous work. It creates the operational procedures necessary to acquire all data required for estimating benefits. In addition, the study completes an operational test of these procedures demonstrating their feasibility.

This research focuses on the benefit component of this analysis as it is elements of the benefits computation that require the most refinement. The overall thrust of the model building remains the same as for the original effort. It is the desire of the author to make the computation model as clear as possible to the potential user and to build it in a form that facilitates use. All computational work is placed in LOTUS 1-2-3 spreadsheets that are annotated for data entry and use. The model is built in reference to a specific, operational aircraft (F-15) but is easily modified to allow comparison to any air superiority jet fighter for which multiship simulators would be developed.

VOCALIZATIONS OF NATURALLY RANGING GROUPS OF THE RHESUS MACAQUE

B. E. Mulligan
Professor
Department of Psychology
University of Georgia
Athens, GA 30602

Abstract

Acoustical recordings and analyses of vocalizations and associated behavior of naturally ranging groups of *Macaca mulatta* were carried out in order to establish a natural basis for understanding the vocal behavior of these animals under captive, laboratory conditions. This was important because vocal behavior can be a strong indicator of emotional condition which, in turn, is reflective of the psychological wellbeing of laboratory-housed research animals, especially non-human primates. Knowledge of normally occurring vocal behavior was an essential first step in the development of an acoustical approach to the assessment of emotionality of rhesus macaques. It was found that adult rhesus utilize seven acoustical categories of calls in communicating vocally under natural conditions. Acoustically different calls also appear to differ in behavioral context and functional significance. Specific types of information transmitted in calls appears to include individual location and identity, distress, solicitations of aid, predator alarm, threat of aggression, defense, submission, and the caller's condition of arousal.

MODELLING SELECTIVE BRAIN COOLING IN HUMANS

David A. Nelson
Associate Professor
Department of Mechanical Engineering - Engineering Mechanics
Michigan Technological University

Abstract

Models of heat exchange in the human cavernous sinus between the carotid artery and the jugular vein were developed. The models were used to test existing theories of Selective Brain Cooling (SBC) in humans, as proposed by Cabanac and Caputa (1979). Results show that the heat exchange in the cavernous sinus is insignificant, and that in the carotid/jugular arterio-venous pair is, at most, a secondary means of cooling the brain.

A simple finite-difference steady state thermal analysis of the brain suggests that only slight temperature increases are anticipated in the brain, even under conditions which would be expected to produce severe heat stress. These results tend to cast doubt on the appropriateness of invoking SBC models in humans.

FUNDAMENTAL SKILLS TRAINING PROJECT:
LIFE SCIENCE TUTOR

Carolyn J. Pesthy
Science Department
Douglas Mac Arthur High School

Abstract

Given that we believe that children are this country's most valuable resource, and therefore, that education must be a priority in this country to prepare todays children to be successful in tomorrows world, the federal government, through the Fundamental Skills Training (FST) project, will be enhancing technological and academic skills in developing literate, life-long learners.

Presently, there are no standards that have been developed and documented on or for science on a national scale. Documentation has been reviewed from different states and national organizations for guidance in this quest. From this, a directory or menu of essential skills and tasks have been developed that incorporate performances which enhance students in becoming successful adults.

The purpose of this paper is to briefly outline the current deficits in American science education and to describe the potential value of advanced educational technologies in remedying these deficits. One particular instructional scenario is described in detail to illustrate this potential.

MODEL DEVELOPMENT FOR USE IN HYPERBARIC OXYGENATION THERAPY RESEARCH

Edward H. Piepmeier, Jr.
Assistant Professor
College of Pharmacy
University of South Carolina

Abstract

One in vivo model and one in vitro model were developed. A rabbit model was developed for use in determining the effectiveness of hyperbaric oxygenation on muscle regeneration following beta-streptococcal induced myonecrosis. Experimental results indicate that a rabbit model has been defined which presents beta-streptococcal induced myonecrosis similar to that exhibited in two cases of streptococcal infection presented at Wilford Hall Medical Center. This model will be used in future experiments to determine the efficacy of hyperbaric oxygenation upon beta-streptococcal induced myonecrosis, and to identify any detrimental effects of co-administration of ibuprofen during beta-streptococcal induced myonecrosis. An in vitro model was developed for determination of the interaction of hyperbaric oxygenation with glucose analyzers' ability to measure blood glucose levels both with and without hyperbaric oxygenation. Five glucose analyzers which measure glucose based upon a glucose oxidase reaction were examined in the initial study. There was a significant difference between the readings each glucose analyzer gave both under normobaric and hyperbaric conditions for all five blood concentrations tested ($p<0.01$). There was a significant difference between the measurements given by each glucose analyzer under normobaric and hyperbaric conditions for three of the blood glucose concentrations tested ($p<0.01$).

A STUDY OF THE WATER FORCES ANALYSIS
CAPABILITY FOR THE ATB MODEL WITH EMPHASIS
ON IMPROVED MODELING OF ADDED MASS AND WAVE DAMPING

David B. Reynolds
Associate Professor
Department of Biomedical and Human Factors Engineering
Wright State University

Abstract

The Water Forces Analysis Capabilty (WAFAC) module for the Articulated Total Body (ATB) model currently does not account for wave damping of a body moving near a free surface. We developed a simplified dimensionless relation between the wave damping coefficient for heave $b_{w,h}$ and the draft of the body, namely: $b_{w,h}/(\rho A_{proj}^{5/4}\ g^{1/2}) = a_h\ (1-\exp[-c_h H])$ where ρ is fluid mass density, A_{proj} is the projected area of the body on a plane normal to its relative velocity, g is the gravitational acceleration, $H \equiv a/d$ is the ratio of body half length to draft, and a_h, c_h are empirically determined constants. From theoretical calculations of heave damping in the literature, we found that a_h=0.24 and C_h=0.53 provided a good fit for damping averaged over $2.4 \leq \lambda/a \leq 31.4$ for H from 0 to ∞, where λ is the wavelength. Using this result, we validated the WAFAC/ATB model for experimental forced oscillation of a heaving hemisphere, indicating not only the importance of considering wave damping, but also the accuracy of the above expression. Parametric studies of the motion of a sphere with half the density of water released from the water surface show that (1) the damped natural frequency agrees with theory, (2) wave damping is an important component of the overall damping, and (3) the motion of the sphere in waves demonstrates broad band resonance. Although it appears from others' computations that our dimensionless damping relation is approximately valid for heaving ellipsoids of revolution, this should be verified by future experiments. Also, dimensionless damping coefficients for a surging sphere at the same draft are 1.5 to 9 times larger than for heave, indicating that a single damping expression may not be valid for more general motion than was considered here. This suggests that surging/swaying experiments be conducted to validate the model for other motions.

A STUDY OF THE EFFECTS OF MICROWAVE RADIATION AND TEMPERATURE ON AMINO ACID METABOLISM BY MOUSE MACROPHAGE CELLS

Donald K. Robinson
Associate Professor
Department of Chemistry
Xavier University

Abstract

In this study we sought to determine if the changes in amino acid metabolism by mouse macrophage cells exposed to microwave radiation (2450 MHz, 30 minutes) are caused by "hot spots" or heat effects. For this study we exposed the cells to 2450 MHz, 103 w/kg, for 30 minutes. Amino acid profiles of the cell culture media were determined at 24, 48, and 72 hours. Treatments consisted of microwave radiation at 37° and sham treatments at 37, 38, and 39°C. In addition, all of these studies were performed using two cell densities; one cell density was approximately 10 fold less dense than the other. The changes in amino acid profiles were determined by thin-layer chromatography. Changes in amino acid profiles were not observed to be more pronounced at 48 hours and 72 hours post-treatment. The changes in amino acid metabolism by mouse macrophage cells were more apparent in the dense cell cultures. The amino acid bands of the sham treated cells at 38 and 39°C were less intense than the samples microwaved and sham treated at 37°C . This indicates that the previously found changes in amino acid metabolism by mouse macrophage cells are due to the bioeffects of microwave radiation rather than to temperature effects. If the changes were due to temperature effects, the band intensities of the microwaved samples would have been considerably diminished.

THE APT: PSYCHOMETRIC, MEASUREMENT, AND PREDICTIVE PROPERTIES

Mary Roznowski
Assistant Professor

David Dickter
Graduate Associate

Department of Psychology
Ohio State University

Abstract

This report describes the results of a research project carried out to investigate aspects of the measurement quality and construct validity of a battery of cognitive information processing measures (the APT: Automated Personnel Testing). Two samples were used to investigate these issues. Criteria included scores on the Armed Services Vocational Aptitude Battery (ASVAB) and performance measures from computerized, intelligent tutors. The data indicate that the APT battery does an excellent job predicting performance on these various criteria and that these tests could be used to predict individuals' abilities to learn knowledge and skills relevant to many Air Force occupations. Other results indicate acceptable to good psychometric properties of the individual tests comprising the APT. Suggestions are given to improve the psychometric and predictive properties of the measures.

ANALYSIS OF ISOCYANATES IN SPRAY-PAINT OPERATIONS

Walter E. Rudzinski
Professor
Department of Chemistry

Southwest Texas State University
San Marcos TX, 78610

Abstract

NIOSH Method 5521 was used for the analysis of toluene diisocyanate (TDI), 4,4'-diphenylmethane diisocyanate (MDI), and hexamethylene diisocyanate (HDI) monomers, Des N-75 polymer, as well as for the kinetic analysis of the reactivity of Des N-75 in a paint formulation. Preliminary results were also obtained for the chromatographic separation of Des N-3300 and Des Z-4370 prepolymers, and isophorone monomer. The NIOSH method was modified for the analysis of polyisocyanate by the use of standards prepared from the bulk prepolymers.

Field studies were also conducted at several spray painting operations, and NIOSH Method 5521 was compared directly with OSHA Method 42 for the analysis of HDI and Des N-75. At high concentrations of particulate, NIOSH Method 5521 gave higher HDI results than those obtained from OSHA Method 42. Total nuisance dust and particle size distributions were evaluated in one field study, and the Des N-75 polyisocyanate results were reasonable when compared with the ratio of polyisocyanate expected in the sample based on the MSDS data sheets and the paint formulation.

EVALUATION OF ASTRONAUT PRACTICE SCHEDULES FOR THE INTERNATIONAL MICROGRAVITY LABORATORY (IML-2)

Robert E. Schlegel, Associate Professor
Randa L. Shehab, Graduate Student
School of Industrial Engineering
The University of Oklahoma
Norman, Oklahoma 73019

Abstract

The National Aeronautics and Space Administration (NASA) is currently conducting a series of space shuttle launches to enable scientists to study the effects of microgravity on a variety of factors. Included in the second International Microgravity Laboratory mission (IML-2) will be an extensive study of the effects of microgravity on astronaut cognitive performance ability. The Sustained Operations Branch of the USAF Armstrong Laboratory (AL/CFTO) has primary responsibility for this effort. This large collaborative study will include the training and testing of astronauts on a battery of human cognitive performance tests prior to launch, periodically during the space mission, and after the flight.

To permit an accurate identification of performance decrements caused by microgravity in space, it is essential to collect stable pre-flight baseline data. A preliminary investigation was conducted to determine the impact on baseline performance stability of less than optimal practice schedules and testing lapses due to such factors as launch delays.

A total of 21 subjects were trained on the NASA Performance Assessment Battery and then assigned to one of five practice schedules. Two groups practiced each day for 15 consecutive days. Two other groups followed a schedule of 5 days testing, 2 days off, 5 days testing, 3 days off, 5 days testing. The fifth group followed a schedule of 2 days testing, 5 days off, 2 days testing, 5 days off, 2 days testing. Then, either three days or five days after the last practice session, subjects returned for five days of retesting to represent mission days.

The study confirmed the overriding importance of providing an adequate number of practice sessions to achieve performance stability. By comparison, occasional missed sessions (i.e., the 5-on, 2-off schedules) had little impact on ultimate performance at the end of practice. The data indicated a possible performance difference between those subjects with only a 3-day gap between practice and "mission days" vs. those with a 5-day gap. High levels of differential stability and reliability were observed for at least one measure on all tests but the Critical Tracking test. Excellent software reliability was demonstrated by less than 0.02% missed data collection points.

SEM-EDXA ANALYSES OF AIRBORNE INORGANIC FIBERS FOR QUALITATIVE IDENTIFICATION

LARRY R. SHERMAN
University of Scranton
Scranton, Pennsylvania 18510-4286

ABSTRACT

The health hazard posed by airborne asbestos fibers is well documented, as well as numerous analytical methods for the identification and characterization of the fibers. Analytical methods for other lung abatement or innocuous fibers are not as well defined and this project was initiated to determine if the deficiency could be overcome using equipment available in the Occupational Environmental Analyses section of the Armstrong Laboratory.

The author and his graduate student used a number of fiber standards to establish a library for fiber identification using morphology and the elemental X-ray analyses obtained with the Amray 1820 Scanning Electron Microscope and Tracor Northern X-ray Analyzer. From the elemental analyses a series of linear equations were developed which are unique for the qualitative and quantitative analysis of each fiber type. These equations along with the average elemental fiber composition were put into computer programs for analyzing air fibers submitted to the AL-OEAO. The success rate for analyzing fibers on standard cellulose acetate filters was approximately 88% and would have been greater if a larger library were available.

CHOICE BETWEEN MIXED AND UNMIXED GOODS IN RATS

Alan Silberberg
Professor
Department of Psychology
The American University

John Widholm
Graduate Student
Department of Psychology
The American University

Abstract

Twelve food- and water-deprived rats chose between two levers. A multiple fixed-ratio 49 fixed-ratio 1 schedule was associated with one lever and a multiple fixed-ratio 25 fixed-ratio 25 was associated with the other. In Phase 1 for both levers, one of the two components defining the multiple schedule delivered access to 0.1-cc of water while the other component delivered a single 45-mg food pellet. The order of food and water presentations was counterbalanced across subjects. To prevent absolute preference for an alternative from developing, the values of each multiple schedule were adjusted according to a titration schedule: If a multiple schedule was selected four times in succession, its ratio values were incremented. In Phase 2, half the rats were exposed to only water reinforcement, while the other half received only food reinforcement. In all other ways, the experiment was unchanged from Phase-1 conditions. There was no reliable change in preference, an outcome incompatible with the economic notion that organisms prefer mixtures of goods over unitary presentations of a good.

THE USE OF SMALL GROUPS IN COMPUTER-BASED TRAINING

Stanley D. Stephenson
Associate Professor
Department of Computer Information Systems
and Administrative Sciences
Southwest Texas State University

Abstract

In the majority of studies which have investigated individual versus small group achievement within the CBT framework, there were no significant differences between the two experimental groups. Some studies produced significantly positive results, but no study produced significantly negative results. However, one would expect groups to outperform individuals. After reviewing the small group CBT literature, this paper suggests that in past studies the behavior of the small group members has not been appropriately structured. Based on related traditional instruction research, it appears that guiding students' discussions following CBT presentation may increase achievement. A reciprocal peer-questioning model is proposed to provide this type of guidance. This model is briefly described and research is suggested. Implications of this model for distance learning are also provided.

ARTERIAL COMPLIANCE AND TOTAL PERIPHERAL RESISTANCE FOR VARYING +GZ FORCES; VENTRICULOARTERIAL COUPLING FOR MAXIMUM LEFT VENTRICULAR WORK; A LATEX TUBE MODEL OF THE AORTA AND NONLINEAR PRESSURE EFFECTS IN SHORT ARM CENTRIFUGES

Richard D. Swope
Professor
Department of Engineering Science
Trinity University

Abstract

Four projects are considered. (1) A method for computing beat to beat arterial compliance and total peripheral resistance for nonsteady conditions is presented. Data for a baboon-centrifuge run for +GZ ranging from 1.4 to 8g are analyzed and discussed. Total peripheral resistance is found to first decrease with the onset of +GZ and then increase after about 4 to 6 seconds. (2) An expression for the ratio of arterial elastance to end-systolic elastance which maximizes left ventricular external work is given. This optimum ratio depends significantly on diastolic pressure and the fraction of stroke volume which flows through the peripheral resistance during ejection. It decreases with increasing diastolic pressure and increases with increasing peripheral flow. (3) Capillary tube bundles are examined as possible candidates for use as terminal resistors in two element windkessel to be used in conjunction with a branching latex tube model of the aorta. When used with a sudden contraction orifice plate (d/D= 0.2), the resistance is a linear increasing function of flow rate but with d/D = 0.4 the resistance is nearly independent of flow rate in the physiological range. (4) In centrifuges the "hydrostatic" pressure distribution is a non linear function of distance. In short arm centrifuges (R = 5 ft) the nonlinear contribution to the pressure is from 20 to 26% of the linear part for +GZ ranging from 3 to 9g. In a long arm (20 ft) centrifuge the contribution ranges from 5 to 6%.

Examination of Response Latencies
to Personality Inventory Items

Lois E. Tetrick
Associate Professor
Department of Psychology
Wayne State University

Abstract

The relations among response latencies and scores on several measures of cognitive information processing tasks and personality measures were examined. The pattern of relations across these measures indicated that response latencies are effected by many aspects of the stimuli presented to individuals. There was no support for a claim that relative response latencies were stable across tasks that might signify such individual differences as impulsivity and intelligence, but rather, they seemed to reflect differential aspects of the task itself, and within subject variability.

THE SIMILARITY OF AIR FORCE SPECIALTIES AS ANALYZED BY ADDITIVE TREES, NETWORKS, AND MULTIDIMENSIONAL SCALING

Stephen A. Truhon

Associate Professor

Department of Social Sciences

Winston-Salem State University

ABSTRACT

Air Force specialties which had been studied in the General Work Inventory and the Ease of Movement studies were reanalyzed for similarity through the use of additive trees, networks, and multidimensional scaling. The clustering through the use of additive trees suggested support for the existing taxonomy with exceptions for the clustering of various communication specialties and the clustering together of mechanical and electrical specialties. Extended trees did not much improve the clusters resulting from the additive trees. Network analysis suggested that some specialty areas such as air traffic control, communication, and the use of simulators show a good deal of interchangeability within those areas. In addition, specialties that are described as difficult are good preparation for other specialties, while easy specialties show ease of transfer from other specialties. Multidimensional scaling analyses revealed one dimension common to both studies involving clerical vs. craft skills. Also important in the Ease of Movement study was a dimension involving the amount of technical knowledge required for the specialty. Recommendations for combining specialties and for vocational counseling are made based on these results.

OBSERVATIONS ON THE DISTRIBUTION, ABUNDANCE, AND BIONOMICS OF AEDES ALBOPICTUS (SKUSE) IN SOUTHERN TEXAS

Michael L. Womack
Associate Professor
Division of Natural Sciences and Math
Macon College

Abstract

The distribution and bionomics of the imported Asian tiger mosquito, *Aedes albopictus* (Skuse), in southern Texas was investigated. Thirty-five new county records were added to its distribution in this state. Additionally, 8 new county records were established for another container breeding mosquito, *Aedes aegypti*. *Aedes albopictus*, the Asian mosquito had a wide distribution in southern Texas, but its abundance decreased in the counties bordering the Rio Grande River. An investigation of the bionomics of *Ae. albopictus* in the San Antonio metropolitan area indicated that this mosquito was utilizing natural tree holes as a larval habitat.

COHERENT HETERODYNE ARRAY DOPPLER IMAGING

Richard Anderson
Professor
Department of Physics
University of Missouri

Abstract

In initial research performed previously coherent heterodyne angle-angle (2-D) imaging was performed. In this research angle-angle-Doppler imaging will be performed. In future research ranging shall be added so angle-angle-range and 3-D-Doppler data may be acquired. The theory of the phase-up and of angle-angle-Doppler imaging is presented. An experiment will be performed on angle-angle-Doppler imaging.

A BRIEF STUDY OF PASSIVE VISCOUS DAMPING FOR THE BULKHEAD STRUCTURE

Thomas J. Thompson
Graduate Research Assistant

Joseph R. Baumgarten
Professor

Department of Mechanical Engineering
Iowa State University

ABSTRACT

The SPICE Testbed at Phillips Laboratory is being used to evaluate the effects of structural vibration on line-of-site error for this strut built structure. A design incorporating active control and passive damping techniques is suggested to reduce the optical path distortion created in the vibrating structure. The passive viscous damping applied to the structure serves to aid the active control system stability in the cross-over and spill-over frequency range by producing a specified magnitude of damping in specified critical modes. This magnitude of damping is to be achieved by replacing the standard filament wound undamped struts with optimally placed D-struts which contain series and parallel combinations of springs and viscous dampers and produce damped vibration response from in-line strut deflection. This D-strut must replace standard struts in a tear-down of the bulkhead. The present study proposes to provide the requisite damping by adding on viscous damping at diagonal nodal locations in the bulkhead, circumventing the need to disassemble the SPICE bulkhead. The study shows specific increase in loss factor and improved damping ratio provided by the diagonal dampers when compared to in-line D-struts for specific modes and frequencies.

CALIBRATION TECHNIQUES FOR A LOW ENERGY X-RAY IRRADIATION CHAMBER

Raymond D. Bellem
Associate Professor
Department of Electrical Engineering
Embry-Riddle Aeronautical University

Abstract

Analytical and experimental techniques required to calibrate the radiation dosimetry of a new low energy (8-160 keV) X-ray facility were developed and demonstrated at the Phillips Laboratory (PL). Theoretical calculations and experimental measurements from NIST calibrated electronic dosimeters, correlate within 20 percent over the range 8-50 keV. This correlation makes the PL X-ray cell operational up to 50 keV. The facility is capable of continuous (and uniform) dose-rate levels up to 200 Krad(Si)/min. over a target, and is a viable adjunct to Cobalt-60 gamma irradiations for total dose measurements.

ULTRAWIDEBAND ANTENNAS WITH LOW DISPERSION

Albert W. Biggs
Professor
Department of Electrical and Computer Engineering
University of Alabama in Huntsville

Abstract

Ultrawideband (UWB) radars or impulse radars are characterized by very wide bandwidths and commensurate fine range resolution. Applications include target identification in the regime of resonant frequencies of target aircraft, foliage penetration, and ground penetration for subsurface detection.

These radars often use "chirped" or pulse compression to increase radiated peak powers and subsequent range capabilities. Many UWB radars are designed without adequate knowledge or ability to design antennas which maintain adequate pulse waveform. While the input pulse to an antenna may be a damped sinusoid of 10-20 nanoseconds, the output is often a dispersively damped sinusoid of 10-20 microseconds. This paper studies UWB antennas which will reduce pulse distortion by decreasing frequency dispersion.

OPTICAL ANGLE-ANGLE DOPPLER IMAGING

J.K. Boger
Assistant Professor
Laser Optical Engineering Technology
Oregon Institute of Technology

ABSTRACT

A coherent imaging experiment has been done where the modulus and phase were measured directly using a heterodyne technique. Information gathered in the transform plane was manipulated to improve the final image over an image constructed from a distorted wave front. Differences between up-link and down-link distortions were investigated and experimental results obtained are presented. Doppler information was also obtained and analyzed for translating and rotating targets. Results of averaged speckle images obtained from Doppler broadened data are presented.

SECOND-HARMONIC GENERATION IN CORONA-POLED MATERIALS

Gene O. Carlisle
Professor
Department of Chemistry
West Texas State University

Abstract

Second-harmonic generation (SHG) and spectroscopic absorption measurements were used to study the nonlinear optical (NLO) properties of three polymeric thin (≈1 μm thick) films and fused quartz. These materials were made optically nonlinear by a parallel-wire corona-poling procedure. Two of the polymers were side-chains containing NLO chromophores covalently attached to every other carbon atom in acrylate chains while the third polymer was a guest-host system of azo-dye guest molecules in the host poly(methyl methacrylate). For the first time, commercial grade fused quartz, 3 in x 1 in x 1 mm, was made optically nonlinear by a parallel-wire corona-poling procedure. The orientational order parameters of the polymeric thin films were determined from polarized absorption spectra; these stabilized parameters, ranging as high as 0.51, are higher than any reported in the literature. Second-harmonic intensities were measured by the Maker-fringe technique. Because of the very high number density, the side-chain polymers were considerably more efficient in producing SHG than the guest-host films or the fused quartz.

USE OF OPTICAL FIBERS IN LONG BASELINE INTERFEROMETRIC IMAGING

Douglas A. Christensen
Professor
Department of Electrical Engineering
University of Utah

Abstract

Optical fibers offer the promise of flexibility, ease of use, and low cost when used to recombine the light in the two branches of a long baseline interferometer. Such interferometers are being studied for imaging stellars objects with high resolution, including geosynchronous satellites, the sun, and stars. The work described in this report is a continuation of a study to ascertain the parameters that are important in implementing fibers in a broadband interferometer. The factors which must be considered include dispersion effects in the fibers, phase variation or wander in each of the branches and how to control the phase, and the low light levels which will accompany the use of single mode fibers. Toward these goals, two tasks were achieved this summer: 1) Broadband interference fringes were found in an intermediate-step interferometric setup in the laboratory, namely a side-by-side arrangement with two subaperture telescopes observing the same quasi-point source and feeding two 60 m long fiber paths before recombination; and 2) A phase-lock condition was obtained in a test fiber interferometer using a piezoelectric fiber modulator and a lock-in amplifier system. This "internal metric" phase-locking condition is important for the eventual application of the interferometer for imaging purposes.

ANALYSIS OF ONYNEX AND MSRP SEISMIC REFRACTION DATA IN NEW ENGLAND

John Ebel
Associate Professor
Department of Geology and Geophysics

Andrew Paulson
Graduate Student
Department of Geology and Geophysics

Abstract

Using interactive two-dimensional seismic raytracing techniques, seismic velocity models of the crust and upper mantle in New England were constructed from data collected jointly by Phillips Laboratory and Boston College from two seismic refraction experiments. One was from the 1984 Maine Seismic Refraction Experiment (MSRP), with the shotpoints in southcentral Maine and the receivers stretching from Rumford, Maine into the White Mountains in New Hampshire. The second was from the 1988 Ontario-New York-New England Seismic Refraction Experiment (ONYNEX) along a 200 km profile from western New York through Vermont and into southern New Hampshire. From the MSRP data the lower crust and Moho discontinuity in Maine were found to vary noticeably across the Norumbega Fault, with a significantly deeper Moho to the west of the fault. From the ONYNEX data the previously reported ramp feature, separating the Grenville basement in the Adirondack Mountains and the Paleozoic basement in the Northern Appalachians, was found. The ramp is inferred to dip from the surface near the Vermont-New York border to 17 km depth beneath the Vermont-New Hampshire border. The configuration of the ramp indicates that it controlled the emplacement of the geology above it during Paleozoic and Mesozoic time. The results of this study suggest models for ancient continental zones which may be applicable to those in other parts of the world.

PREPARATIONS FOR NEUTRON SCATTERING INVESTIGATIONS OF LIQUID-CRYSTAL POLYMERS

David M. Elliott, Ph.D.
Associate Professor
Department of Engineering
Arkansas Tech University

Abstract

Researchers at the Phillips Laboratory at Edwards Air Force Base have been instrumental in the development and characterization of thermotropic liquid crystal polymers (LCPs). One of the most interesting and potentially valuable areas of research on these materials is the question of physico-chemical annealing. The mechanical and chemical properties of some of these materials are known to dramatically improved upon annealing. In order to realize the full potential of annealed LCPs, a firm understanding of the molecular structure, morphology, texture, and the dynamics and mechanism of formation of the annealed state must be obtained. Neutron scattering techniques are thought to be capable of providing much of the basic structural information necessary to develop that understanding.

During the summer of 1992, the author was privileged to have participated in the Phillips Laboratory LCP Research Program at Edwards Air Force Base. His work was primarily involved with preparations for a series of planned neutron scattering experiments. A preliminary search of the literature available about neutron scattering in general and small angle neutron scattering in particular was completed. The information obtained from the literature search was used to investigate some preliminary experiment design considerations for a small angle neutron scattering experiment on LCPs. In addition, a survey of world wide neutron scattering facilities was made. Both their physical capabilities and their user requirements were determined. The results of the survey and the preliminary experiment design considerations were used to recommend a primary and a first alternate neutron scattering facility at which to perform the planned experiments.

ESTABLISHMENT OF AN ARCJET OPTICAL
DIAGNOSTICS FACILITY AT PHILLIPS LAB

Daniel A. Erwin, John H. Schilling, and Jeff A. Pobst
Department of Aerospace Engineering
University of Southern California

Abstract

An arcjet optical diagnostic facility was established at the Phillips Laboratory. This facility is expected to provide accurate measures of flow properties in the plume and nozzle region of arcjet thrusters to assist in the development of more efficient arcjet thrusters for spacecraft stationkeeping and orbit-raising applications. A 30-kW arcjet was mounted and successfully operated in a vacuum test chamber capable of accurately duplicating the space environment. Optical elements were installed to allow active or passive measurement of flow properties using the techniques of emission spectroscopy and laser-induced fluorescence. A tunable ring dye laser pumped by a 20-watt CW argon-ion laser were installed and aligned for LIF experiments. Finally, an automated control and data-acquisition system was installed and softwar developed to conduct a variety of experiments.

ION-MOLECULE REACTIONS AT HIGH TEMPERATURES

Melani Menéndez-Barreto
Graduate Student
Department of Physics
University of Puerto Rico at Mayaguez

Jeffrey F. Friedman
Assistant Professor
Department of Physics
University of Puerto Rico at Mayaguez

Thomas M. Miller
Professor
Department of Physics and Astronomy
University of Oklahoma

Abstract

A flowing afterglow apparatus designed for the measurement of ion-molecule reaction rate coefficients at temperatures higher than any previous work was debugged and put into operation during the summer of 1992. Ion-molecule reaction rate coefficients were measured for a variety of systems in the temperature range 300-1200 K: O^- + H_2, D_2, N_2, CO, NO, and CH_4; Ar^+ + H_2, O_2, CO, NO, and CH_4; O_2^+ + CH_4; and Cl^- + CH_3Br and CH_3I.

Environmentally Safe Solution Propellants: Ionophilic Polymer and Liquid Salt Binder Systems

Daniel Lee Fuller
Professor of Chemistry
Department of Chemistry and Physics

Abstract

Energetic polymeric salts as well as mixtures of polymeric salts and liquid HAN have been investigated for use in environmentally safe solid propellants. HAN is a liquid solution of 95% hydroxylammonium nitrate, 5% ammonium nitrate, and a stabilizer. In this study, polymeric salts have been prepared. Poly(allyl amine) and poly(ethyleneimine) served as the cation source. The anions were nitrates, NO_3^-; nitroformates, $C(NO_2)_3^-$; and dinitramides, $N(NO_2)_2^-$. Characterization of these compounds is reported with respect to thermal properties, impact, friction sensitivity, as well as their miscibility, compatibility, and gelatination in HAN.

Binary and ternary mixtures of HAN with selected polymers, prepolymers, plasticizers, and monomers have been prepared. The miscibility, compatibility, and gelatination of these mixtures are presented in the report.

Free radical polymerization of monomers in HAN has been undertaken. Five monomers have been studied. Of these five, acrylamide appears to be the most likely candidate for further consideration as a propellant binder in conjunction with gelatination of HAN to achieve the required mechanical strength needed for a solid rocket propellant.

AN INVESTIGATION OF THE FEASIBILITY OF VARIOUS ENERGETIC SALT COMBINATIONS FOR USE IN SOLUTION PROPELLANTS

Vincent P. Giannamore
Assistant Professor
Department of Chemistry
Xavier University of Louisiana

Abstract

Mixtures of energetic salts were examined for their feasibility of use in solution propellants. The principle goal of this initial study was to discover mixtures which were liquid near 298 K. Six different combinations of salts were investigated. These included ammonium dinitramide/ammonium nitrate, ammonium dinitramide/hydrazinium nitrate, ammonium dinitramide/guanadinium nitroformate, ammonium dinitramide/hydrazinium nitroformate, guanidinium nitroformate/ammonium nitrate, and guanidinium nitroformate/hydrazinium nitroformate. A total of thirty-three different compositions of these mixtures were examined. None of the mixtures studied were entirely satisfactory. However, some appear to be worth further study. Mixtures of ammonium dinitramide and ammonium nitrate containing 75 mole percent and 90 mole percent ammonium dinitramide appear to be the most promising

DEVELOPMENT OF A PROTOTYPE LIDAR SYSTEM AT THE STARFIRE OPTICAL RANGE

Gary G. Gimmestad
Principal Research Scientist
Georgia Tech Research Institute
Georgia Institute of Technology

Abstract

A prototype lidar system has been developed and demonstrated at the Starfire Optical Range (SOR). The lidar system uses a copper vapor laser (CVL) as a source. This laser has two output wavelengths, 0.5106 and 0.5782 microns, with roughly equal power. The laser beam is projected through a 1.5 meter telescope and is focussed at 10 km range. The lidar receiver is based on a 14-inch telescope mounted on the side of the 1.5 meter telescope. The receiver has two optical channels and the lidar can be configured either as a two-color system or as long-range and short-range receivers which span an altitude range from the planetary boundary layer through the stratospheric aerosol layer. The receiver components are mounted on an optical breadboard to allow easy changes in configuration. The two-channel data system has 12-bit transient recorders with a maximum digitization rate of 20 MHz and digital memories capable of averaging up to 64 k sweeps. The digitizers were interfaced to a PC AT computer which was used for data acquisition, recording, analysis and display. The system was normally operated with 10 Mhz digitization rate, which yields 15 m range resolution, and 3000-sweep averaging which required 3.6 seconds per measurement. The maximum range of the system was limited to 30 km by the 5 kHz pulse repetition frequency of the CVL. The system was demonstrated by monitoring subvisual cirrus drifting across the zenith sky with 30-second time resolution. Analysis of this data showed that the transmittance of the cirrus, which ranged from 0.9 to 1.0, could be determined with an accuracy of about +/- 0.02.

DYNAMICS OF THE REACTIONS OF Ar^+, N_2^+ AND Kr^+ WITH NO

Susan T. Graul
Assistant Professor
Department of Chemistry
Carnegie Mellon University

Abstract

Absolute cross sections for the reactions of $Ar^+(^2P_{3/2,\,1/2})$, $N_2^+(^2\Sigma)$, and $Kr^+(^2P_{3/2,1/2})$ with NO have been measured in a guided-ion beam apparatus for the laboratory energy range of 0.1-20 eV. Throughout this energy regime, charge transfer is the dominant process, and in all three cases, the cross section decreases with increasing collision energy. Preliminary measurements of time-of-flight distributions indicate that the NO^+ charge transfer products are formed predominantly with near-thermal kinetic energies, but a minor backscattered channel is observed at low energies that can be associated with long-lived complex formation. For all three reactions, the dissociative charge transfer products N^+ and O^+ are also formed, with appearance energies close to their thermodynamic thresholds. The Ar^+ + NO reaction yields ArN^+ in the energy range between about 5 and 20 eV, but no ArO^+ could be detected.

RADAR SIMULATION AND ANALYSIS TOOLS
FOR SATELLITE ANALYSIS - A RECOMMENDATION

Dr. J.M. Henson
Assistant Professor
Department of Electrical Engineering
University of Nevada

Abstract

In order for the Phillips Laboratory, Advanced Weapons Directorate, Satellite Signature and Imaging (WSAI) working group to realize its mission, certain radar data and image simulation and analysis tools and techniques must be defined and integrated into the group's existing modeling and analysis techniques. While there are several modeling issues (multispectral model compatibility requirements) that are of serious concern to WSAI, these concerns are beyond the scope of this report. Rather, it is our purpose herein to briefly describe current radar related data analysis, imaging, image analysis and software simulation options and to recommend that WSAI adopt the Lincoln Laboratories RCS Toolbox and the Enhanced Lincoln Interactive Analysis System (ELIAS) software packages to support its signature and imaging simulation and analysis requirements.

OPTICAL AND ATMOSPHERIC TURBULENCE

MAYER HUMI, Professor
DEPARTMENT OF MATHEMATICAL SCIENCES
Worcester Polytechnic Institute

Abstract

For many important applications it is imperative to estimate correctly the spectral density of atmospheric turbulence. To this end one must collect meteorological data and "detrend" it to obtain the turbulent residual. The objective of this project was to experiment with different detrending (= filtering) strategies and gauge their impact on the computed spectral densities of the flow variables. To help accomplish this objective a general purpose software package was written and used.

A THERMAL MODELING OF DIRECTIONALLY WOVEN CARBON-CARBON FIBER MATERIALS - PREDICTION OF ORTHOTROPIC THERMAL CONDUCTIVITY

Amir Karimi
Associate Professor
Division of Engineering
The University of Texas at San Antonio

Abstract

This study investigates the thermal characteristics of directionally woven carbon-carbon (C-C) composite materials. It contains thermal modeling of composite materials for the prediction of orthotropic thermal conductivities. The prediction formula is based upon a thermal circuit analysis of a unit cell, describing the repetitive construction pattern within a directionally woven C-C composite material. It illustrates that a unit cell, itself, can be divided into smaller components, or sub-cells. A circuit approach is employed to formulate the effective directional thermal conductivities of a generic sub-cell, containing an arbitrarily oriented carbon fiber within the precursor matrix. The influence of the longitudinal and transverse thermal conductivities of carbon fiber, the thermal conductivity of the precursor matrix, and the contact resistance, are incorporated in the thermal modeling. The orthotropic thermal conductivity is then based upon thermal circuit analysis of the network of the sub-cells within a unit cell of a directionally woven C-C fiber composite material.

The model developed in this study may be used to predict the orthotropic thermal conductivities for several geometrical configurations of directionally woven carbon-carbon fibers including unidirectional (1-D), bi-directional (2-D), and multidirectional (3-D, and 4-D). The proposed model could be utilized for the examination and design of active and passive radiators for space applications. Existing thermal conductivity data necessary for verification of the model is very limited. Specifically, the transverse thermal conductivity data of carbon fibers is scarce. It is suggested that further investigations are required for thermal conductivity data collection and verification of the model. Creation of a data base on the thermal conductivities of individual carbon fibers and fabricated C-C composite materials is recommend for future studies. An extension for the application of this model is the prediction of effective thermal conductivity of wire screens used in heat pipes. The comparison of this model shows good agreement with available data.

SPIN DYNAMICS OF LAGEOS SATELLITE

Arkady Kheyfets
Assistant Professor
Department of Mathematics
North Carolina State University

Abstract

The long term prediction of the LAGEOS satellite (laser-ranged geodynamic satellite) spin dynamics is very important for a successful completion of its mission of measuring the relativistic Lense-Thirring effect According to the current model, there is a possibility that, under combined influence of gravitational and magnetic fields of the Earth, the rotational dynamics of the LAGEOS satellite might become chaotic due to a fast growth of the satellite precession rate as its spin motion is slowed down by the Earth's magnetic field. We have reconsidered this prediction. A more detailed analysis of the Lagrange equation describing rotational dynamics of the satellite shows that the rate of the satellite precession is bounded, the bound being much smaller than the orbital angular velocity, even if magnetic forces are neglected. Inclusion of magnetic forces further reduces the value of the bound. Our Lagrangian formulation of the satellite spin dynamics can be used in the future investigation of the satellite nutation and the time scales of dissipating the rotational motions of the satellite under the influence of the gravitational and magnetic fields of the Earth.

Generation of ELF and VLF Waves by a Thermal Instability Excited in the HF Heater-Modulated Polar Electrojet

S. P. Kuo
Professor
Department of Electrical Engineering
Polytechnic University

Abstract

A thermal instability responding to the modulation of polar electrojet by HF heater as a potential efficient mechanism for the generation of ELF and VLF waves has been investigated. It is shown that a positive feedback through the electron-neutral collisional heating process can cause the transient response of the plasma to the modulated HF heater to grow exponentially. Considering a sinusoidally modulated HF heater wave having its field amplitude proportional to $|\cos\omega_1 t/2|$, the threshold fields of the thermal instability under normal electrojet conditions are found to be about 0.3 V/m and 0.15 V/m for the o-mode and x-mode operation respectively. For a heater wave field of 0.5 V/m, the instability can be excited by the x-mode heater within a few tenth of a second and by the o-mode heater within one second.

EQUATION OF RADIATIVE ENERGY TRANSFER
IN ELECTROMAGNETIC THEORY
WITH WAVE-OPTICAL CONTRIBUTIONS

Arvind S. Marathay
Professor
Optical Sciences Center
University of Arizona

Abstract

The conventional equation of radiative transfer is formulated in the frame work of ray optics. It is applicable to scalar waves. Since light is an electromagnetic wave, the ray optic and scalar description is incomplete.

The research reported here formulates the energy transfer problem in the language of wave optics. Starting from Maxwell equations, a radiative energy transfer equation is derived. It shows explicitly the wave optics contributions and includes the source terms generated by induced dielectric polarization. This will provide a basis for studying the effects of polarized light in any state of polarization and properly account for coherence effects in applications.

PARTICLE SIMULATIONS OF PLASMAS

R. D. Murphy
Professor
Department of Physics
University of Missouri - Kansas City

Abstract

Studies of the applicability of "particle" computer simulations to plasma phenomena were performed. A number of problems for which such simulations appear to be feasible were identified. A direct simulation Monte Carlo code, necessary for such efforts, was written and tested.

POINTING AND ACCURACY ANALYSIS OF SOLAR CONCENTRATORS

Rupa Purasinghe
Associate Professor
Department of Civil Engineering
California State University at Los Angeles

Abstract

Under the space environment the paraboloid solar concentrators and support structures can deform and hence the focal point of the concentrators can diffuse. If this diffusion is large, energy will not concentrate on the thruster as desired. This report addresses this aspect of pointing and accuracy analysis of solar concentrators.

A simplified finite element model including support struts and simple torus were used. The torus model was made up of several equal length beams. The simple model did not contain the paraboloid reflector, and assumes the reflector does not affect the deformation of torus. Modal and buckling analysis of the structure and a static analysis due to equivalent thrust loads were done using the finite element Nastran program. The results demonstrate diffusion of the focal point of the concentrator.

MIXED-MODE FRACTURE OF SOLID PROPELLANTS

Krishnaswamy Ravi-Chandar
Associate Professor
Department of Mechanical Engineering
University of Houston
Houston, TX 77204-4792

Abstract

The initiation of crack growth under mixed-mode loading conditions in a solid propellant material was examined experimentally. Compact tension-shear specimens were prepared from a solid propellant. The specimens were loaded under combined tension and shear in a special grip capable of varying the ratio of tension and shear. The crack tip deformation was examined using a coarse grid (0.2 mm spacing) painted on the surface of the specimen and photographed with a video camera before and during the loading. While the critical stress intensity factors at crack initiation were found to correlate well with the maximum tangential stress theory, the angle of crack kinking did not. This is attributed to extensive crack blunting and damage near the crack tip region.

VIBRATION AND COMPRESSION TESTING OF COMPOSITE ISOGRID PANELS

Sean A. Webb
Graduate Student

Dr. Christopher A. Rotz
Associate Professor
Department of Manufacturing Engineering and Engineering Technology
Brigham Young University

Abstract

Experimental vibration and compression tests of a composite isogrid panel have been successfully carried out. The first four natural frequencies and mode shapes were successfully identified. A simple analytical model developed in the study provided good estimates of the natural frequencies of the bending modes. Bending and torsional modes were analyzed with a simple finite element model. The predicted mode shapes agreed very well with those observed experimentally. Failure loads in the compression test were lower than predicted. This may have been caused by problems with the fixtures used to hold the specimen. Predicted strains were in good agreement with the average values measured in the test. The strains varied more with location on the panel than anticipated in the model, resulting in some strains being higher and others lower than predicted.

Solar Scintillation and the Monitoring of Solar Seeing

Edward J. Seykora
Professor
Department of Physics
East Carolina University
Greenville, NC 27834

Abstract

A non—telescopic method of determining the quality of atmospheric seeing is discussed for large angular diameter objects, such as the sun. In this method the concept of thermodynamic fluctuations is used to relate the observed intensity fluctuations to the RMS angular diameter of the atmospheric seeing cells and telescopic angle of arrival fluctuations. Comparisons between the measured RMS cell size and telescopic angle of arrival fluctuations are presented for various degrees of seeing. Cross correlation coefficients of 0.95 have been measured during such comparisons.

SPACE DEBRIS IMPACT EFFECTS ON SPACECRAFT MATERIALS

by

Jon H. Shively
School of Engineering
California State University at Northridge

1.0 SUMMARY

Tests to simulate the effects of hypervelocity collisions of space debris were conducted at Los Alamos National Laboratory. The collisions were produced by propelling a thin plate of aluminum in air and in vacuum at targets of polysulfone and a polysulfone graphite fiber composite. The chemical species in the blow-off produced by the collision were measured using a time-of-flight mass spectrometer. Also the resultant damage was examined using optical and scanning electron microscopes.

In addition to the testing, a review of data on hypervelocity shock led to the development of a correlation of shock data for homogeneous materials in which all materials follow a master curve. The basis of the correlation follows from theoretical predictions in the literature in which shock can be represented using the principle of corresponding states. The ramifications of the correlation mean that temperature, pressure, and density can be represented by a single equation-of-state.

ESTIMATION OF MISALIGNMENT PARAMETERS OF MULTI-APERTURE TELESCOPES

Johanna K. H. Stenzel
Associate Professor
Department of Arts and Sciences
University of Houston-Victoria

Abstract

Discrete optimization using the phase-diversity method and optical transfer functions calculated for one hundred piston values in a smaller frequency region yielded very similar piston estimation as did a conjugate-gradient optimization over the entire frequency region. Both methods successfully estimated piston misalignment (within ±0.1 waves of piston) of an experimental two-aperture telescope for some objects but not others. Wiener-Helstrom filter restoration of the objects showed less noise for the images with piston misalignments that were more successfully estimated.

This paper develops a model for the optical transfer functions of mirrors with arbitrary numbers of apertures and presents a method for reducing the dimension of their misalignment-parameter space and the size of their frequency domain.

SATELLITE FRAGMENTATION DUE TO EXPLOSION AND COLLISION

A. Tan
Professor
Department of Physics
Alabama A & M University

Abstract

Past studies to determine the cause of satellite fragmentations in space have been limited by the phenomenological nature of the investigations. In this study, a more analytical approach has been initiated by noting the physical processes taking place in an explosion and a hypervelocity collision. It is argued that an explosion is more effective in producing trackable fragments than a collision with the same amount of available energy. This assertion is substantiated by investigating an on-orbit satellite explosion as exemplified by the NOAA-3 Rocket explosion in 1973 and a hypothetical event in which a similar rocket is impacted by a projectile at 7 km/s. An empirical code (IMPACT 2.0) and an analytical code (2-d MAGI) have been employed to attain the objective. While IMPACT 2.0 modelled the explosive event reasonably well, it failed to fragment the satellite through hypervelocity impact. The mass (and therefore energy) of the projectile had to be increased tenfold before fragmentation could be achieved. The MAGI code modelled the ejecta from the collision event very precisely as expected, but fell short of fragmenting the satellite. At present, both the empirical and analytical codes need significant upgrading before satellite fragmentation events could be analyzed accurately.

SPECTROSCOPIC DATA OF ATMOSPHERIC INTEREST

R. H. Tipping
Professor
Department of Physics and Astronomy
University of Alabama

Abstract

Spectroscopic data, including such important parameters as rotation-vibrational transition frequencies and intensities, have been calculated for three diatomic molecular species: $^{14}N^{15}N^{+}$, $^{16}O^{18}O^{+}$, and OH. Although the heteronuclear nitrogen and oxygen molecular ions have low concentrations in the Earth's atmosphere, they are polar and, consequently, are infrared active. The fundamental transitions were looked for in atmospheric spectra obtained by researchers at the Phillips Laboratory but were not found. In contrast, highly rotationally excited OH pure rotational transitions were recently observed. Because previous intensity calculations were made assuming a constant dipole moment and these become progressively inaccurate as the rotational quantum number increases, we have calculated improved values that should be of use in the analysis of the OH excitation mechanism.

THE ROLE OF ATOMIZATION IN LIQUID PROPELLANT ROCKET COMBUSTION INSTABILITY

Robert J. Turnbull
Professor
Department of Electrical and Computer Engineering
University of Illinois

Abstract

A study was made to determine fruitful areas for research on combustion instabilities in liquid fuel rockets. These instabilities involve the interaction of acoustic waves with fuel combustion processes. Atomization of the propellants, specifically the final droplet size, is one of the crucial parameters that determine the burning rate. The size of the droplets resulting from secondary atomization is susceptible to change by acoustical disturbances, thus it could couple into an instability. An investigation was begun on the effects of droplet shape, droplet orientation, and sound wave frequency on the interactions between drops and acoustic waves. The goal is to determine how the secondary atomization process is affected by sound waves and, in turn, how this interaction can produce an instability. Finally possible instability control techniques were examined. Further work in these areas is planned.

EXPERIMENTAL INVESTIGATION OF HOMOGENEOUS AND HETEROGENEOUS NUCLEATION/CONDENSATION PROCESSES AND PRODUCTS IN COIL.

Philip D. Whitefield
Research Associate Professor
and
W. Mark Barnett
Graduate Student
Department of Chemistry Cloud and Aerosol Sciences Laboratory,
University of Missouri - Rolla.

Abstract

This paper describes the preliminary results of an ongoing study to characterize the nature and sources of sub-micron aerosols in the Phillips Laboratory small scale supersonic COIL device and other COIL devices. Aerosols from both sub- and supersonic flow regimes were sampled and characterized using the University of Missouri-Rolla, Mobile Aerosol Sampling System (MASS). Under all operating conditions where the oxygen generator discs were rotating, significant concentrations of aerosols were detected. Typically these aerosols had peak dry diameters of <0.05microns and nascent wet diameters of <0.08microns. Their total number density increased with increasing rotating disc velocity and with the addition of chlorine. A maximum number density of <3000/cc was observed at maximum chlorine flow rates when the initial generator mixture had been heavily depleted (i.e.neutralized with chlorine). Experiments to observe homogeneous nucleation of aerosols in simulated supersonic laser gas flows were unsuccessful. The critical supersaturation spectra for a KOH, KCl, I_2 have been measured and compared to theoretical calculations.

INSTALLATION OF OSCILLATING NEURAL NETWORK ALGORITHMS INTO A KHOROS TOOLBOX

Carla C. S. Williams
Assistant Professor
Department of Physics and Engineering
Fort Lewis College

Abstract

Many of the Air Force laboratories are interested in providing an environment supporting multidimensional signal processing research using neural network algorithms for pattern recognition and classification. This paper presents the results of an on-going project to develop, implement, and test a number of generic neural network algorithms that could be used by an application engineer with limited domain expertise in neural computation. The current focus of the project is on the simulation of coupled oscillatory neural networks which hold promise in exploiting the massive parallelism offered by newer hardware technologies. Several routines were implemented under the Khoros software development system which provides tools for integrating new programs to be used within a visual programming environment which also includes a large number of predefined signal and image processing routines.

THE TRAJECTORIES OF EASTERN HEMISPHERE SOLAR ELECTRON EVENTS AS INFERRED FROM ISEE-3 RADIO AND PARTICLE DATA

Robert F. Willson
Research Associate Professor
Department of Physics and Astronomy
Tufts University

Abstract

We use radio and particle data from the International Sun-Earth Explorer (ISEE-3) satellite to trace the paths of energetic electrons as they propagate from flare sites on the Sun to the earth. Our study extends over the period of operation of the electron experiment on ISEE-3 from August 1978 to November 1979. Previous investigations have suggested that particles in eastern hemisphere flares are much less likely to reach the terrestrial environment because they travel along Archimedean magnetic field spirals that curve away from the earth. Based on the timing of Hα flares, and metric and kilometric metric Type III bursts, we first compiled a list of all electron events that could be associated with eastern hemisphere flares. The trajectories of the kilometric Type III bursts were then examined using data from the ISEE-3 radio experiment. Our results show that some of these associations were in fact spurious: the Type III bursts appeared to have originated from behind the west limb or from regions that are magnetically well-connected to the earth. Other, positively identified, eastern hemisphere bursts show complicated trajectories that suggest a role for coronal propagation or interactions with pre-existing structures that disrupt a well-ordered interplanetary field pattern.

TOWARD THE DEVELOPMENT OF A GENERALIZED METHOD AND CODE FOR ANALYZING INFINITE ARRAYS OF ANTENNAS PRINTED ON BOTH SIDES OF PROTRUDING DIELECTRIC SUBSTRATES

Jean-Pierre R. Bayard
Associate Professor
Department of Electrical & Electronic Engineering
California State University, Sacramento

Abstract

A method for analyzing infinite arrays of antennas printed on both sides of protruding substrates and covered with a dielectric radome is described. By using the equivalence principle, the array unit cell is decomposed into homogeneous regions where the fields are expressed as Floquet summations, and an inhomogeneous cavity region where the fields can be found by a combination of the method of moments and modal analysis. The approach is rigorous in the sense that the combined effects of the radiating element and feed geometry printed on both sides of a protruding substrate are accounted for. It is general, capable of modeling any antenna elements with currents that are perpendicular and parallel to the ground plane. In addition, both the radiating and scattering/receiving modes of operation are treated. The method is used to calculate the active element impedance of an infinite array of dipoles transmission line - coupled to microstrip feeds. Examples of numerical results are presented for various scan conditions and the effects of a near-field dielectric radome are demonstrated.

STATISTICAL COMPARISON OF SEVERAL AUTOMATIC TARGET RECOGNITION (ATR) SYSTEMS

PINYUEN CHEN

Associate Professor
Department of Mathematics
Syracuse University

ABSTRACT

A selection procedure is proposed to select the best Automatic Target Recognition system among several candidate systems based on two performance measures, the probability of detection and the probability of false alarm. Two classical statistical approaches, the indifference zone approach and the subset selection approach, are integrated to form a meaningful approach to meet the evaluation requirements. The proposed procedure allows us to select the best system if there is a significant improvement of the best over the second best, or the procedure will select a subset of systems that contains the best when the difference between the top two systems is not significant. Four examples and a table are given at the end of this report to implement the procedure.

Photonics Technology Development at Rome Laboratory

Richard L. Fork
Professor
Leonard Lyon
Sean McCaul
Students
Department of Physics
Rensselaer Polytechnic Institute

Abstract

Six projects relevant to photonics, high transmission rates, and optical processing were developed: the achieving of lasing action using forsterite crystals; designing, ordering components for, and commencing construction of a figure eight optical fiber laser; the measurement of stimulated brillouin backscattering in optical fiber; the alignment of an external cavity semiconductor laser; setting up a demonstration unit for video signals over optical fibers; construction of a soldering station for bonding leads for a semiconductor laser; and the development of educational modules on fusion splicing, calculating loss through a fusion splice, and optimizing coupling laser emission into a bare fiber.

ISSUES IN ADAPTIVE FAULT MANAGEMENT FOR SURVIVABLE C^3I SYSTEMS

Rex E. Gantenbein
Associate Professor
Department of Computer Science
University of Wyoming

ABSTRACT

Most strategies for fault management are effective for a narrow range of fault classes. In survivable distributed systems, a wide range of operating environments may be encountered that require different strategies to be used at different times. This report discusses how adaptive fault management can be used to select the most appropriate methods for assuring survivability under conditions that can suddenly and drastically change.

A model for adaptive fault management is presented that outlines the major research issues: managing adaptivity, modeling the strategies, and evaluating the system behavior in a dynamic environment. A taxonomy for fault management mechanisms that establishes three basic classes of strategies is defined as a basis for modeling these mechanisms. A generalized metric by which the effectiveness of a fault management strategy can be measured against system requirements -- the objective function -- is also defined. This metric can be used to determine how well a survivable system meets its requirements in the current operating environment. The research being carried out into this approach at Rome Laboratory and at Wyoming is described. Finally, some suggestions for future research are given, along with a schema that relates these topics to the current work.

Atomistic Simulation of Grains in Submicron Aluminum Interconnects

Surendra K. Gupta
Associate Professor
Department of Mechanical Engineering
Rochester Institute of Technology

Abstract

A two-dimensional model to simulate motion of atoms in a submicron width aluminum line with bamboo grain structure is developed. The model is implemented on computer platforms supporting the VMS operating system. Real-time graphics is incorporated in the software using the UIS Graphics Library. The computational cell consists of two grains, one in the center and the other split in two halves. One-half is located at the left edge and the other half is located on the right edge so that the edges are properly aligned to create periodic boundary conditions. Atoms in the top and bottom row of subcells are fixed, and the interior atoms interact with one another following the Lennard-Jones potential energy function.

Simulations are performed for a cell consisting of approximately 2000 atoms with a time step of 0.01 pico seconds for 5000 iterations at T = 375°, 400°, 425°, 450°, 475° and 500°K. Total energy in each case is found to remain constant within 0.1%. Overall diffusion coefficients computed during each simulation are plotted against 1/T, and the activation energy for diffusion is found to be 1.292 kcal/mol-K.

WIDEBAND ATM NETWORKS WITH ADAPTIVE ROUTING FOR THE DYNAMIC THEATER ENVIRONMENT

Robert R. Henry
Professor
Department of Electrical & Computer Engineering
University of Southwestern Louisiana

Abstract

Traditional tactical and theater military communication networks are characterized by relatively low bandwidth links. The environment is dynamic in the sense that the links are subject to jamming and the nodes to destruction by the enemy. Modern and future military equipment and tactics require the use of wideband links to exchange bandwidth-intensive information such as video and images. However, current and proposed wideband networks such as ATM have been designed for peacetime, *ie*, *well-behaved* operation. The research described herein proposes and evaluates three ways in which wideband ATM networks may be adapted for operation in the dynamic theater environment.

Multipath Channel Equalization for Spread Spectrum Communication System

Presented By

Dr. H. K. Hwang
Department of Electrical and Computer Engineering
California State Polytechnic University
Pomona, California 91768-4065

Abstract

Spread spectrum communication systems use a much wider transmission bandwidth than that is required for information transmission. The advantage of using the excessive bandwidth is that the system becomes less sensitive to noise, jammer, and intersymbol interference (ISI). To further aid the spread spectrum in reducing the ISI, an adaptive equalizer is used. The idea of using adaptive equalizer to suppress the ISI is similar to reference 1, which using the adaptive filter to reject the narrow band interference.

AN INVESTIGATION OF THE BENCHMARK EVALAUATION TOOL

K. Kalkhah
Chair, Department of Computer Science
Huston-Tillotson College

ABSTRACT

Recently, natural language processing has received tremendous support and popularity. As a consequence, the number of natural language processing systems has dramatically increased and the need for a systematic evaluation procedure of such systems seems inevitable. Until recently, there has not been a universal evaluation procedure for evaluating all types of NLP systems. Evaluations of such systems are usually conducted during the implementation phase and, in most cases, do not involve a comprehensive plan or independent evaluators. Developers of NLP systems can benefit from an unbiased evaluation procedure which measures their efforts and the power of their systems. At the same time, the consumers of NLP systems can benefit greatly from an evaluation tool which assists with the selection of the appropriate system for their needs.

The Calspan Corporation has proposed and implemented the Benchmark Evaluation Tool for evaluating all natural language processing systems, regardless of type or application. The study was sponsored by the Rome Laboratory and was concluded in May of 1992. The Benchmark Evaluation Tool is designed to be domain independent. Therefore, it concentrates on the linguistic issues rather than on the application domain. This feature is unique, in that, the tool is sensitive to each individual linguistic capability and not to each individual application. It is composed of twelve independent sections which are designed to progressively test different linguistic features of NLP systems. The Benchmark Evaluation Tool also includes definitions and explanations for each section as well as a five-choice scoring strategy to measure the responses.

Our objective is to investigate the effectiveness of the Benchmark Evaluation Tool by applying the tool to a natural language processing system. This particular system is composed of two major parts: a domain-independent part which has general knowledge of syntactic rules, and a domain-specific part which provides the necessary semantic and pragmatic knowledge for a specified domain. The application domain accompanying the NLP system for testing purposes is an interface to a relational database of *air travel planning information.*

MEASUREMENT OF THERMOPHYSICAL PROPERTIES OF SEMICONDUCTORS AT HIGH TEMPERATURE

Joseph B. Milstein
Associate Professor
Paul J. Chandonnet
Graduate Student
Department of Electrical Engineering
University of Massachusetts Lowell

Abstract

InP is potentially a superior material for use in high-speed devices, microwave devices, optoelectronic devices, and radiation hard, highly efficient solar cells. The production of high quality single crystal substrates is required to attain the technological promise that such materials hold out. The thermophysical properties of these materials in the molten state have an appreciable bearing on the crystal growth process. These properties include the density, thermal conductivity, thermal diffusivity, kinematic viscosity, and emissivity of the liquid. These properties have not been measured for InP, because one requires a pressure of 27 atmospheres of phosphorous above the melt at a melting temperature of 1062 °C (1335 K) in order to maintain stoichiometry.

An Arthur D. Little Model HPCZ High Pressure Furnace, capable of operation to 1500 psi, and an associated 50 KW, 450 KHz Lepel Radio Frequency Generator were used in this work. A cylindrical thermal cell was designed and constructed which permitted the controlled melting of InP under a conventional B_2O_3 encapsulant which was contained in a flat bottomed quartz crucible. Temperature mesurements were made using type K thermocouples, and an Omega Engineering OM-900 computer interfacing module, which included a model 992 CPU module. Custom circuitry was designed and constructed to provide electrical power to a secondary molybdenum filament heater under computer control, and with provision for monitoring and logging the voltage and current in a secondary heater. Software to control the experimental procedure and to record data was also written.

The experimental setup was used for measuring properties of copper (a standard material), boric oxide, and indium phosphide.

PHOTONIC DELAY LINE FOR HIGH-FREQUENCY RADAR SYSTEMS

Evelyn H. Monsay
Associate Professor
Department of Physics
Le Moyne College

Abstract

Good pointing accuracy and sidelobe-level noise control in wideband phased array radar antennas depend on the use of true time delays between the microwave elements. A photonic true time delay line was introduced by Toughlian and Zmuda for systems operating in the hundreds of megahertz frequency range (VHF). In the experimental part of this study, their concept is extended to operation in the radar C band through the use of a dichromatic solid state laser. In addition, a system analysis is initiated which relates system-level concepts such as antenna directivity and noise suppression to device-level concepts such as laser jitter and drift.

User-Based Requirements for Large-Scale Distributed Information Management Systems: Representation for System Designers

Michael S. Nilan
Associate Professor
School of Information Studies
Syracuse University

Abstract

This report describes our efforts this summer to generate a method for translating our user-based information system requirements into a representation form that would be readily interpretable by system designers and system analysts. Typically, the kind of requirements specification that we produce from our user requirements analyses are text-based descriptions of problem solving processes as perceived by a group of users. In the past, these text-based descriptions have proven to be difficult for system designers and analysts to interpret. Since our long term research agenda is oriented towards large-scale information management systems which are more complex than traditional applications, we felt that we needed some systematic and easily interpretable format that we could use for communicating our user requirements. Using a combination of hypertext-like representations and a 3-dimensional virtual reality display, we have been able to create a representation system that not only provides for effective interpretation of our user requirements on the part of system designers and analysts, but the virtual reality graphic display configuration also allows us to represent system components (e.g., display devices, databases, network linkages, etc.) in the same graphic environment. We believe that this combination of hypertext descriptions and virtual reality graphic displays will facilitate the accurate representation of user perspectives in large-scale information resource management systems.

FLUX CREEP IN A Y-Ba-Cu-O FILM CHARACTERIZED BY A c-AXIS MICROSTRUCTURE IMBEDDED WITH a-AXIS GRAINS

John L. Orehotsky
Professor
Departments of Physics and
Mechanical/Materials Engineering
Wilkes University

Abstract

Flux creep in an epitaxial grown, YBCO high temperature superconducting oxide thin film was examined by magnetization measurements in the plane of the film as a function of time at temperatures between 5 and 30°K and in fields between 0.5 and 2.0 Telsa. In this particular film, the magnetization relaxation when plotted on a logarithmic time scale generally exhibited a two-stage kinetic response which was most evident at the lower temperatures and fields. In a field of 0.5T, the experimentally apparent activation energy characterizing the first stage creep response was found to increase with temperature, approaching a plateau level of 33meV at 30°K. At 15°K, the activation energy was found to be relatively field insensitive. These response features for the first stage behavior are in modest agreement with theoretical concepts. Because of insufficient data at long time values, no attempt was made to characterize the second stage behavior. The experimentally observed two-stage kinetic response feature in this film is suggested to be a direct consequence of the particular microstructural details of this film.

Toward Implementation of a Certification Framework for Reusable Software Modules

Allen S. Parrish
Assistant Professor
Department of Computer Science
The University of Alabama

Abstract

At Rome Laboratory, a "strawman" framework has been proposed for certifying reusable software. This framework consists of static analysis, including the use of metrics and formal verification, and dynamic analysis, including various testing strategies such as branch coverage and mutation testing. In this paper, we consider the application of this framework to a class of software modules called *passive modules*, which constitute a fundamental part of the vast majority of software reuse. Our emphasis is in two areas. First, we consider an expansion of the framework to include some new dynamic testing strategies, some of which are very important in achieving higher levels of certification of certain passive modules in the context of reuse. We then consider an implementation of the expanded framework, and we discuss some of the requirements of the toolset needed to support this framework.

DATA ASSOCIATION PROBLEMS IN MULTISENSOR DATA FUSION AND MULTITARGET TRACKING

Aubrey B. Poore
Department of Mathematics
Colorado State University
Fort Collins, Colorado 80523

ABSTRACT

The ever-increasing demand in surveillance is to produce highly accurate target and track identification and estimation in real-time, even for dense target scenarios and in regions of high track contention. The use of multiple sensors, through more varied information, has the potential to greatly enhance target identification and state estimation. For multitarget tracking, the processing of multiple scans all at once yields high track identification. However, to achieve this accurate state estimation and track identification, one must solve an NP-hard data association problem in real-time. The only known method for solving this central problem in both multisensor data fusion and multitarget tracking optimally is branch and bound. Herein lies the limitation and difficulty. Data association algorithms based on branch and bound, e.g., multiple hypothesis tracking (MHT), are inevitably faulty in dense scenarios and in regions of high track contention. These failures are not graceful. With the emergence of fast (real-time), near-optimal, and Lagrangian relaxation based algorithms for multidimensional assignment problems, the opportunity now exists to greatly enlarge the number of complex problems solvable in real-time. Thus, in this work a general class of data association problems is formulated as a multidimensional assignment problem. Since the most popular futuristic method for solving difficult data association problems is MHT, the equivalence between solving data association problems by MHT and by multidimensional assignment problems is established. Track initiation and track maintenance using an N-scan moving window are then used as illustrations. MHT is also permeates multisensor data fusion, and thus two classes of simple problems are formulated as multidimensional assignment problems - collocated sensors and noncollocated sensors.

THERMAL CHARACTERIZATION OF IN-SITU SYNTHESIS FOR LEC/MLEK GROWTH OF InP SINGLE CRYSTALS

Vishwanath Prasad
Associate Professor
Department of Mechanical Engineering
Columbia University, New York

Abstract

For one-step, in-situ synthesis of phosphorus vapor and indium melt, and liquid-encapsulated Czochralski growth of InP crystals to succeed and produce single crystals of uniform quality and at lesser cost, it is important to understand the mechanics of heat transfer and gas flow in a high pressure crystal growth (HPCG) system. A series of experiments performed recently in order to characterize the thermal coupling between the melt and the phosphorus injector and to develop an understanding of the buoyancy-induced flow in an HPCG furnace is reported here. It is observed that although the flow in a high pressure puller is turbulent and oscillatory, radiation dominates the heat transfer. The thermal response of the system is therefore quite stable and predictable. An almost linear relationship exists between the power input and the melt temperature. The correlation between the temperatures at various locations of phosphorus injector and the melt is very interesting. The heat of reaction also affects the melt temperature. The phase change phenomenon at the bottom of the phosphorus injector is oscillatory in nature. Theoretical estimates of the strength of gas convection and radiation loss by the melt surface are also presented.

FDTD ANALYSIS OF A NOVEL ANECHOIC CHAMBER ABSORBING BOUNDARY CONDITION FOR EM SCATTERING SIMULATION

Carey M. Rappaport
Assistant Professor
Department of Electrical and Computer Engineering
Northeastern University
Boston, MA 02115

ABSTRACT

During the Summer of 1992, work was performed at Rome Laboratories at Hanscom Air Force Base to develop and test a novel absorbing boundary condition (ABC), used in the finite difference time domain (FDTD) method for simulating electromagnetic wave propagation. This new type of lattice termination algorithm is based on anechoic chamber absorber foam geometry, with specially simulated electric and magnetic conductivity, and electric permittivity and magnetic permeability chosen to prevent reflections and simulate infinite, open free space. The advantage of this ABC over currently used ones is that it prevents reflections from much wider incident angles. Since incident waves need not be normal to this boundary for absorption, the boundary can be placed much closer than previously possible. This new type of ABC can be used to absorb scattered waves in a local sense, so the electrical size of the scattering object does not affect the distance from it to the ABC. Since even a modest decrease in the required separation distance yields a huge saving in the number of required matrix elements for three dimensional geometries, this novel ABC may greatly improve the general applicability of computational electromagnetics.

X-BAND T/R MODULE
CONDUCTED INTERFERENCE SIMULATION AND MEASUREMENT

Final Report

John P. Rohrbaugh
Senior Research Engineer
and
Randall H. Pursley
Graduate Research Assistant
Georgia Institute of Technology
Georgia Tech Research Institute
Atlanta, GA 30332

Abstract

Conducted electromagnetic (EM) interference measurements and analyses were performed on X-band Transmit/Receive (T/R) modules built by Raytheon and Texas Instruments. The T/R module's Clock, Mode[1], +5 and -7 volt dc supply input lines and the Output Built-in-Test and Evaluation (OBITE) line were evaluated. The Clock and Mode differential input pins are connected within the T/R module to a CMOS gate array through DS8820/7820 differential line receivers. EM interference effects were simulated using PSPICE, and verified through measurements, to determine if the model of a DS8820/7820 provides accurate EM interference simulation results at very high frequencies. The objectives of performing measurements and simulations on the DS8820 were to demonstrate that interference effects can accurately be determined on simpler devices and models prior to developing more complex and costly products, such as T/R modules.

Limited simulations were also performed on the OBITE driver IC (54ALS03 NAND gate) and Power Condition Monitoring (PCM) circuits that are connected to the +5 and -7 volt dc supply lines. The PCM circuits are used to monitor over-voltage conditions on the +5 supply and over-temperature on the transmit power amplifier and to disable receive and transmit modes in the event of over-voltage or over-temperature conditions occur. All interference effects, with the exception of receiver low noise amplifier (LNA) gain compression, could be simulated. Effects that were duplicated during simulation included Mode words not received properly by the T/R module, and the T/R module receiver LNA cycling off and on with the application and removal of interference to the OBITE, +5 and -7 volt supply lines.

Damage effects that were observed while performing the interference mesurements could not be simulated. Two T/R modules and two DS78?0 IC's were damaged over the course of this effort.

[1] The Data lines were not tested on this effort. The Mode lines are used to send commands to the T/R module to place the module in transmit, receive, etc., mode-of-operation, hence the nomenclature Mode. The Data lines are used to place the T/R module in a particular state-of-operation once the mode-of-operation has been selected. The default state-of-operation was selected, and thus the reason for not testing the Data lines.

MONTE CARLO VALIDATION OF A THEORETICAL MODEL FOR THE GENERATION OF NON GAUSSIAN RADAR CLUTTER

JORGE LUIS ROMEU
ASSOCIATE PROFESSOR
DEPARTMENT OF MATHEMATICS
SUNY CORTLAND
RESEARCH FELLOW OF THE
CASE CENTER OF SYRACUSE UNIVERSITY

Abstract

Generation of multivariate Non Gaussian random variates is of importance in radar clutter studies. For, when the analytical evaluation of a radar clutter distribution is difficult or impossible, it is through computer simulation studies that this problem is attacked and solved.

A new statistical method, based on SIRP's (Spherically Invariant Random Processes) has been proposed. This theoretical method allows, both, fit testing of a multivariate Non Gaussian process, and the computer generation of these processes. The theoretical method in question works by decomposing the Non Gaussian process into the product of two sub processes. One these processes is univariate and drives the distribution of the Non Gaussian process. The other subprocess is multivariate Gaussian.

In theorey, the new method appears sound and correct. However, in practice we deal with limited data. In such cases, results may not always reflect the theoretical properties with the required accuracy. For example, it may not be possible to recognize, from the sample, which is the univariate process that drives the multivariate Non Gaussian one. Or the lack of knowledge about the true covariance matrix of the Non Gaussian process, which is then estimated from the data, may substantially degrade the method's accuracy.

The present report describes a Monte Carlo validation experiment, designed to evaluate this theoretical method. Using this approach, we generate two specific SIRP Processes. Then, we perform goodness-of-fit tests on several variables theoretically derived from the Processes and on the Processes themselves. We use different sample sizes and number of p-variates. We also work with the covariance matrix from which we generated the Process and the covariance matrix estimated from the data. Results are compared and statistical tests are discussed.

HIERARCHICAL AND INTEGRATED MODELING AND SIMULATION

Robert G. Sargent
Professor
Simulation Research Group
L.C. Smith College of Engineering and Computer Science
Syracuse University

Abstract

This short paper discusses the three basic approaches to hierarchical and integrated (discrete event) modeling and simulation: software, metamodeling, and "coupling of models" in a new modeling paradigm. Also the desired requirements in a new modeling paradigm for (discrete event) modeling are given.

METAMODEL APPLICATIONS USING TERSM

Michael A. Zeimer
Graduate Student

and

Dr. Jeffrey D. Tew
Assistant Professor

Department of Industrial and Systems Engineering
Virginia Polytechnic Institute and State University

and

Dr. Robert G. Sargent
Professor

Simulation Research Group
L. C. Smith College of Engineering and Computer Science
Syracuse University

Abstract

Tactical simulation models are often used to assess vulnerabilities and capabilities of combat systems and doctrines. Due to the complexity of tactical simulation models, it is often difficult to assess the relationship between input factors and the performance of the simulation model. To facilitate this type of assessment, simulation analysts often use the simulation model to emirically construct a *black-box* approximation of the causal and time dependent behavior of the simulation model. This type of approximation is known as a *metamodel* and can be viewed as a summary of the behavior of the simulation model. We demonstrate this technique in the context of an example using TERSM (Tactical Electronic Reconnaissance Simulation Model). The results indicate that metamodeling is applicable to tactical simulation models and that the technique has a wide range of uses.

FRACTAL IMAGE COMPRESSION TECHNIQUES

Gut'alu R. Viswanath
Profєssor of Mathematics
Department of Mathematics and Computer Science
South Carolina State University

Patrick K. McCabe
Joseph D. Stooks
RL/IRDD
Griffiss Air Force Base

Abstract

Display and analysis of terrain and imagery data has become common in computerized information systems. However, the massive storage and transmission requirements required for terrain and imagery data remain major problem areas. Current Joint Photographic Group(JPEG) algorithms achieve compression ratios no greater than 30 to 1. The development of robust compression algorithms based on fractal mathematics may mitigate the storage and transmission problems and ultimately lead to more cost effective utilization of terrain and imagery data at the unit level. In addition, the compression of data can lead to increased volume of data transmitted in decreased amounts of time. Our investigation identified promising approaches, which are candidates for further development.

PROMINENCE IN SPONTANEOUS SPEECH: ANNOTATION AND APPLICATIONS

Colin W. Wightman
Assistant Professor
Department of Electrical Engineering
New Mexico Institute of Mining and Technology

Abstract

Prominences, which occur when a speaker emphasizes a word so that it "stands out" to the listener, play a number of important roles in aiding the listener in the interpretation of speech. In particular, prominences are crucial for signaling many of the discourse events which conversants use to coordinate a conversation. In this work, we investigate the ability of untrained human subjects to consistently label prominences in spontaneous speech. Consistent labels will be needed to develop the automated detection algorithms necessary to make use of prominences in automatic speech processing systems. Our results indicate that, even without training, the subjects were able to produce labels in agreement with those done by an expert labeler 83.6% of the time. Moreover, merging the transcriptions done by the test subjects by using a 3-of-8 criterion produced labels in agreement with the expert 88.2% of the time and cut the missed detection rate in half.

THE CASE FOR LIKE-SENSOR PRE-DETECTION FUSION

Peter Willett
Associate Professor
Electrical and Systems Engineering Department
University of Connecticut

Abstract

There has been a great deal of theoretical study into decentralized detection networks composed of similar (often identical), independent sensors, and this has produced a number of satisfying theoretical results. At this point it is perhaps worth asking whether or not there is a great deal of point to such study - certainly two sensors can provide twice the illumination of one, but what does this really translate to in terms of performance?

We shall take as our metric the ground area covered with a specified Neyman-Pearson detection performance. To be fair, the comparison will be of a multi-sensor network to a single-sensor system where both have the same aggregate transmitter power. The situations examined are by no means exhaustive but are, we believe, representative.

Is there a case? The answer, as might be expected, is "sometimes". When the statistical situation is well-behaved there is very little benefit to a fused system; however, when the environment is hostile the gains can be significant. We shall see, depending on the situation, gains from co-location, gains from separation, optimal gains from operation at a "fusion range", and sometimes no gains at all.

WRIGHT LABORATORY

VALIDATION OF A HYPERSONIC NONEQUILIBRIUM CODE FOR NOZZLE FLOW

Brian M. Argrow
Assistant Professor
School of Aerospace and Mechanical Engineering
University of Oklahoma

ABSTRACT

A computer code, has been validated for the external flow of hypersonic nonequilibrium air over a blunt body. The full Navier-Stokes equations with nonequilibrium chemistry and a five-species dissociation model are solved using a Roe flux-difference splitting scheme. Modifications for the computation of hypersonic nonequilibrium nozzle flows have been partially completed. Work is continuing on developing characteristic-based inflow and outflow boundary routines that allow for subsonic inflow and mixed supersonic-subsonic outflow conditions. Once boundary routines are completed, the code will be validated using data from the Boeing 30-Inch Hypersonic Shock Tunnel 'ts are shown for an internal flow test of the flow solver assuming a perfect gas. Application of the second law of thermodynamics in the forn. of a numerical entropy production is also briefly discussed.

MOTION SEGMENTED OBJECT IDENTIFICATION USING 1-D SIGNAL ANALYSIS AND A HETEROASSOCIATIVE COMPLEX NEURAL NETWORK

Abdul Ahad S. Awwal
Assistant Professor
Department of Computer Science & Engineering
Wright State University

Abstract

A complete and novel pattern recognition system is proposed which utilizes techniques of motion analysis coupled with a complex associative memory in a neural network architecture. Motion was used for segmenting the scene, obtaining a continuous edge information, and calculating chain code data from a sequence of moving images. The FFT of the sampled edge co-ordinates was used as an input to a complex inner product associative memory. The complex inner product associative memory model was formulated based on an efficient optical amplitude modulated phase only filter to serve as the decision making module. An adaptive threshold was used to indicate a match or identify a mismatch. The research has pointed out new directions for tracking, use of motion analysis in making a library of templates which may yield predictable matching behavior, use of other cues to reduce the search space, and other problems for segmentation using motion for further investigation.

ANALYTICAL GUIDANCE LAWS AND INTEGRATED GUIDANCE/AUTOPILOT FOR HOMING MISSILES

S. N. Balakrishnan
Department of Mechanical and Aerospace Engineering and Engineering Mechanics
University of Missouri-Rolla
Rolla, MO 65401

ABSTRACT

An approach to integrated guidance/autopilot design is considered in this study. It consists of two parts: 1) recognizing the importance of polar coordinates to describe the end game in terms of problem description and measurement acquisition, the terminal guidance problem is formulated in terms of polar coordinates; 2) through a commonly used approximation on time-to-go and a coordinate transformation, a family of proportional navigation optimal guidance laws is obtained in a closed form. A typical element of such a guidance law is combined with the autopilot dynamics to result in a feedback control law in terms of output variables. Numerical simulations are in progress.

ESTIMATION OF ASPECT ANGLES OF TARGETS IN FLIR IMAGES

Prabir Bhattacharya

Associate Professor

Department of Computer Science & Engineering

University of Nebraska-Lincoln

Abstract

We develop a model-based approach to estimate the aspect angle of a target in a FLIR image. From a set of given 3-D models represented in the voxel form, a database of binary images matching algorithm is then used to match a silhouetted version of the given target with the images in the database. The angle of rotation corresponding to the matched image in the database from the database is equal to the required aspect angle of the target.

CRACK ARREST IN COMPOSITE PLATES
REINFORCED WITH TOUGH LAYERS

Victor Birman
Associate Professor
Engineering Education Center
University of Missouri-Rolla

Abstract

The paper presents theoretical foundations of a crack arrest technique applied to composite plates. The approach is based on reinforcement of the original structure with thin tough layers. These layers reduce the stress field around the crack tip resulting in its effective arrest.

The theory utilizes the existing solution for a crack in an anisotropic sheet. It is shown that the addition of tough layers results in a decrease of displacements and stresses by a single factor. This factor is evaluated using the principle of virtual work.

All crack tip stresses and displacements, as well as the components of the strain energy, are expressed in terms of real functions. To the best knowledge of the author, this is the first such presentation of these parameters for a general case of an arbitrary directed crack in arbitrary laminated layers.

SOME RESULTS IN MACHINE-LEARNING

Mike Breen
Assistant Professor
Department of Mathematics
Tennessee Technological University

Abstract

The research here focused on pattern-based machine-learning. A machine's performance is modeled by a function. Previously, results have been obtained for functions of less than ten variables. For functions with more variables, new techniques are needed because of the huge amounts of memory required. We researched the topic of column multiplicity and obtained results that may make the learning task practical for these larger functions. We also described how some future problems involving noise might be reframed to resemble problems already solved by Dr. Tim Ross and the AART-2 group. We also assisted in an experiment to determine the relationship between human-learning and machine-learning.

EFFECT OF ANTIOXIDANTS ON THERMAL DECOMPOSITION OF ENERGETIC MATERIALS

Theodore J. Burkey
Associate Professor
Department of Chemistry
Memphis State University

Abstract

The effect of free-radical inhibitors (antioxidants) on the thermal decomposition of NTO, RDX and TNAZ was studied. In addition the possible role of redox reactions in the thermal decomposition of NTO was investigated. The inhibitor was doped in the energetic material at about 1% by weight. The heat from isothermally heated samples was detected by differential scanning calorimetry. In general, the inhibitor accelerated or increased the heat evolution of the energetic compounds. The effect was more pronounced for inhibitors that were better reducing agents. While these studies are still incomplete the results suggest that electron or hydrogen atom transfer processes are involved in thermal decomposition of some nitro group compounds. Such reactions can ultimately lead to the oxidation of NTO. In related studies, the gas products of NTO oxidation were studied. Oxidation of NTO with $KMnO_4$ results in the decomposition of NTO and formation of carbon dioxide. Oxidation of NTO with ammonium ceric nitrate results in carbon dioxide and nitrogen gas evolution. These results are consistent with a mechanism of NTO decomposition that involves the formation of didehydro-NTO. This compounds is expected to be unstable and undergo a spontaneous electrocyclic ring opening yielding small gaseous molecules. Taken together these studies show that thermal decomposition and oxidative decomposition yield similar results and may have common intermediates and mechanisms.

EVALUATION OF THE SBR AND GRE METHODS FOR COMPUTING THE TIME DOMAIN ELECTROMAGNETIC SCATTERING FROM LARGE OPEN-ENDED WAVEGUIDE CAVITIES

Robert J. Burkholder
Postdoctoral Research Associate
Department of Electrical Engineering
The Ohio State University

Abstract

Two approximate but versatile high-frequency asymptotic ray shooting methods are evaluated in terms of their ability to accurately and efficiently predict the time domain electromagnetic scattering from large open-ended waveguide cavities: (1) the shooting and bouncing ray (SBR) method and (2) the generalized ray expansion (GRE) method. A hybrid modal solution for simple rectangular and circular open-ended waveguide cavities is used as a reference solution. It is found that the SBR method does not predict the time dispersive effects of cavities because it does not include the fields diffracted into the cavity by the rim at the open end. However, for very large cavities (on the order of 20 wavelengths wide or larger), the diffracted fields are much weaker so the dispersive effects are less significant and the accuracy of the SBR method in the time domain improves. The GRE method predicts the time dispersive effects because the diffracted fields are intrinsically included, but it may require a much larger number of rays to be tracked and is not as easily implemented as the SBR method. In general, the SBR method is more efficient than the GRE method unless more than approximately 100 incidence angles are to be computed for a given cavity geometry. Approximate expressions are included for estimating the number of rays required for a given cavity geometry for both methods.

ONE-DIMENSIONAL WAVE MECHANICS MODEL FOR TERMINAL BALLISTICS

E. Eugene Callens, Jr.
Associate Professor
J. Scott McMurtry
Graduate Student
Department of Mechanical and
Industrial Engineering
Louisiana Tech University

Abstract

A quasi-steady wave mechanics model for penetration of structural targets by high strength cylindrical penetrators is presented. The model is based on the postulated physical behavior of one-dimensional penetrator response, axisymmetric target response, negligible thermal effects in the interface region, and steady state conditions at the interface between wave reflections. The developed equations constitute a comprehensive model for the terminal ballistics process including the initial transient, the developed penetration regime, and the terminal transient. The model predicts crater depth, penetrator velocity, and penetrator length as a function of time as well as the final crater diameter as a function of crater depth. It also gives the penetrator stress history and the stress history in the target bow region. The equations are easily programmed and readily solved on a personal computer. Typical run times are 15 seconds on a 25-MHz 386 PC with a math coprocessor. Comparisons with experimental data for several different metal penetrators into metal targets are presented for penetrator length to diameter ratios from 3 to 20. The predictions are shown to be within the experimental uncertainties for the entire velocity regime of interest from 500 to 4,500 m/s. Two significant characteristics of the method are that it contains no empiricisms and it permits the quantification of physical property effects on crater depth and diameter. These effects include penetrator strength, density, length to diameter ratio, and impact velocity as well as target strength and density.

AN INVESTIGATION OF THE USE OF EMBEDDED FIBER OPTIC SENSORS IN COMPOSITE MATERIALS

Gregory P. Carman
Visiting Assistant Professor
Department of Engineering Science and Mechanics
Virginia Polytechnic Institute and State University

Abstract

The use of embedded optical sensors in aircraft for control of structural components and health monitoring of critical members has evolved in the last decade. The emergence of the "Smart" structures and materials field provides a crucial product to United States industries for giving them the technological edge required in today's market place. However, the mechanics of embedded sensors essential to this evolution process has not been adequately addressed in the literature. It is the purpose of this report to present first an understanding of the detrimental effect embedded sensors have on the performance of a composite material and second to investigate the accuracy and usefulness of an embedded extrinsic Fabry Perot Fiber Interferometric (EFPI) strain sensor near large stress gradients. The first task is evaluated by experimentally measuring the degradation in an unidirectional graphite-epoxy's transverse strength due to the presence of an optical fiber. This parametric study which varies fiber size, fiber coating, and adhesion properties, demonstrates that the transverse strength can be degraded as much as 50%. These results also suggest that an optimum coating thickness exists for polyimide coated optical fibers which minimizes their effect on composite performance. The experimental results of the second task demonstrate that an EFPI sensor provides accurate strain data without a calibration procedure. The test data also suggests that the EFPI may provide a valuable tool in studying stiffness reduction which occurs in a composite around anomalous regions such as holes. The EFPI sensor embedded in the graphite epoxy layups failed prior to failure of the composite and their fatigue life was shorter than the composite. The sensors considered in this study are crudely manufactured, however, with proper construction the strength and fatigue life of an EFPI should rival and surpass that of a composite.

A STUDY OF FLIGHT DYNAMIC MODELING FOR NONLINEAR AERODYNAMIC PARAMETER ESTIMATION

Gary T. Chapman
Adjunct Professor
Department of Mechanical Engineering
University of California, Berkeley

Abstract

A review of modeling of flight dynamic systems for nonlinear aerodynamic parameter estimation is presented. Modeling of the flight dynamic system is considered in a comprehensive manner: First, the modeling of a powered rigid body with controls is considered. Second, the aerodynamic modeling is considered in detail, including the effects of controls, propulsion and atmospheric winds. The assumptions involved in aerodynamic modeling are examined in detail. Third, the impact of elasticity of the modeling is considered including the effects on the aerodynamics. Work is required on aerodynamic modeling of high angle-of-attack and unsteady aerodynamics where an analysis of the assumptions shows a break down in conventional modeling. In addition work is required on handeling the effects of winds, elasticity and the propulsion system on aerodynamic parameter estimation. These latter issues of winds, elasticity and propulsion will also require more work on the measurements of these quantities, a topic not considered here.

BUILT-IN SELF-TEST DESIGN OF PIXEL CHIP

Chien-In Henry Chen, Assistant Professor
Department of Electrical Engineering
Wright State University
Dayton, OH 45435

ABSTRACT

Presented in this paper is the Built-In Self-Test (BIST) design for Wright Laboratory, ELED's PIXEL graphics chip. Based on the inadequacy of the COMPASS design tools to provide an efficient BIST methodology, a custom BIST plan was designed. Numerous combinational and sequential fault simulations support the efficiency of this design. Sequential testing reduces hardware overhead and concurrent testing reduces test time. In addition, an in depth study of a derivative of Circular Built-In Self-Test was performed and evaluated on a number of sequential benchmark circuits. While the results were extremely favorable, Circular BIST required more hardware overhead than the proposed BIST design with similar fault coverage.

CHARACTERIZATION OF PART SHRINKAGE
FOR LARGE, THICK INJECTION MOLDED ARTICLES

Joe G. Chow
Associate Professor
Industrial and Systems Engineering Department
Florida International University

Abstract

The shrinkage of large, thick injection molded parts was investigated to support the directly formed aircraft transparency program at WL/FIVR. To determine part thickness and shrinkage, a previously developed measuring procedure using a coordinate measuring machine (CMM) was employed. The part and mold thickness data were computed and plotted in the form of color contours for ease of interpretation. The causes of variable shrinkage were identified and the correlations between shrinkage and process parameters established. Based on this study and previous researches, recommendations were made for the shrinkage characterization and the mold cavity design for the molding of full scale frameless transparencies.

DETERMINATION OF MULTIPLE-SOURCE SCHLIEREN SYSTEM CAPABILITIES

Steven H. Collicott

Assistant Professor

School of Aeronautics and Astronautics

Purdue University

1 Abstract

Original analysis is performed to determine the noise-reduction potential of multiple-source (sharp-focusing) schlieren systems. System geometry is constrained to that arising from modification of existing traditional single-source schlieren systems. Applications in the Tri-sonic Gasdynamics Facility (TGF), the Mach 6 tunnel, and the 20-inch hypersonic tunnel are considered. Analysis based on propagation of the mutual intensity function is shown to describe the small perturbation case. Results of the analysis indicate that the smallest length scale disturbances are simple to remove, but that the largest length scales possible (on the order of the field of view) are not likely to be removed.

Computational Studies on Rigid Rod Model Polymer and NLO Model Substances

John W. Connolly
Professor
Dept. of Chemistry

Abstract

Section 1: Using a heterocycle-phenylene-heterocycle type of model structure, semiempirical AM1 calculations indicate that either removing and electron from or adding an electron to the closed-shell model PBO and PBZT structures brings about a substantial increase in torsional barrier.

Section 2: Semiempirical AM1 calculations of conformational energies using large model structures, i. e. three polymer repeat units for PBO and 2.5 polymer repeat units for PBZT, result in calculated torsional barriers of zero for PBZT and 1 Kcal/mol for PBO for a torsional angle of 90° down the entire model structure. These barriers are much lower than those calculated using small model structures as consequence of cooperativity between the rotating structural units.

Section 3: *Ab initio* calculations of ionization energy of some candidate NLO materials have been begun. The technique involves calculating the difference between the total energy of neutral molecules and the corresponding cation radicals. Structures are optimized at the *ab initio* or semi empirical level depending on size. Benchmark calculations on malononitrile and malonic acid successfully reproduce experimental values.

1. Performing Target Classification Using a Fuzzy Morphology Neural Network

Jennifer L. Davidson
Assistant Professor
Department of Electrical Engineering
Iowa State University

Abstract

This report details a neural network application to target classification using a different type of neural network called a fuzzy morphological neural network. Neural networks are used mostly as pattern recognizers, and the main goal of this research was to give proof of concept that a simple form of this new neural network could perform object classification. The type of data used was the range data from ladar data on tanks. A two-tiered approach was used on the data. First, a linear convolution with a fixed template was performed. Then this data was input to a neural network for classification. The image was divided up into zones, with the expectation that a partially occluded object could still carry forward enough information from fewer zones to the neural network to identify the object. The simplified neural network was essentially a multilayer perceptron with backpropagation, so this network was used to train the data. The results showed that with proper training, the network can perform very good classification. The numerical results are given in this report, and substantiate our initial ideas. With the proof of concept in hand, the next step is to develop training algorithms and network architectures which take advantage of the complex range of parameters available in the network. This is the main topic of research described in a follow-up minigrant proposal.

VLSI SYNTHESIS GUIDING TECHNIQUES USING THE SOAR ARTIFICIAL INTELLIGENCE ARCHITECTURE

Joanne E. DeGroat
Assistant Professor
Department of Electrical Engineering
The Ohio State University

Lindy Fung
Graduate Student (Master's Degree)
Department of Electrical Engineer
The Ohio State University

The design of VLSI circuits is a very complex problem. As such, there are numerous computer aided design (CAD) tools to assist the designer in the generation of VLSI circuits. These tools range from layout editors, physical design tools, to high level synthesis tools. In all of these tools the design style and architectural structure are very constrained to limit the complexity to a manageable level. These constraints result in circuits that require more area and are slower than circuits produced manually by a skilled VLSI designer. The application of SOAR to the problem of VLSI creates the possibility of relaxing some of these constraints. The design of VLSI circuits is a design process. Existing tools and methodologies are incapable of capturing any of the essence of this design process and therefore must severely limit the design methodology. This research is a first step in the application of the SOAR Artificial Intelligence Knowledge Based Architecture developed at Carnegie-Mellon University to the synthesis of VLSI circuits. This first step is the application of SOAR to the VLSI placement problem. Findings, limitations, and recommendations for future research are presented.

MODELING OF PULSATING JET IN CROSSFLOW
USING VORTEX ELEMENT METHODS

Mark A. Dietenberger
Associate Research Physicist
Environmental Science Group
Materials Engineering Division
University of Dayton Research Institute

Abstract

The vortex element methods were investigated for predicting the behavior of a pulsating turbulent jet injected through a circular orifice into a turbulent crossflow. Published experimental results showed that modulating the diluting jets in a combustor or the cooling jets on a turbine blade can potentially increase the combustor's operating temperatures for better jet engine efficiency. In order to solve for the transient development of the jet's curved trajectory, cross-section shape, and mixing in the crossflow, the time-dependent Navier Stokes equations were descretized using the vortex element methods. The resulting system of first order ODE's described the changing motions and strengths of many discrete vortices. In devising a practical numerical scheme, the problem was analyzed in two stages. The first stage was to solve for the pulsating circular free jet. The results could then be used to calibrate the axial integral momentum equation for unsteady and quasi-irrotational flow in the axial direction. For the tranverse direction of the jet, the vorticity equation was solved for a quasi-two-dimensional transient flow around a pulsating and bending jet. Thus the response of toroidal and bound vortices to the effects of forcing and baroclinity can be calculated and can predict the jet's motion and mixing in crossflow.

Laser Multiphoton Ionization Detection of Methyl Radicals
in a Filament-Assisted Chemical Vapor Deposition Reactor

David A. Dolson
Assistant Professor
Department of Chemistry
Wright State University

Abstract

An apparatus and procedures were developed for the detection of methyl radicals in the discharge-assisted decomposition of methane/hydrogen gas mixtures flowing over a heated wire filament. The apparatus was designed to detect small transient changes in the discharge current as the focussed output of a tunable dye laser ionizes methyl radicals between a hot filament and a deposition substrate. This design does not require the use of an additional (intrusive) electrode for ion detection, and it allows for adjustment of the filament-to-substrate distance. Results from a conventional flow tube reactor suggests that the detection sensitivity for methyl radicals is better than 0.3 mtorr or 10^{13} radicals per cm^3. Preliminary data is presented for methyl radical detection in the filament reacto*

PERFORMANCE ANALYSIS OF A HETERODYNE LIDAR SYSTEM INCORPORATING A MULTIMODE OPTICAL WAVEGUIDE RECEIVER

Bradley D. Duncan, Ph.D.
Assistant Professor

Department of Electrical Engineering
Center for Electro-Optics
University of Dayton

ABSTRACT

A theoretical/numerical performance analysis of a heterodyne lidar system incorporating a multimode optical waveguide receiver has been performed. For our purposes, the performance parameters of interest are the coupling and mixing efficiencies of the lidar receiver, as they relate to the overall system carrier to noise ratio (CNR). The coupling efficiency relates the ability of the lidar receiver optics to couple light returning from a distant object into the multimode optical waveguide receiver. The energy thus received is then mixed with a local oscillator (LO) field in an evanescent wave coupler to generate the desired intermediate frequency (IF) signal current. The efficiency with which this mixing occurs, however, is very strongly influenced by the receiver waveguide geometry, and thus the constituent modal structures of the guided LO and signal beam fields. Initial results indicate that for a symmetric square waveguide supporting seventy-five distinct modes, the coupling and mixing efficiencies can approach 78% and 23%, respectively. These results rival the performance characteristics of many free space and single mode waveguide lidar receiver designs, while higher efficiencies are expected for more realistic multimode waveguides supporting many more modes, and for lidar receivers constructed from circular (possibly graded index) multimode optical fiber waveguides.

TURBULENT HEAT TRANSFER IN COUNTER-ROTATING DISKS WITH THERMOGRAPHIC PHOSPHOR TEMPERATURE DETERMINATION

Dr. Jamie Ervin
Department of Mechanical & Aerospace Engineering
University of Dayton
Dayton, Ohio 45469-0226

Abstract

A state-of-the-art gas turbine design which implements counter-rotating blades has been recently submitted to the Air Force. As a first step in the study of the associated complex heat transfer phenomena, a counter-rotating disk system was designed. No experimental data concerning source flow between two parallel counter-rotating disks appears to have yet been published, and this planned study will be the first experimental examination of turbulent flow and local heat transfer between counter-rotating disks with radial outward flow.

The velocity field in rotating disk systems with source flow is complex. The fluid velocity vector has a component in the tangential direction from shear stresses induced by each rotating surface, and the mean radial velocity decreases with increasing radial distance from the source since the fluid moves through an increasing cross-sectional area. Centrifugal forces induce radial outward motion on the fluid near each disk surface in the presence of Coriolis forces. For non-isothermal systems, buoyancy forces present an additional complication. Furthermore, in the region of large pressure gradients, particularly as the radius tends to zero, flow separation and recirculation may occur.

One of the counter-rotating disks will be heated uniformly, and surface temperatures will be measured using a thermographic phosphor, lanthanum oxysulfide doped with Europium (La_2O_2S:Eu). When excited by ultraviolet radiation, thermographic phosphors emit fluorescent spectra characterized by unique emission lines, and the intensity of these lines varies with temperature. The ratio of the intensity of a high energy level emission line to that of a low energy level can be accurately correlated with temperature with geometric effects appropriately taken into account.

Molecular Modeling of Materials for Non-Linear Optical Applications

B. L. Farmer
Professor
Department of Materials Science and Engineering
University of Virginia

Abstract

Molecular modeling calculations were undertaken on a series of materials having potentially useful non-linear optical properties for laser-hardening applications. Molecular mechanics and molecular dynamics calculations examined the conformational properties of several-siloxane based liquid crystalline materials. Siloxanes having cyclic, star, and linear geometries were examined. Biphenyl and cholesteryl mesogens attached by leader groups having vinyl or allyl components were considered. Irrespective of the geometry of the siloxane core, the molecules all had sufficient flexibility to allow close associations between mesogens to develop. Associations between cholesteric mesogens were particularly stable.

The properties of several graphite-based materials were also examined. Semiempirical molecular orbital calculations were used to determine the deformation behavior of benzene, naphthalene and pyrene. All showed remarkable tendency to remain planar, even though imposed constraints introduced severe geometric distortions. Calculations on cyclic and linear acene oligomers were also carried out. The energies of linear acenes were consistently lower than those of the corresponding cyclic molecule. For small cycles containing 6-10 benzene units, the energy dependence on ring size is less sharp than it is for larger cycles.

Nonlinear Dynamics and Control Issues for Aeroelastic Enhancement Using Piezoelectric Actuators

George T. Flowers
Assistant Professor
Department of Mechanical Engineering
Auburn University

Abstract

A topic of current interest in the aeronautical community is the use of adaptive and 'smart' materials for health monitoring and performance enhancement for aircraft. One such material is piezoelectrics, which produce an electric current when subjected to strain and conversely is strained when an electric current is passed through it. As a result, such devices are being considered as actuators/sensors for a variety of applications. The goal of this investigation is to develop an understanding of issues relevant to the use of piezoelectric actuators/sensors in order to enhance the aeroelastic behavior of advanced aircraft.

PASSIVE RANGING AND ROLL-ANGLE APPROXIMATION FOR FUZE APPLICATION

Simon Y. Foo
Assistant Professor
Department of Electrical Engineering
Florida State University

Abstract

This research presents a stereo vision approach to passive ranging and roll-angle approximation using an array of image sensors. Specificall·', a divergent multisensor imaging system for fuze application is presented. Although there may be a loss in accuracy due to small baselines of sensors and potential mismatches in pixel registration, this method is computationally quick and simple. Therefore this stereo vision technique is most suitable for fuze application where speed is critical and accuracy is not so important. A method for determining the roll-angle from divergent imaging sensors is also presented.

VELOCITY AND TEMPERATURE MEASUREMENTS
IN A HIGH SWIRL DUMP COMBUSTOR

Dr. Richard D. Gould and Mr. Lance H. Benedict
Mechanical and Aerospace Engineering
North Carolina State University
Raleigh, NC 27695

ABSTRACT

Successful two component laser Doppler velocimetry (LDV) and single point temperature measurements were made in the highly swirling flow field of a model dump combustor. A type S Platinum/10 % Platinum-Rhodium thermocouple probe was used to make temperature measurements. A lean propane-air diffusion flame with an overall equivalence ratio of $\Phi = 0.45$ was stabilized in the combustion chamber by the flow pattern of the Wright Laboratory/Rolls Royce (WL/RR) swirler. The reacting flow case was found to have higher axial and tangential mean velocities than the isothermal flow case throughout most of the flow field due to heat release. A shorter central recirculation bubble was found in the reacting flow case due to the pressure gradients produced by these higher mean velocities. Turbulent normal stresses were found to be larger while the maximum value of the $\overline{u'w'}$ turbulent shear stress was found to be less in the reacting flow case when compared to the isothermal flow case. Maximum mean temperatures occurred were maximum turbulent stresses occurred thus suggesting that gradient transport modeling may be successful in predicting this flow field.

Effect of Aeroelasticity on the Measurement of
the Indicial Response of an Airfoil

Gary M. Graham
Associate Professor
Department of Mechanical Engineering
Ohio University

Abstract

An analytical model for simulating the aeroelastic response of a tow tank test rig undergoing high inertial loading is described. The rig comprises an airfoil coupled to a drive shaft for pitching the airfoil, and whereon strain gauges are mounted for measuring the airfoil loading. The required input to the model is the torque imparted on the drive shaft for pitching the airfoil in a prescribed way. The model predicts the dynamic structural deformation of the test rig during the motion, as well as a "sensible" force at the strain gauges. The analytical sensible force is compared with actual strain gauge measurements for the case of the airfoil undergoing a small step change in angle of attack. Such a motion theoretically produces an airfoil indicial response. The analysis indicates that aeroelasticity has a significant effect on the strain gauge output. The present analysis combines the mode superposition method for dynamical systems undergoing forced motion with linear airfoil theory based on the convolution integral formulation for the loading on an airfoil in arbitrary motion.

A STUDY OF VIRTUAL REALITY AND ITS
APPLICATION TO AVIONICS

Elmer A. Grubbs
Assistant Professor
Department of Electrical Engineering
New Mexico Highlands University

Abstract

A literature search on the topic of virtual reality was performed. Books and magazine articles on the topic were read and relevant ones saved. A review of work categories in Wright Laboratory's Avionics Directorate was performed and work areas were matched to possible virtual reality applications. A commercial program, "Virtual Reality Studio" was used to design several possible applications, including building design, visual programming, virtual office, and data visualization. A flicker free 3-D television system using standard television equipment with no hardware modification was designed, built and tested. Two patent disclosures were filed for 3-D television and computer monitor viewing.

ENHANCEMENT OF THE TIME RESPONSE OF LINEAR CONTROL SYSTEMS VIA FUZZY LOGIC AND NONLINEAR CONTROL

Charles E. Hall, Jr.
Assistant Professor
Department of Mechanical and Aerospace Engineering
North Carolina State University

ABSTRACT

The use of linear feedback, of either outputs or state variables, is the standard technique for control of dynamical systems. In many problems the gain of the feedback is a constant that was determined by analysis of the behavior of the dynamics. While usually this yields acceptable results for many systems it can produce unacceptable results, due to either large disturbances or the invalidity of the linear approximation and thus gain scheduling is used in order to improve system performance. The techniques of fuzzy logic control and nonlinear control offer methods of increasing the system's performance without the need of gain scheduling. Fuzzy logic is a linguistic based system and accordingly it is much simpler and faster to implement than standard control techniques. It was found that fuzzy logic controllers produce deterministic maps and thus can be reduced off-line to these deterministic maps for real time implementation in a control system. Fuzzy logic control systems are not as linguistic based as the proponents contend. There is a large numerical base that needs to be established for each system, which is more complex than normal control techniques. Analysis and simulations involving two types of fuzzy logic based systems were run and compared to similar linear systems. Further examination of fuzzy logic systems were terminated since they were not producing desirable results. Nonlinear control techniques were examined for an improved linear system response. It was found that a linear and cubic operation on the error signal to a first order scalar differential equation improved the system's performance. This technique was not, by itself, applicable to higher order systems, but since the systems of interest were for the control of aircraft, this nonlinear technique was applied to the elevator servo for control of the short-period longitudinal mode of the Lambda URV. This method did provide desirable results.

Microstructural Evolution of Ti-23.2Al-24.4Nb

Ian W. Hall
Chairman, Materials Science Program and
Associate Professor of Mechanical Engineering
Spencer Laboratory
University of Delaware
Newark, DE 19716

Abstract

A Ti-23.2Al-24.4Nb alloy has been subjected to long term heat treatments at temperatures within its projected use range. The microstructure was studied by transmission electron microscopy and the phase changes which occurred were investigated as the heat treatment temperature was increased from 500°C to 800°C. It was found that the alloy transformed from an initial microstructure which was predominantly ordered beta to a predominantly orthorhombic structure containing a few percent of beta and alpha-2 phases. Furthermore, it appears that the orthorhombic phase undergoes an ordering reaction within the temperature range of interest.

INVESTIGATION OF THE COMBUSTION CHARACTERISTICS OF SWIRLED INJECTORS IN A CONFINED COANNULAR SYSTEM WITH A SUDDEN EXPANSION

Paul O. Hedman, Professor
David L. Warren, Master Candidate
Departments of Chemical and Mechanical Engineering
Brigham Young University

ABSTRACT

This report contains a brief summary of work done during the 1992 AFOSR summer faculty research program to investigate the flow and combustion characteristics of a burner designed to "specifically reproduce recirculation patterns and LBO processes that occur in a real gas turbine combustor." The Pratt & Whitney Task 150 Combustor uses a swirling fuel injector from an actual turbojet engine installed in a sudden expansion combustor which closely simulates the geometry of a jet engine combustor. The Task 150 burner has been configured so the geometry around the injector is nearly axisymmetric, but incorporates quartz windows permitting optical (laser-based) measurements to be made in the flame.

The primary effort during this summer's AFOSR sponsored research program for faculty and graduate students was to use OH^- laser induced fluorescence (LIF) imaging to investigate OH^- ion concentrations and laser Doppler anemometry (LDA) to make gas velocity measurements. These two techniques were employed in both the Task 100 and Task 150 combustors. Preliminary analysis of the Task 150 OH^- images, combined with flow split information obtained during last year's summer research program, revealed basic mixing patterns. The images also further defined characteristic flame shapes previously measured. LDA measurements have quantified the axial, radial, and tangential velocity components in the combustor. Preliminary analysis of iso-axial velocity contours have identified the major recirculation zones. This data will allow streamlines to be determined which will give a good understanding of the flow field within the combustor. This data is also useful for model validation. Measurements of the fuel equivalence ratio at lean blow out as a function of air flow rate with nitrogen dilution were also obtained with the Task 100 burner.

STRESS WAVE PROPAGATION THROUGH THE THICKNESS OF GRAPHITE/EPOXY LAMINATED PLATES USING PVDF SENSORS

David Hui
University of New Orleans
Dept of Mechanical Engineering
New Orleans, LA 70148

ABSTRACT

The object of this study was to determine the stress wave (or pulse) propagation through the thickness of a graphite-epoxy laminated plate. This was part of an overall study to understand the damage of these plates under normal projectile impact. Upon a sharp impact by a tiny spherical steel ball, the stress wave propagated from the impact point into the rest of the material. It was found that the embedded polyvinylidene fluoride (PVDF) sensors enabled prediction of the wave velocities and wave attenuation.

PRELIMINARY MISSILE AUTOPILOT DESIGN USING REACTION JETS AND AERODYNAMIC CONTROL

Mario Innocenti
Associate Professor
Department of Aerospace Engineering
Auburn University, AL 36849-5338

Abstract

The feasibility of combining traditional aerodynamic control with reaction jets is studied, in the framework of missile autopilot design. The purposes of reaction jets are to increase the missile turning capabilities in critical phases of flight, as well as to help the traditional aerodynamic control in configurations where the fin size is reduced because of limited storage volume. Due to the nonlinear characteristics of both controller and airframe dynamics during fast maneuvers, a control strategy based on variable structure systems is used. A control law is synthesized for the pitch loop and some initial results are presented and compared with a traditional controller based on linear quadratic techniques.

LASER IMAGING AND RANGING (LIMAR) PROCESSING

Jack S.N. Jean
Assistant Professor
Department of Computer Science and Engineering
Wright State University

Louis A. Tamburino
Avionics Directorate
Wright Laboratory

Ahmet A. Coker
Department of Computer Science and Engineering
Wright State University

Abstract

The LIMAR (Laser IMaging and Ranging) project is a Wright Laboratory effort to develop an advanced imaging and ranging system for robotics and computer vision applications. LIMAR embodies a concept for the fastest possible three-dimensional camera. It eliminates the conventional scanning processes by producing a registered pair of range and intensity images with data collected from two video cameras. The initial prototype system was assembled and successfully tested at Wright Laboratory's Avionics Directorate in 1992. This prototype LIMAR system used several frame grabbers to capture the demodulated LIMAR image signals from which the range and intensity images were subsequently computed on a general purpose computer. The prototype software did not address the errors which are introduced by differential camera gain, misalignment, and distortion. The tasks performed during this Summer Research Program include (1) modeling and developing algorithms to correct the distortion introduced by using two cameras and (2) design of special purpose hardware to convert, in real-time, the outputs from the two cameras into a fully registered range and intensity image.

DESCRIPTION AND RECOGNITION OF RADAR TARGETS USING WAVELETS

Ismail Jouny
Assistant Professor
Department of Electrical Engineering
Lafayette College

Abstract

A method for characterizing radar signatures using wavelets is developed based on the principle of scattering centers. The adopted target representation is based on the colored bright spots approach which is closely related to wavelet transform. Scattering features extracted using wavelets are directly related to target geometry and can be used for target identification. An optimal M-ary target classification technique utilizing wavelet decomposition is presented. The proposed target analysis and recognition techniques are tested using experimentally measured radar data.

AXISYMMETRIC THERMOELASTIC RESPONSE OF A COMPOSITE CYLINDER CONTAINING AN ANNULAR MATRIX CRACK AND A FRICTIONAL INTERFACE

Autar K. Kaw
Associate Professor
Department of Mechanical Engineering
University of South Florida

Abstract

The effect of a frictional interface on the response of a unidirectional ceramic matrix composite under a remote axial tensile strain is studied. The geometry of the composite is approximated by a concentric cylinder model with a transverse annular crack in the matrix. The fiber-matrix interface follows the Coulomb friction law. On applying the boundary and the continuity conditions at the interface, the solution is obtained in terms of three coupled integral equations.

An asymptotic analysis of the coupled integral equations will reveal the nature of the singularity of the stress and strain functions in the fiber and the matrix. The extent of the interfacial damage and the stress fields in the fiber and the matrix will be studied as a function of the fiber volume fraction, the elastic moduli of the constituents, the thermal expansion coefficients of the constituents, the coefficient of friction, the temperature change and the remote uniform axial strain. The objective of the study is to give an idea of what features accelerate or inhibit the interfacial damage.

An AFOSR Research Initiation proposal is being submitted for continuing the work initiated in this report.

ON THE FAILURE MECHANISMS IN TITANIUM ALUMINIDE COMPOSITES

Demitris A. Kouris
Associate Professor
Department of Mechanical and Aerospace Engineering
Arizona State University

I. ABSTRACT

Certain mechanisms of failure associated with titanium aluminide composites were studied. The focus of the analysis was directed towards the thermomechanical behavior of unidirectional composites under the influence of transverse loading. Recent experimental investigations indicated that there exist considerable differences in the mechanical behavior of composites with coated fibers, as compared to the uncoated systems. In addition, transverse mechanical loading yielded longitudinal matrix cracking in the regions of closely spaced fibers. A simple analytical model and finite element calculations were utilized in order to qualify the experimental results. Some preliminary thoughts on the issue of fiber fracture were also discussed, an issue that is currently under investigation.

A NEW TECHNIQUE FOR MEASURING RAYLEIGH AND LAMB WAVE VELOCITIES IN METALS, GRAPHITE-EPOXY AND METAL MATRIX COMPOSITES

Tribikram Kundu
Associate Professor
Department of Civil Engineering and Engineering Mechanics
University of Arizona

Abstract

A new technique is developed to measure Rayleigh and Lamb wave velocities in metals and composites. In this technique two transducers are positioned above the specimen in a pitch-catch orientation. The time of flight of the signal from the transmitter to the receiver is recorded. Then the rate of change of this time as the distance between the reflector and the transducer varies is experimentally determined. This rate remains constant when leaky Rayleigh or Lamb waves are generated, otherwise it varies. Thus surface waves can be detected in an indirect manner. An expression is derived to relate the surface wave velocity to the signal flight time change rate with the transducer specimen distance. Using this expression Rayleigh and Lamb wave velocities have been accurately determined in isotropic metals and anisotropic composites.

Fatigue Damage Accumulation of

Angle-Plied Cord-Rubber Composites

by

Byung-Lip ("Les") Lee and Jeffrey A. Smith
Associate Professor and Graduate Student
Department of Engineering Science and Mechanics

Pennsylvania State University
University Park, PA 16802

ABSTRACT

Current phase of the study was undertaken to examine tensile fatigue behavior of cord-rubber composites representing bias tire carcass under various frequencies up to the level which closely simulates loading during high-speed take-off of aircraft. At a given stress amplitude, the use of higher cyclic frequency was found to affect strain response and heat build-up characteristics of composites significantly. The lower level of *initial strain* observed at higher frequency stems clearly from strain rate dependence of deform... on of rubber matrix composites. The temperature profile of the specimens subjected from 20 to 30 Hz loading showed that hysteretic heating under these conditions may lead to thermal fatigue failure as well as chemical degradation influencing both fiber-matrix adhesion strength and matrix strength. The involvement of material degradation process was indicated by the fact that gross failure of composites requires lower value of *dynamic creep* when the frequency is increased. At the same time, the use of higher frequency resulted in exponentially higher *dynamic creep rate*. For load range tested, the *energy loss per cycle* was found to be nearly constant and independent of the frequency. As a result, the *energy loss per unit time* became linearly proportional to the frequency. Since fatigue life of carcass composites is linearly proportional to the inverse of frequency, it was postulated that the rate of energy loss determines the lifetime of composites. The study revealed that the specimen surface temperature may not describe such critical parameters as internal heating particularly at the point of crack initiation or true heat dissipation rate.

A PHYSICS-BASED HETEROJUNCTION BIPOLAR TRANSISTOR MODEL
INCLUDING HIGH-CURRENT AND THERMAL EFFECTS

Juin J. Liou
Associate Professor
Department of Electrical & Computer Engineering
University of Central Florida, Orlando, FL 32816

Abstract

We present a detailed, analytical model to predict the d.c. and high-frequency performance of AlGaAs/GaAs heterojunction bipolar transistors (HBTs). The model is developed based on the device configuration and relevant device physics such as current-induced base pushout and thermal effects associated with high collector current density in the HBT. The characteristics of the current gain, cutoff frequency, and maximum frequency versus the collector current density, which is a function of the applied voltage as well as the corresponding temperature in the HBT, are calculated. Our results suggest that the conventional HBT model, which assumes the HBT temperature is the same as that of the ambient, can overestimate the current gain, cutoff frequency, and maximum frequency considerably when the collector current density is high. Furthermore, we have shown that the experimentally observed HBT high-current behavior, like the rapid fall-off of the current gain and cutoff frequency, can be accurately predicted if thermal effect is properly accounted for in the analysis. The model predictions compare favorably with the results obtained from a model which solves numerically the Poisson and continuity equations coupled with the heat transfer mechanism.

A Switched Reluctance Motor Drive Using MOSFETs, HCTL-1100, and MC6802 Microprocessor

Shy-Shenq P. Liou
Assistant Professor

Lawrence Vo
Graduate Student

Division of Engineering
San Francisco State University

Abstract

A switched reluctance motor drive is designed, built, and tested using the MOSFETs as the power switches. The control function of this drive is done by a general purpose motion control chip HCTL-1100 from Hewlett Packard. The interface between the HCTL-1100 and the user is through a Motorola microprocessor MC-6802. A bang-bang current control circuit is also built into the drive to limit the motor current to be less than or equal to the rated motor current. Simple assembly program can enable the user to input the command velocity, command position, and command profile to the HCTL-1100 motion control chip. The test run of this drive is very successful.

THERMAL ANALYSIS AND MOLECULAR WEIGHT DISTRIBUTION OF A TRIARYL PHOSPHATE SOLUTION

Christopher C. Lu
Associate Professor
Department of Chemical and Materials Engineering
University of Dayton

ABSTRACT

Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were used to study the chemical and physical behavior of a triaryl phosphate (TAP) solution which has potential for use as a high temperature, vapor phase lubricant for turbine engines. The heat of vaporization of the TAP solution was found to be 20.8 kcal/mol which is very close to a literature value for tricresyl phosphate (TCP). Gel Permeation Chromatography (GPC) was used to measure the molecular weight distribution of the TAP solution and showed that larger molecular weight molecules were formed when the TAP solution was heated under oxygen and nitrogen environments. This study suggests that the molecular weight increase is due to polymerization. As would be expected, the kinematic viscosity of the TAP solution also increases with heating. This is believed to be the reason that TAP vapor deposition films can be used as a high load/high speed bearing lubricant for low traction operation at temperatures of at least 670°C.

EFFECTS OF FREE-STREAM TURBULENCE AND SURFACE RIBLETS ON HEAT TRANSFER IN A LINEAR TURBINE CASCADE

Paul K. Maciejewski

Assistant Professor
Mechanical Engineering Department
University of Pittsburgh

ABSTRACT

The present study is an experimental investigation of the effects of free-stream turbulence and surface riblets on heat transfer in a linear turbine cascade. The primary goal of the study is to determine if surface riblets will reduce the average heat transfer rate in a cascade in the absence and in the presence of free-stream turbulence. A smooth, airfoil shaped, constant temperature heat transfer test surface was inserted into the AFIT linear cascade facility, where heat transfer tests were run at three levels of Reynolds number and two levels of free-stream turbulence. The heat transfer test surface was then removed from the facility so that riblets could be engraved on its surface. The newly ribleted heat transfer surface was then re-inserted into the cascade facility, where a second set of heat transfer tests were run at the same set of conditions used during the testing of the test surface while it was smooth. The test results indicate that, under certain conditions, surface riblets reduce the average heat transfer rate in the cascade by 6%.

TRADE-OFF ANALYSIS OF SENSOR FUSION METHODOLOGIES FOR AN X-BAND AND W-BAND RADAR SENSOR SUITE

Charlesworth R. Martin
Associate Professor
Department of Physics and Engineering
Norfolk State University

Abstract

Various methods for implementing multi-sensor fusion for a dual mode RF (Radio Frequency) sensor suite were reviewed. The primary objective being to ascertain which methodology holds the most promise for practical implementation. The criteria for best being (a) Performance capability, (b) Simplicity of algorithm, (c) Ease of implementation, and (d) The stage of the process at which it makes possible for fusion to take place. Preliminary results seem to suggest that the Bayesian Fusion methodology is the scheme that emerges as the most practical. The paper concludes with hardware implementation for the dual RF Bayesian sensor system fusion algorithm.

EFFICIENT ANALYSIS OF PASSIVE MICROSTRIP ELEMENTS FOR MMIC'S

Krishna Naishadham, Assistant Professor
Todd W. Nuteson, Graduate Associate
Department of Electrical Engineering
Wright State University

ABSTRACT

Passive microstrip elements such as meander lines are analyzed by the full–wave, space domain moment method at microwave and millimeter wavelengths. Redundant calculations in the moment matrix are eliminated by utilizing various symmetries. At lower microwave frequencies quasi–static approximations of the Green's functions are invoked to simplify the analysis. The Green's functions are in general Sommerfeld–type integrals, which are computationally intensive. In this paper, closed–form analytical approximations of the integrals, recently developed by Chow et al., Aksun and Mittra, are utilized to increase the efficiency of the algorithm such that a circuit of moderate electrical size can be analyzed in reasonable time. Sample computed results are presented for the scattering (S) parameters of meander lines and multi–turn spiral inductors. Computed results compare reasonably well with measurements on a vector network analyzer.

THIRD ORDER NONLINEAR OPTICAL PROPERTIES OF STRAINED LAYER SEMICONDUCTORS WITH APPLICATION TO OPTICAL WAVEGUIDES

M. J. Potasek
Research Professor
Department of Applied Physics
Columbia University

Abstract

Nonlinear optical phenomena are of interest because of their wide variety of applications in many fields. Therefore I have investigated the waveguiding properties of strained layer III-V semiconductors. In view of the semiconductor growth facilities here as well as measurement capabilities, particular attention was paid to InGaAs/GaAs multiple quantum well materials. Using the numerical beam propagation method, I calculated the coupled waveguide characteristics for these materials and examined the effects of various physical parameters.

DEVELOPMENT OF CONTROL DESIGN METHODOLOGIES FOR FLEXIBLE (HIGH ORDER) MISSILE SYSTEMS WITH MULTIPLE HARD NONLINEARITIES

Armando A. Rodriguez
Assistant Professor
Deptartment of Electrical Engineering
Arizona State University

1 Abstract

The primary goal of this research endeavour has been to initiate a program directed at the development of practical methods for designing robust full envelop autopilots for *flexible missile systems with multiple hard nonlinearities*. The methods developed will permit control engineers to systematically generate full envelop controllers on the basis of very complex (high order) missile models.

The research has been driven by the ultimate goal of designing a full envelop autopilot for an Extended Medium-Range Air-to-Air Technology (EMRAAT) Bank-to-Turn (BTT) missile with significant structural modes. Of particular interest is the terminal phase of an air-to-air intercept during which control surfaces may saturate in both position and rate. This is critical because structural modes may be excited and, more importantly, missile destabilization may be induced. Assuring robust performance during such a high control scenario has guided the path of this research.

Contents

DETERMINATION OF THE OPERATIONAL CHARACTERISTICS OF A PHASE-DOPPLER DROPLET ANALYZER AND APPLICATION TO A RAMJET FUEL-INJECTION RESEARCH TUNNEL

Larry A. Roe
Assistant Professor
Mechanical Engineering Department
Virginia Polytechnic Institute and State University

Abstract

A single-component, phase-Doppler particle analyzer was assembled, validated and characterized in bench-top testing, and applied to an experimental fuel injection tunnel. The influences of instrument settings, including laser beam intersection angle, diffraction grating speed, photomultiplier voltage, and filter settings, were evaluated. It was concluded that the system produces reliable droplet size information over the range of interest and good results for average velocity. Indicated results for RMS velocity were not felt to be generally reliable under the conditions tested. Data sufficient to produce three-dimensional contour plots of the spray pattern produced by normal injection of water into a crossflowing air stream were acquired for air Mach numbers of 0.2 and 0.4. Additional data were obtained for Mach 0.3. A preliminary analysis of the data indicates that droplet diameters are generally larger on the upper periphery of the plume, with large densities of smaller droplets in the central core of the spray. Small droplets, of low number density, were found near the tunnel floor. Full three-dimensional mapping of the acquired data is recommended.

A STUDY OF MILLIMETER-WAVER RADAR AND INFRARED SENSOR FUSION USING NEURAL NETWORKS

Thaddeus A. Roppel
Assistant Professor
Department of Electrical Engineering
Auburn University

Abstract

The application of an artificial neural network (ANN) to the problem of sensor fusion was studied. Pixel-level data from captive flight tests was used to form the training and testing data sets. The neural network simulation program Aspirin was used to perform back-propagation training. Infrared (IR) pixel images from the available data sets were reduced from 128 x 544 pixels to 10 x 10 pixels after manually rotating and segmenting the images.

During the first phase of the experiment, a two-layer ANN consisting of 100 inputs, 20 hidden layer nodes, and two output nodes was trained to distinguish between two target types, a T-62 tank and a Lance missile launcher. A total of 14 IR target scenes were available, of which 9 were used for training the ANN and 5 were used for testing the ANN after training. Testing showed that the trained ANN was able to distinguish between the two target types 100% of the time with high confidence.

During the second phase of the experiment, the IR data was augmented by including an additional 128 pixels of millimeter-wave (mmw) radar data which had been obtained simultaneously with the IR data. Inclusion of the mmw radar data reduced the overall rms error in the ANN output layer by 14% compared with using the IR data alone.

TOWARD A CHARACTERIZATION OF THE DEBRIS CLOUD
CREATED IN A HYPERVELOCITY IMPACT ON A THIN PLATE

Dr. William P. Schonberg
Associate Professor
Civil Engineering Program
University of Alabama in Huntsville

Abstract

Current semi-analytical lethality assessment models typically fall into one of two general categories: discrete particle models and expanding shell models. Discrete particle models account for and track only a small number of solid fragments in a debris cloud generated by a high speed impact. As such, they are best suited for impact scenarios in which melting and/or vaporization of the projectile and target materials do not occur. Alternatively, expanding shell models typically assume that all of the debris cloud material is homogeneously distributed over a uniformly expanding spherical shell and are therefore applicable only in those impact situations where melting and/or vaporization of the projectile and target materials do occur. A need clearly exists to bridge the gap between the discrete particle models and the expanding shell models. Specifically, a lethality assessment model that considers the creation and subsequent effects of debris clouds containing all three states of matter is needed. This report describes the results of an investigation into the composition of the material in a debris cloud generated by a hypervelocity projectile impact. The work completed represents the first step in a long-term research program whose overall objective is to develop a general model of the response of a target structure to a hypervelocity impact over the 4-16 km/sec impact velocity regime.

QUANTUM MECHANICAL INVESTIGATIONS OF MOLECULAR STRUCTURE AND CONFORMATION IN PERFLUOROPOLYALKYLETHERS

Martin Schwartz
Professor
Department of Chemistry
University of North Texas

Abstract

Molecular Orbital calculations have been performed on perfluoroethylmethyl ether [PFEME] and perfluorodimethoxymethane [PFDMOM] in order to determine the geometries and energies of their equilibrium and transition state structures.

In PFEME it was found that the CCOC skeleton in the "trans" conformer is twisted by 17° from 180°, and there is a similar rotation of the perfluoromethoxy fluorines about the terminal CC bond, giving the molecule an overall helical structure. It was also determined that the energy of the gauche conformers (relative to the trans form) is unusually high,resulting in virtually 100% trans conformers at normal temperatures.

The structure of "trans" PFDMOM was also found to be helical with a twist of both the COCO skeletal and FCOC terminal dihedral angles from 180°. It was further observed that rotation about both of the internal CO bonds is much more facile (low barriers and roughly equal equilibrium energies) than the equivalent internal rotation in PFEME.

These results indicate that the rigidity and, hence, viscosity of linear perfluoropolyalkylethers should rise with an increasing proportion of -OCCO- linkages in the chain, a conclusion that is in agreement with experimental observations. These quantum mechanical data will be utilized in future molecular dynamics simulations of the molecular motions and bulk properties of PFPAE liquids.

DETECTION AND ADAPTIVE FREQUENCY ESTIMATION FOR DIGITAL MICROWAVE RECEIVERS

Arnab K. Shaw
Assistant Professor
Electrical Engineering Department
Wright State University

Stven Nunes
Graduate Student
Electrical Engineering Department
California State University, Chico

Abstract

Detection of presence of targets and estimation of Angles-of-Arrival (AOA) are two of the important tasks of a digital EW receiver. In this report, the time-domain detection problem and an adaptive frequency/AOA estimation scheme have been studied. For the detection problem, detection thresholds have been derived for square-law detectors in cases of single and multiple observation samples. The adaptive frequency/AOA estimation scheme has been studied to analyze its behavior at various noise and input conditions. Simulation results indicate that the use of higher estimation model order than the actual order improves the bias and variance of the estimates at the cost of longer convergence time.

HARDWARE IMPLEMENTATION OF THE ANVIL ALGORITHMS: A STUDY OF THE APPROACH

Janusz A. Starzyk
Professor
Department of Electrical
and Computer Engineering
Ohio University

Abstract

Hardware implementation of the Artificial Neural VIsion Learning (ANVIL) system algorithms has been studied. Major stages of ANVIL processing steps are represented as separate functional blocks. They are designed as specialized neural networks with the interconnection weights learned off-line, during ANVIL training and associative mapping operations. Tradeoff between hardware requirements and computation efficiency was a motivating factor behind three variants considered during this study. A completely parallel system was analyzed and was found impractical for implementation. A hybrid system, which combines parallel processing in neural network layers with sequential scanning, can be implemented with reasonable hardware costs and perform within an acceptable time delay. Finally, a system of object identification at a given location was analyzed. This task was found to be much easier than the combined task of the object location and identification. Different technologies were considered and my recommendation is to combine MOS technology with the gallium arsenide ACT devices.

WAVELET ANALYSIS OF ULTRASONIC SIGNALS

Theresa A. Tuthill
Assistant Professor
Electrical Engineering Department
University of Dayton

Abstract

Wavelet theory provides a new approach to time-frequency analysis of signals. Waveforms are decomposed into various scales of a single "wavelet." Dilations and translations of the wavelet provide increased resolution over standard Fourier transform techniques and are useful in detecting transient signals. The wavelet transform was applied to ultrasonic signals to enhance the detection of delaminations and other subsurface defects in materials and also to aid in data compression. Difficulties arise in interpreting the wavelet coefficients and correlating them to spatial deformities due to the time-variancy of the transform. A better understanding of wavelet decomposition was gained by analyzing fundamental signals such as impulses and pure sinusoids. An optimal class of wavelets still needs to be determined for the non-destructive evaluation of materials.

MBE Surface Kinetics of Semiconductors- A Stochastic Model Study

R. Venkatasubramanian

Abstract

A stochastic model for the MBE growth of Ge is developed based on the master equation approach with solid-on-solid restriction and quasi-chemical approximation. The surface kinetic processes included are: adsorption, evaporation and intralayer and interlayer surface migrations. The growth rate, the time averaged surface roughness and the time averaged intensity of reflection high energy electron diffraction (RHEED) (using kinematical theory of electron diffraction) were obtained for the MBE growth of Ge with the temperature in the range 423 – 698°K and a flux of 1 Å/sec. The growth rate was observed to be 1 Å/sec implying unity sticking coefficient. The time averaged surface roughness and isol .ted terrace adatom concentration which are good indicators of the average surface roughness, are found to be independent of the substrate temperature below 473°K and above 648°K. In the intermediate temperature range, the isolated terrace adatom concentration and the surface roughness decrease with increasing temperature. The kinetic roughening temperature above which a smooth surface remains smooth, is identified from the temperature dependence of the time averaged surface roughness, terrace adatom concentration and the RHEED intensity, as 648°K. The temperature dependence of the time averaged RHEED intensity and the kinetic roughening temperature obtained from this study compare favorably with the experimental results. The phenomenon of kinetic surface roughening is explained in terms of competition between the incorporation of Ge atoms on the surface which is a surface roughening process and the migration of Ge atoms to energetically favorable island edge sites which is a surface smoothing process.

DEVELOPMENT OF A RESONANT DC LINK INVERTER FOR INDUCTION MOTOR DRIVE

Subbaraya Yuvarajan
Associate Professor
Department of Electrical Engineering
North Dakota State University

Abstract

Resonant DC Link Inverters have negligible switching losses compared to the conventional hard-switched inverters. A three phase dc link inverter suitable for feeding an induction motor was developed. The complete operation of the resonant dc link inverter system was studied using the simulation package PSpice. The elements of the inverter like the link inductor and the link switch were designed and built. The control circuit for the three phase inverter was then developed. The experimental system with the inverter feeding the induction motor was tested. The principle of the resonant link was later extended to a single phase Pulse Width Modulated (PWM) inverter.

ARNOLD ENGINEERING DEVELOPMENT CENTER

EXPERIENCES USING MODEL-BASED TECHNIQUES FOR THE DEVELOPMENT OF A LARGE PARALLEL INSTRUMENTATION SYSTEM

Ben Abbott
Csaba Biegl
Research Faculty
Theodore A. Bapty
PhD. Candidate
Department of Electrical Engineering
Vanderbilt University

Abstract

Experiences using a *model-based* approach to develop an 83 processor parallel instrumentation system for turbine engine aeromechanic stress analysis is described. The approach includes using a graphics based editor to describe the structure of the desired signal flow graph as well as the target hardware architecture. Program synthesis techniques are used to automatically transform these models into an executable system.

DATA REDUCTION OF LASER INDUCED FLUORESCENCE IN ROCKET MOTOR EXHAUSTS

Stephen H. Cobb
Assistant Professor
Department of Physics and Astronomy
Murray State University

ABSTRACT

Laser induced sodium fluorescence data from a liquid-fueled rocket engine's exhaust plume have been reduced and analyzed. By correlating the experimental fluorescence linewidths with those of the theoretically predicted Voigt profiles, a temperature has been calculated as a function of radial position in the flow field. Also, by monitoring the Doppler shifted centroid of the fluorescence lineshape, the radial component of flow velocity has been determined. These experimental results are compared with computer code predictions.

FEASIBILITY OF
WAVELET ANALYSIS
FOR PLUME DATA STUDY

Kenneth R. Kimble
Associate Professor
Department of Mathematics
University of Tennessee Space Institute

Abstract

The recovery of information from images of rocket plumes presents severe challenges to image processing techniques. Severe noise is usually present since equipment is operated near the limit of its design. The images are non-stationary making Fourier analysis problematic. Classical non-Fourier analysis techniques require considerable manual judgement and intervention. Recent developments in an extension to Fourier analysis, "wavelet" analysis, and new techniques in fractal theory based on iterated function systems (IFS) both showed promise for developing automatic computer techniques which could treat both scale and dynamic variation in image data. Systematic investigation indicated that IFS is currently underdeveloped and the only published technique for image encoding utilizes an image grid segmentation which causes additional artifacts in the image at the grid lines. Wavelets, however, are applied without any such gridding, their encoding can be done with existing DSP hardware, and several classical image processing techniques can be implemented as adaptive wavelet bases. The analysis of textures in images has been found to be quite successful using wavelets and this analysis was attempted for rocket plumes. It was found that noise levels currently mask most texture in currently available images. However it was also found that wavelets form a more suitable tool than Fourier analysis for image understanding and that the potential exists to simplify other forms of image processing tools into wavelet filters.

CURRENT FLOW IN THE PLASMA EROSION OPENING SWITCH

by

Carlyle E. Moore
Physics Department
Morehouse College
Atlanta, GA 30314

ABSTRACT

The Plasma Erosion Opening Switch (PEOS) is a fast-opening switch that has been used successfully in a variety of pulsed power generators. It uses inductive, rather than capacitive, energy storage in order to exploit the high energy density associated with an inductor. A great deal of progress, both experimental and theoretical, has been made within recent years in describing the operation of the switch, and a number of approaches have been proposed in an effort to elucidate the underlying principles of switch behavior. While these provide a great deal of insight into the Physics involved, a comprehensive theory is yet to be found. This Report undertakes a review of some of the more important theoretical developments, with special emphasis on the dynamics of current flow in the Plasma, and examines them in light of experimental observations.

EXTENSION OF THE SMIRF FLARE MODEL TO
COMPLEX GEOMETRICAL SHAPES

Olin Perry Norton
Research Engineer
Diagnostic Instrumentation and Analysis Laboratory
Mississippi State University

Abstract

The SMIRF flare model was written to calculate the infrared signature of flares. The existing code was limited to flares whose shapes were simple geometric forms, such as cylinders, spheres, and rectangular parallelepipeds. This work describes the removal of that restriction, and the modifications that were made to the code to allow for more complex geometrical shapes.

The code was modified to read the geometrical data from a user-supplied data file. If an appropriate data file can be supplied, then SMIRF will be able to compute the signature for flares of arbitrary shape. This data file contains information describing how the surface area and volume of the flare change as the flare burns.

In addition, an approximation method is developed for modeling flares with grooved surfaces. This approximation expresses the increased surface area of the grooved surface in terms of an area augmentation ratio. Thus, the area of the surface is calculated ignoring the grooves, and the result is multiplied by the augmentation ratio to find the area of the grooved surface.

FOURIER TRANSFORM SPECTROMETRIC INFRARED DETECTION OF AIRBORNE SOLVENTS

Randolph S. Peterson
Associate Professor
Physics Department
The University of the South

ABSTRACT

DOD, EPA, and DEA have quantitative and qualitative measurement needs for airborne solvents used in chemical processing and combustion facilities. These airborne solvents provide dim, extended sources for spectrometric studies that are not temporally stable by most laboratory standards. The use of a Michelson interferometer-based Fourier transform infrared spectrometer (FTIR) has been used to study a dilute gaseous solvent, acetone, in the laboratory under conditions expected in the field. Limitations of detection and opportunities for use of new technologies have been explored and comprise the bulk of this report.

COMPUTATIONAL METHODS FOR CALCULATING RADIATION TRANSPORT FROM PULSED X-RAY SOURCES

Richard M. Roberds
The University of Tennessee Space Institute

ABSTRACT

Calculation of the transport of radiation from pulsed X-ray sources is a necessary part of radiation-effects testing. The characteristics of the radiation and the heterogeneity of the transport medium provide a challenge to traditional computational methods. This paper offers an introductory perspective of computational methods used for calculating photon transport associated with flash X-ray machines.

A brief review of the Monte Carlo (stochastic) approach is provided, but the focus of the paper is on the deterministic approaches of the discrete-ordinates and finite element methods. The derivation of the Boltzmann transport equation is reviewed along with *simplifying assumptions* (*time-independent*, multigroup) that are made. The discrete-ordinates method of discretizing angle is described, and mention is made of the numerical problems (ray effect and artificial dispersion) resulting from that approach. The finite element method as applied to radiation transport is briefly explained with emphasis on its promising aspects. Numerous references and a bibliography are provided which will enable the reader to gain an in-depth, comprehensive understanding of the subject if desired.

It is concluded that the Monte Carlo method is versatile and reliable and an essential backup method, but an inherently inefficient approach. Deterministic methods have specific advantages over Monte Carlo if they can be applied. The discrete-ordinates (S_N) method has been developed to a high level of sophistication, but the finite element method shows promise as a deterministic approach that may provide solutions to multi-dimensional problems which are impractical for the discrete-ordinates approach. While further development is required, the finite element method may eventually provide accurate deterministic solutions to problems with awkward geometries, and with an efficiency that surpasses the Monte Carlo method.

CIVIL ENGINEERING LABORATORY

CHARACTERIZATION OF SEAGRASS MEADOWS IN ST. ANDREW (CROOKED ISLAND) SOUND, NORTHERN GULF OF MEXICO: PRELIMINARY FINDINGS

Sneed B. Collard
Professor
Biology Department
The University of West Florida

Abstract

Seagrass meadows in St. Andrew (Crooked Island) Sound, a shallow marine lagoon bounded by Tyndall Air Force Base, Florida, were studied from mid-June to mid-August 1992. The study site was located at the narrowest part of the Sound about 3 km from its eastern origin. Seagrass meadows were monocultures of *Thalassia testudinum* and *Halodule wrightii*. Beds of the two species were often contiguous, with little or no overlap in distribution. Water temperatures during the study period ranged from 29.9 to 34.4 °C; salinity ranged from 30.1 to 36.0 ppt. At the deepest station (P5 CTL) water depth ranged from 40 to 118 cm. A pycnocline was often present at mid-depths in deeper water. Currents in the Sound are complex, and react instantaneously to wind stress. Seagrass densities ranged from 951 leaves m^2 at the shallow *T. testudinum* site (P3 CUT) to 2078 leaves m^2 at the deepest *T. testudinum* site (P5 CUT). Reliable measures of *H. wrightii* densities were not obtained. Growth rates ranged from -0.3 cm day^{-1} to 2.5 cm day^{-1}. Fish and macroinvertebrate species diversity was high compared to other seagrass communities described in the literature. During a three day period a total of 57 species of fishes were collected using a small trawl and a crab scrape. This compares to a total of 128 species caught during both day and night trawl hauls over a one year period in the entire St. Andrew Bay estuarine complex. Heat and low tide exposure stress caused short-term diebacks in the shallowest beds, and contributed to a mass mortality of the sea urchin *Lytechinus variegatus*. Dominant macroepibenthic invertebrates included sea urchins, the Florida crowned conch, the horn shell, *Bittium varium*, blue crabs, hermit crabs, paleomonid shrimp, pink shrimp, mud crabs, hermit crabs, and arrow shrimp. Preliminary lists of species are included in the report. Infaunal species were inadequately sampled, and epiphytes were not sampled. Macroalgae were not found in or near the sampling area, an unusual, if not singular characteristic of the seagrass community in Crooked Island Sound (CIS). Large alligators are common in CIS both day and night, and pose some hazard to swimmers during nighttime sampling activities. Alligators may be important predators in CIS. Loggerhead and Kemp's ridley sea turtles were frequently observed from the entrance to Wild Goose Lagoon to the southeastern limit of the system. Sea turtles were presumably feeding on crabs and other crustaceans. Damage to seagrass meadows in the sampling area was caused by boat propellers, recreational scallop harvesting and intrusive sampling by the author. No direct or presumptive evidence of pollution from anthropogenic activities in the area was detected. Compared to other coastal ecosystems in the northern Gulf of Mexico CIS is relatively undisturbed, biologically diverse, and in many respects, appears to be ecologically unique. Results suggest that additional long-term studies of the system are warranted.

A PRELIMINARY STUDY OF THE WEATHERING OF JET FUELS IN SOIL MONITORED BY SFE WITH GC ANALYSIS

Larry E. Gerdom, PhD
Associate Professor
Division of Natural Science
Mobile College

Abstract

An offline supercritical-fluid extraction method was further developed for soil samples containing jet fuels. Supercritical-fluid carbon dioxide was used for extraction at 80 °C and 300 atm. This method is rapid with an extraction time of 20 minutes or less and it appears to be nearly quantitative for JP-4. Laboratory extracts were analyzed by GC with an FID detector. Modeling studies designed to determine how jet fuel components weather at a spill site are incomplete at this time.

PRELIMINARY NUMERICAL MODEL
OF GROUNDWATER FLOW AT THE MADE2 SITE

Donald D. Gray
Associate Professor
Department of Civil Engineering
West Virginia University

Abstract

The Air Force has embarked on a program of environmental restoration which includes many sites where the groundwater has been contaminated by jet fuel or solvents. In order to design effective groundwater remediation plans, it is necessary to be able to predict how dissolved and immiscible pollutants will be transported by advection and dispersion. This capability is being developed by the Civil Engineering Support Agency. As part of this effort, the public domain groundwater flow program MODFLOW and its associated programs were applied to predict the groundwater flow at the site of the Macrodispersion Experiment 2 on Columbus Air Force Base in Mississippi. The program was used in the steady state mode with hydrologic conditions as they existed in October, 1990. Field data were used to estimate the boundary conditions and the hydraulic conductivity distribution. The net recharge to the aquifer was estimated from meteorological data. The importance of accurately specifying the recharge was illustrated by performing simulations with and without recharge. In order to interpret the head distributions predicted by MODFLOW, particle trajectories were calculated by the program MODPATH and plotted using MODPATH-PLOT. Among the conclusions of this study are that realistic simulations must be three dimensional and transient, and that our ability to visualize the results lags our ability to perform the simulations.

DECISION ANALYSIS FOR SELECTION OF HALON 1301 REPLACEMENT AGENTS

Charles J. Kibert
Associate Professor
Fire Research and Testing Center
University of Florida

Abstract

The U.S. Air Force program to replace Halon 1301 in total flood applications with suitable compounds entails the requirement to set selection criteria that will provide technical and management decisionmakers with the basis for evaluating the alternatives. Classic decision matrices allow a single evaluator to both rate and provide weights for each criterion against the various alternatives. The methodology described in this paper allows multiple evaluators to rank the criteria in order to generate criteria weights. A symbolic scheme to state the relative importance of the criteria and a system for "collapsing" the rankings are described.

HYDRAULIC CONDUCTIVITY VARIABILITY, KRIGING, TREND SURFACES
AND
TRAVELLING WAVES WITH NONLINEAR, NONEQUILIBRIUM ADSORPTION

Valipuram S. Manoranjan
Associate Professor
Department of Pure and Applied Mathematics
Washington State University

Abstract

The spatial variability of hydraulic conductivity is studied using the (grain-size analysis) data collected at a tracer test site, located at Columbus Air Force Base in Mississippi. The study involves vertical kriging and constructing segmented planar trend surfaces. It is shown that such an investigation can provide a better understanding of the variability pattern of hydraulic conductivity. Further, a relationship between the results from borehole flowmeter study and grain-size analysis study is conjectured. Lastly, a one dimensional transport model with nonlinear, nonequilibrium adsorption is analyzed and an expression for the travelling wave solution is obtained in a closed form employing a linear caricature approximation of the nonlinear isotherm.

IMMOBILIZED CELL BIOREACTOR FOR 2,4-DINITROTOLUENE DEGRADATION

Kenneth F. Reardon
Assistant Professor
Department of Agricultural and Chemical Engineering
Colorado State University

Abstract

2,4-Dinitrotoluene (DNT) is an EPA priority pollutant that is found in wastes from the manufacture of 2,4,6-trinitrotoluene (TNT) and toluenediisocyanate. Treatment of DNT-containing waste by activated sludge processes is usually difficult owing to the high toxicity of this compound. In this work, removal of DNT from aqueous solutions was achieved with a bioreactor containing immobilized *Pseudomonas* PR7. This microorganism, which is able to use DNT as its sole source of carbon and energy and degrades DNT oxidatively, was isolated by the Microbiology Group of HQ AFCESA at Tyndall AFB.

Studies using suspended cells showed that *Pseudomonas* PR7 is able to degrade DNT concentrations as high as 1500 μM, the solubility limit at 25 °C, although concentrations above 1000 μM lengthened the lag phase in batch growth. Higher cell densities were obtained on a growth medium containing both succinate and DNT than when DNT was the sole carbon source, but 12-fold higher specific rates of DNT degradation were obtained in succinate-free cultures. High concentrations of nitrite (>5000 μM) inhibited the growth of this microorganism but did not affect the specific DNT degradation rate.

The packed-bed bioreactor contained diatomaceous earth pellets to which the microorganisms were attached. The feed to the system contained DNT (from 500 to 1200 μM) as the sole carbon source in a minimal medium containing phosphate, ammonium, and other nutrients. During a 712-hour test of this bioreactor, various studies were carried out to characterize the system. When the system was configured to emulate a continuous well mixed reactor, the maximum performance was 325 μmol/L·h (based on total liquid volume) or 470 μmol/L·h (based on the column volume). The comparable rate in a continuous suspended cell reactor was 25 μmol/L·h. The bioreactor also demonstrated resistance to large perturbations and the ability to function stably for long periods. When fed a mixture of DNT and TNT, both were degraded, and the rate of DNT consumption was unaffected by the presence of TNT.

UNIAXIAL STRESS-STRAIN BEHAVIOR OF UNSATURATED SOILS AT HIGH STRAIN RATES

by

George E. Veyera, Ph.D.
Associate Professor
Department of Civil and Environmental Engineering
University of Rhode Island

ABSTRACT

The Split-Hopkinson Pressure Bar (SHPB) at AFCESA/RACS was used to study the uniaxial stress-strain behavior of compacted moist soils under one-dimensional, undrained, confined compression loading at high strain rates (1000/sec and 2000/sec). Three soils, Eglin sand, Tyndall sand and Ottawa 20-20 sand were tested. Each sand was compacted to a constant dry density at varying degrees of saturation between 0% (air dry) and 100% (fully saturated). General features of the uniaxial stress-strain results indicate: a) an initially steep loading portion associated with the initial rise in the loading pulse which appears to be strain rate independent; b) the slopes of each curve are about the same after the initial steep portion up to lock-up; c) the initial saturation affects the point at which lock-up occurs; and d) after lock-up the slope is approximately that of pure water. Lock-up refers to the sharp increase in the slope indicating a stiffening behavior at some compressive strain after the initial steep loading portion of the curve. The results suggest that the stress-strain response is dominated by the water phase from the lock-up strain and beyond, while the soil skeleton dominates the response from the start of loading up to the lock-up strain. It appears that there may be some strain rate effects, however, the data are insufficient to adequately demonstrate this and further investigations are required.

The research described in this report has demonstrated that the SHPB system is a viable technique for high strain rate dynamic geotechnical testing of unsaturated, saturated and dry soils, and provides a framework for conducting further studies using the SHPB with soils. While the saturation dependent uniaxial stress-strain behavior observed in this study has been theorized and hypothesized in the past by other researchers, these results appear to be the first detailed measurements of this phenomenon for <u>undrained</u> uniaxial confined compressive loadings at high strain rates. The results of studies such as that described herein will lead to a better fundamental understanding of the load transfer mechanisms in unsaturated soils and have direct applications to groundshock prediction techniques including stress transmission to structures. The research is important to the U.S. Air Force since there are currently no theoretical, empirical or numerical methods available for predicting the dynamic uniaxial stress-strain response of unsaturated soils from loading environments such as those produced by conventional weapons effects.

APPLICATION OF FIBER-OPTIC LASER FLUORESCENCE SPECTROSCOPY TO ENVIRONMENTAL MONITORING

Brian S. Vogt
Professor
Department of Chemistry
Bob Jones University
Greenville, SC 29614

Abstract

Recent acquisition of a fiber-optic laser fluorescence spectrometer in the Environics Division of the Headquarters Air Force Civil Engineering Support Agency (HQ AFCESA/RAV) has opened up possibilities for rapid characterization of model aquifers and contaminated Air Force Sites. The goals of this project were to familiarize research personnel with the operation of the spectrometer, characterize spectrometer response, incorporate new computer and optical components into the system, optimize fiber-optic probe design, employ the instrument in a model aquifer study, and document the principles underlying the instrument and its application for distribution to Air Force personnel not familiar with the system.

All but two of the goals were achieved. Problems with laser cooling were diagnosed and resolved. Spectrometer response to naphthalene was characterized over a range of conditions. Several modifications of fiber-optic probe design were considered and tested. A prototype of the most promising design was designed, constructed, and tested. A refined and scaled-down version of the prototype was designed, constructed, tested, and found to be highly successful in monitoring not only analyte fluorescence, but also light scattered by turbidity introduced into samples. Results indicate that it may be possible to correct fluorescence signals for the effects of turbidity. Difficulties with procurement prevented the incorporation of additional computer and optical components into the system. There was not enough time to employ the spectrometer in a model aquifer study.

Recommendations were made concerning refinements in probe design and construction, further studies dealing with turbidity, studies dealing with potential interferences, and the application of the system to model aquifer studies. Additional recommendations were made as to how to accelerate the development and transfer of this technology to the field.

APPLICATIONS OF SMES IN AIR FORCE

Xingwu Wang
Assistant Professor
Department of Electrical Engineering
Alfred University

Abstract

The concept of Superconducting Magnetic Energy Storage (SMES) had been examined by government agencies and utility industries for several decades. However, in the public domain, we could not find publications dealing with the applications of SMES in Air Force. In the past eight weeks, we carried out a technical study. Besides an extensive literature search, we discussed various issues with the leading experts on SMES, and talked to personnel related to electricity usage in different Air Force installations. Our findings are summarized in this report. In section I, development of SMES is briefly introduced. In section II, operational principles of SMES is described. In section III, seven possible areas of the applications are examined: (1) regular base, (2) bare base, (3) communications squadron, (4) air traffic control, (5) Sector Operational Control Center (SOCC) Radar stations, and (6) energetic weapon. Other six possible areas are also suggested for future studies, including space command and intelligence command. In section IV, discussions and recommendations are presented. The recommendations include both short and long term plans. In the Air Force applications, SMES can be used as an energy storage unit, or a power conditioning unit. The required energy of SMES can be divided into three ranges: 20 MW-Hr (72 GJ), 100-500 MJ, and 1-20 MJ. The 20 MW-Hr unit is stationary, and similar to that of an Engineering Test Model (ETM) currently being studied by the Defense Nuclear Agency (DNA). The 100-500 MJ unit may need more development due to lack of previous experiments. The 1-20 MJ unit is mobil, and similar to that of commercially available products. In most SMES applications, magnetic field has to be confined to insure the Air Force operation. It is suggested that further research should be conducted to transform existing technologies into practical SMES units suitable for the Air Force environment.

FRANK J. SEILER RESEARCH LABORATORY

MULTIVARIABLE TRANSFER FUNCTIONS AND OPTIMAL PASSIVE DAMPING FOR A SLEWING PIEZOELECTRIC LAMINATE BEAM [1]

Thomas E. Alberts & Travis V. DuBois
Department of Mechanical Engineering and Mechanics
Old Dominion University
Norfolk, Virginia 23529-0247, USA
Phone: (804) 683-3736
Email: talberts@mem.odu.edu

Abstract

This report presents the development and experimental verification of a distributed parameter model for a slewing beam system with piezoelectric actuators and sensors. The beam is pinned at the proximal end, an endpoint motion sensor is attached at the distal end, and patches of thin piezoelectric laminates attached to its surface. The differential equation of motion for this system is transformed to Laplace domain transfer functions after application of the appropriate boundary conditions. Transfer functions relating the various actuator/sensor pairs are developed. The transfer functions are rationalized using a Maclaurin series expansion so that there is no need to assume mode shapes. Experimental results, which verify the model, are presented using a beam experiment at the US Air Force Academy, Frank J. Seiler Research Laboratory. The existing clamped beam experiment was modified through the addition of a hinged joint and appropriate instrumentation to carry out this work.

The transfer functions are eventually to be used to develop and experimentally validate a simultaneously optimal active and passive damping design for the experimental system. A preliminary damping design is discussed and initial experimental results presented.

VORTICITY AND VELOCITY MEASUREMENTS IN TRANSIENT OSCILLATORY SEPARATING BOUNDARY LAYER FLOWS

B. Terry Beck
Associate Professor

Paul K. Berg
Graduate Student

Department of Mechanical Engineering
Kansas State University

Abstract

The velocity and vorticity distribution within a transient oscillatory separating boundary layer was investigated using a single-component Laser Doppler Velocimeter System. The flow was initiated above a flat plate test model by means of a computer-controlled rotating spoiler (flap), mounted above the model surface. The tests were conducted in a water tunnel test facility, and dye injection was also utilized for visualization of the flow separation phenomena. The rotating spoiler subjected the plate below to a time-dependent spatial pressure gradient, inducing periodic flow separation and vortex shedding from the region near the plate and downstream of the spoiler. Measurements of both horizontal and vertical velocity components were made by rotating the optics of the LDV system. These profile measurements were obtained for discrete angular flap positions, thus mapping out the spatial and time-dependent flow field downstream of the flap. From the separate velocity component profiles, a computerized scanning algorithm was implemented to obtain both scan-averaged velocity and velocity gradient fields. Using this technique resulted in remarkably smooth results, in spite of the limited spatial resolution of the transient measurements. Clear evidence of reverse flows and flow bifurcation is indicated from the measurements near the region of boundary layer separation. The effect of flap frequency on the separation phenomena was also investigated.

NMR Relaxation Studies of Microdynamics in Chloroaluminate Melts

William R. Carper
Professor
Department of Chemistry
Wichita State University

Abstract

The microdynamics of $EtAlCl_2$ containing melts are examined by ^{13}C NMR relaxation methods as a function of melt composition and temperature. Application of the Dual Spin Probe (DSP) method to these systems reveals interaction between (1) the MEI^+ methyl group, (2) the terminal CH_3 of the MEI^+ ethyl group, and various $EtAlCl_2$ containing species. Unlike MEICl-$AlCl_3$ room temperature melts, there is no indication of interaction between the MEI^+ ring CH's and $EtAlCl_2$.

CHARACTERIZATION OF MATERIALS FOR NON-LINEAR OPTICAL THIN FILMS

Thomas M. Christensen
Assistant Professor
Department of Physics
University of Colorado at Colorado Springs

Abstract

Recent progress in non-linear optical materials has opened up tremendous opportunities for the development of inexpensive, non-linear optical devices. For this to occur, we need to better understand the origins of the non-linear optical properties of these materials. This is facilitated by being able to make thin films of these materials with desirable properties. We have explored the chemical composition, defect concentration and non-linear optical properties of thin films of GeO_x and SiO_2 doped with GeO_x produced by laser ablation and sputter deposition. The GeO_x films produced by laser ablation in a vacuum are laterally non-uniform with Ge enrichment at the center while those produced in an oxygen environment are more uniform and more like GeO_2. A photoluminescence experiment was set up, but the small sample volume available for analysis in thin films probably produced too small a luminescence to detect. A method for periodically poling films externally to enhance second harmonic generation is presented along with some calculations of field penetration into the films.

Modeling of the NLO properties of Silica

Ravi Pandey
Physics Department, Michigan Tech University
Houghton, MI 49931.

ABSTRACT

The microscopic NLO properties in terms of static and frequency-dependent polarizabilities of pure and Ge-doped silica glasses are determined using a cluster approximation. Both the semi-empirical and ab initio methods are used to describe $Si(OH)4$ and $Ge(OH)4$ clusters. The semi-empirical PM3 model appears to provide a reliable starting point for ab initio calculations. The calculated results show that the cluster configuration induced by the presence of a defect plays a significant role in predicting a non-linear response of the silica glass.

Electrochemistry in Lithium Chloride Buffered-Neutral
Room Temperature Melts

Bernard J. Piersma
Professor
Department of Chemistry
Houghton College

Abstract

The feasibility of using room temperature chloroaluminate molten salts for the development of high energy-density batteries has been the focus of on-going electrochemistry research at this laboratory. The primary objective of this project is to determine whether lithium would be a suitable anode for a secondary battery in 1-methyl-3-ethylimidazolium chloride chloroaluminate molten salt electrolyte. Initially several approaches were explored to achieve the buffering of neutral melts (neutral in terms of Lewis acidity) using lithium chloride as the buffering agent. Following this the role of protons, added as methylethylimidazolium hydrogendichloride, to facilitate lithium deposition and stripping and to extend the melt window was studied using tungsten, platinum, gold and glassy carbon electrodes. Finally the stability of lithium in an optimized proton-rich buffered-neutral melt and the charge-discharge processes that lithium would undergo as the anode in a secondary battery were studied using cyclic voltammetry, chronoamperometry and other electrochemical techniques.

ENHANCED PHYSIOLOGIC MONITORING OF CLOSED HEAD-INJURY

Michael L. Daley
Associate Professor
and
Brian Carter
Graduate Student
Department of Electrical Engineering
Memphis State University

Abstract

The aim of this study was to develop both a laboratory model of closed head-injury and an analytical model of venous blood flow from the brain to test the *hypothesis that variations in venous pressure associated with the respiratory cycle can have a dominant influence on venous flow from the brain during elevated intracranial pressure.* A young adult pig with an implanted intracranial balloon designed to manipulate intracranial volume was used as a laboratory model. An analog electrical circuit model was used to provide a theoretical analytical description of cerebral venous blood flow during elevated intracranial pressure. Both experimental and theoretical results indicate that during intact autoregulation of cerebral blood flow, respiratory induced venous pressure changes systematically influence intracranial blood volume. Specifically, intracranial blood volume increases during inhalation and decreases during expiration. Furthermore, the difference in change of intracranial volume between the two phases of ventilation, inhalation and expiration, increases with increasing mean intracranial pressure. However, during loss of regulation of cerebral blood flow, venous blood flow and the resulting changes of intracranial blood volume are not systematically influenced by respiratory induced venous pressure changes.

TEMPERATURE EFFECTS ON AQUEOUS POLYMER AND BIOPLOLYMER SOLUTION VISCOSITIES, ERYTHROCYTE SEDIMENTATION RATES AND CELL VOLUMES IN MAMMALIAN BLOOD.

Professor W. Drost-Hansen

ABSTRACT

In spite of continued, extensive clinical use (especially overseas) , the dynamics and mechanism of the Erythrocyte Sedimentation Rate (ESR) remain poorly understood. As in previous years we have concentrated on elucidating some of the factors affecting the ESR through studies of the effects of temperature on the sedimentation process. In this connection we have extended the range of temperatures investigated to include far lower temperatures than previously considered: data are now available for many species down to about 8 ^{o}C. For the higher temperatures it appears that the dramatic changes with temperature seen near 45 ^{o}C in the ESR and Mean Cell Volumes (RBC) reflect changes in the structure of the interfacial water (the vicinal water) of the systems. For the ESR (and possibly for the MCV)we propose that the anomalous responses to temperature near 45 ^{o}C are most likely effected through the action of the vicinal water on the structural integrity of the spectrin molecule. Similarly, the effects of temperature on the rheological properties of aq. solutions of Polyvinyl pyrrolidone, Polyethylene oxide, Dextran, Bovine Serum Albumin (BSA), Fibrinogen and Cytochrome-c are intimately tied to the vicinal water of hydration of these polymers; thus, more or less dramatic changes in viscosity of such solutions are seen at (or very near) the "Drost-Hansen thermal transition temperatures," [T_k], (for instance, near 15, 30 and 45 ^{o}C.) Similar transitions are seen in the viscosities of blood plasma from a number of mammalian species. In view of the ubiquitous nature of vicinal water it is hardly surprising that nearly all cell-physiological parameters - including osmotic and rheological aspects - vividly demonstrate thermal anomalies at T_k. Most likely, the involvement of vicinal water may explain many previously poorly understood aspects of the ESR while at the same time no doubt further complicating the kinetic picture of this process - for instance due to a distinct shear rate dependence [and hysteresis] of the nature and extent of the vicinal water. Finally, the thermodynamic properties of the intracellular water are also affected by the presence of the vicinal water; thus, the observed , anomalous cell volume changes with temperature (of both erythrocytes and platelets) reflect the influence of the vicinal water on the osmotic equilibria controlling cell volume regulation.

APPENDIX I:

GSRP REPORT ABSTRACTS

ARMSTRONG LABORATORY

FEATURE CONJUCTION SEARCH IN THREE-DIMENSIONAL SPACE

Jennifer L. Blume
Department of Psychology
Texas Tech University

Abstract

Assumptions posed by Previc's model (1990) that the upper visual field (UVF) and lower visual field (LVF) are specialized for far and near vision, respectively, were investigated. A further assumption that the left brain hemisphere, and thus the right visual field, as well as the UVF are characterized by focal processing was also tested. Detection speed and accuracy of random-dot stereogram targets in a feature conjunction task were measured as a function of target position (lateral half-field, vertical half-field, eccentricity, and depth). Targets appearing in the UVF and the right half-field did result in faster responding than targets in the LVF or left half-field. The results are discussed in support of Previc's theoretical model of visual processing.

Fractal and Multifractal Aspects of an Electroencephalogram

John E. Erdei
Associate Professor
and
Elaine M. Brunsman
Department of Physics
University of Dayton

ABSTRACT

The tools of fractal analysis have been used in an attempt to better understand the relationship between dynamical systems analysis and cognitive task assessment. The main thrust of the research has been to determine both the fractal and multifractal scaling behavior of an electroencephalogram (EEG), and to determine if this scaling behavior is sensitive to tasks being carried out by a subject. Universal features of the EEG have been examined by comparing the scaling behavior for 5 subjects, each of which performed the same tasks. The results were compared with known results for random noise, in an effort to determine the amount of randomness in the signal. Upon determination of the details of the scaling behavior of the EEG, the sensitivity of this behavior to cognitive task was examined by comparing EEG recorded under 12 different task conditions. Four 30 second EEG segments taken from a single 3 minute record were examined, and the scaling behavior for each segment was averaged to produce a single result for the given task. Scaling exponents and the multifractal spectrum was computed for each subject under all task conditions. Although the determination of the scaling exponents and the multifractal spectrum was successful, association of these characteristics with particular tasks yielded ambiguous results. A great deal of the ambiguity stems from the lack of stationarity of the signal, since the scaling behavior is not uniform from one section of the EEG to another.

The Relationship Between Serum 2,3,7,8-tetrachlorodibenzo-para-dioxin Blood Levels and Psychological Problems: Social Class, Exposure to Toxins and Mental Distress*.

Russell P.D. Burton
Department of Sociology
Kent State University
Kent, Ohio 44240

ABSTRACT

This paper has expands on the work of the 1991 AFHS and explores, with newly constructed dependent measures, with updated assumptions regarding consistency across measures, and with more fully specified models, the association between dioxin and mental distress. Results differ considerably from the 1991 AFHS report. While, by no means conclusive, results produced from these analysis strongly suggest that the body burden of dioxin is related to mental distress.

In Utero Taste Aversion Conditioning in the Rat Fetus

Jed S. Cohen
Summer Research Assistant
Department of Biology
Trinity University

Abstract

The ability to teach rat fetuses a taste aversion *in utero* was examined. Fetuses were conditioned by exposing them to a .15% saccharin solution and to a .8% lithium chloride solution. Initial experimental results indicate that saccharin consumption in all groups was low, possibly due to neophobia. In later test weeks, however, the saccharin and lithium chloride treatment group was found to consume greater quantities of saccharin. Although, the aforementioned group consumed much less saccharin than the other groups, they consumed far more than expected for animals with a conditioned taste aversion. If the protocol did lead to a successful taste aversion, its presence was very subtle. As of this writing, the protocol is being adjusted to ensure the presence of a taste aversion. Future experiments will focus on the ability to transfer the taste aversion from a trained fetus to a naive adult male rat in order to refine neural transplantation techniques.

ANIMAL EMOTIONALITY AND RHESUS MACAQUE (Macaca mulatta) VOCALIZATIONS

James W. Collins, M.S.

Department of Psychology
University of Georgia
Athens, GA 30605

Abstract

A state-of-the-art computer-based bioacoustics laboratory was established for the recording, digitization and analysis of rhesus macaque (Macaca mulatta) calls, their visual display, and playback. Two trips were taken to record vocalizations under naturalistic conditions from a free-ranging rhesus colony (Morgan Island, South Carolina) maintained by L.A.B.S., in Yemassee, South Carolina. Also, recordings of rhesus monkey calls under differing experimental and control conditions were made from animals at Brooks AFB. The literature on animal emotionality was reviewed and is reported in the form of an annotated bibliography. The great promise that research into the expression of emotionality by animals via their vocalizations holds for detecting the emotional state of animals, especially primates, has not yet been tapped. It is our aim to achieve a higher level of understanding of the emotional component of animal vocalizations. Meeting this goal will significantly expand our understanding of the internal states of animals as well as enable us to comprehend future assessments of research/captive animal wellbeing.

THE PREDICTIVE VALIDITY OF AUTOMATED PERSONNEL TESTS AND ASVAB TESTS FOR PERFORMANCE ON AIR FORCE TUTORS

David Dickter
Graduate Associate

Mary Roznowski
Assistant Professor

Department of Psychology

Abstract

In two studies, regression analyses provided evidence that the computerized Automated Personnel Tests (APTs) are useful supplements to the paper-and-pencil Armed Services Vocational Aptitude Battery (ASVAB) tests for predicting ability to learn from Air Force tutors. Further, the APTs may even outperform ASVAB tests in predicting the criteria when used alone.

INORGANIC FIBER ANALYSIS
BY SEM-EDXA

Robert F. Diskin
University of Scranton
Scranton, Pennsylvania 18520-4626

Abstract

The air asbestos analysis laboratory at Brooks Air Force Base often needs to identify fibrous material that may or may not be asbestos. In order to help improve the laboratory's ability to identify such fibers, the author prepared and analyzed a number of inorganic fiber standards and several air filters submitted to Brooks with an Amray 1820 Scanning Electron Microscope and Tracor Northern X-ray Analyzer. All seven types of asbestos and twenty non-asbestos man-made and natural fibers were analyzed on the SEM. The objective of the project was to supply the author's professor with the necessary data to design a system for fiber identification using morphology and the elemental analyses obtained.

COMPONENTS OF SPATIAL AWARENESS: AFFECTS OF AIR FORCE FIGHTER PILOT TRAINING AND EXPERIENCE

Itiel E. Dror
Department of Psychology
Harvard University

Abstract

Air Force pilots with varying experience and training participated in two experiments which assess different components involved in spatial awareness. One experiment examined the ability to track the motion of multiple moving objects; and the other experiment examined the ability to extrapolate motion. We found that motion tracking skills were affected by a "recency of flying" affect --pilots who recently flew were more accurate than pilots who did not. No such affect was found for motion extrapolating skills. We also found that although experienced fighter pilots and novice non-fighter pilots had comparable performance on both tasks on the easiest conditions, the experience fighter pilots were better at both tasks on the most difficult conditions. However, novice pilots were better at the intermediate levels.

A PRELIMINARY INVESTIGATION OF THE EFFECTS OF A DYNAMIC GRAPHICAL MODEL DURING PRACTICE OF A CONSOLE OPERATION SKILL

John D. Farquhar
Graduate Student
Department of Instructional Technology
University of Georgia

Abstract

A preliminary investigation was conducted to observe the effects of a dynamic model during acquisition of a console operations task. The console operations task studied was a simulation of a procedure involving the operation of a remote crane control arm. One group of subjects had access to a dynamic graphical model during practice of the procedure. The dynamic model appeared as a meaningful display that responded to console operations. While one group of subjects received the dynamic model during acquisition, all subjects were tested on their knowledge of the procedure without access to the model. Results indicated that during acquisition, time-on-task and errors were roughly equivalent for the model and no-model groups. During testing, however, the model group was able to perform the procedure faster and more accurate. Future studies on the effects of a dynamic graphical model during procedural acquisition are being planned.

VALIDATION OF THE ARTICULATED TOTAL BODY MODEL
REGARDING ROLLOVER CRASHES

Jennifer M. Ferst
Graduate Student
Department of Engineering Science and Mechanics
Virginia Polytechnic Institute and State University

ABSTRACT

It is known that occupants of vehicle rollover accidents experience complicated and often violent motion. In order to heighten standards for occupant safety during rollover crashes, additional research of occupant behavior in rollover crashes is necessary. Research using actual vehicles would be extremely expensive and time consuming. Alternatively, research on rollover accidents is being done with a human body gross motion simulation program, called the Articulated Total Body (ATB) model. In order to produce reliable data, this model must be validated. Validation is accomplished by comparing actual test results to a computer simulation. In particular, the verification of the ATB model was attempted by comparing the motion of the simulated vehicle and occupant to that recorded on high speed film during an actual 30 mph crash, in which the vehicle rolled over one time and the occupant was a Hybrid III dummy. The vehicle simulation had an acceptable comparison to the test, but the occupant simulation did not compare as well. The difficulty in obtaining a reasonable occupant simulation was due to the unrealistic initial conditions of the test, not to the capabilities of the ATB model. Further work in simulating other rollover tests is necessary to fully validate the predicted motion of an occupant that is produced by the ATB model.

Transmission Delays and Bursting in Statistical Mechanical Neural Network Models

Michelle A. Fitzurka
Doctoral Candidate
Department of Physics
The Catholic University of America

Abstract

The ultimate aim of this study is to further our current understanding of the electroencephalogram (EEG), or electrical recording of the activity of the human brain, in its resting state so as to better comprehend the effect of external fields applied to it. To this end, we invoke a neural network model that employs the language and formalism of statistical mechanics to order to explain the behavior of neurons in the brain on average, speaking of the *probability* of a neuron firing, rather than predicting the individual firing pattern of a specific neuron at a specific time. While there is much to be gained by this novel and rich approach, caution must be utilized in the mathematical development and application of any such model to bioloical systems. We intend to investigate the current statistical mechanical neural network models and suggest ways in which to impose more stringent, biological accuracy on models of brain functioning while retaining mathematical tractability. Eventually, we see a need to summon the techniques of non-equilibrium statistical mechanics, a promising direction which to date has not been wholly explored.

ASSESSING THE IMPLEMENTATION OF A
MULTIVARIATE RISK SCREENING PROCEDURE
IN THE DIAGNOSING OF DOWN SYNDROME ASSOCIATED PREGNANCY (DSAP)

William R. Fletcher, Jr.
Graduate Student
Department of Mathematics
Howard University

Abstract

The mathematical basis of the multivariate risk screening procedure is that, though various nonrelated data originate from the same source and add no more to the modification of the established odds than a single datum from the same source, these multiple independent parameters do, however, improve success. Currently, a quantitative biochemical Alpha-fetoprotein procedure is used. However, according to the Foundation for Blood Research (FBR), it is far less accurate than the proposed AFP diagnostic profile procedure, which not only tests quantities of Maternal Serum Alpha-Fetoprotein (MSAFP), but also, unconjugated Estriol (uE_3), as well as Human Chronic Gonadotropin (HCG). On the other hand, the new procedure has not been approved by the ACOG (American College of Obstetrics and Gynecologists), even though the FBR asserts that the new profile test is three times more accurate in predicting Down Syndrome.

My mission at Brooks Air Force Base, San Antonio, Texas, in the Epidemiologic Research Division, was to reinterpret the multivariate algorithm submitted by the Foundation for Blood Research (FBR) so that the new screening procedure could be implemented into Armstrong's existing laboratory data base.

PROBABILITY AND CUE TYPE MANIPULATIONS
IN A VISUAL ATTENTION TASK

Lawrence R. Gottlob
Department of Psychology
Arizona State University

Abstract

In a previous study, it was found that observers could allocate attention to four locations in a display based on the probability that a peripheral (abrupt-onset) cue was valid. The first experiment presented in this report sought to investigate the effects of a central cue, and the second experiment compared central to peripheral cues.

Observers in both experiments were run in visual attention tasks. The target was a T-like character in different orientations, that was presented in one of four different locations (subtending a total of 12 degrees visual angle) on a computer screen. The target was preceded by a central (Experiments 1 and 2) or a peripheral (Experiment 2) cue, and followed by a mask. The probability that the cue was valid was varied over blocks of trials. The observers' task was to indicate the direction that the "T" was pointing. Proportion correct scores indicated that observers allocated more attention to more probable locations (across valid trials only) with a peripheral cue, but that there was no probability effect with a central cue.

The Effects of Two Doses of Exogenous Melatonin on Temperature and Subjective Fatigue

Rod J Hughes
Graduate Research Assistant
Psychology Department
Bowling Green State University

Abstract

The effect of orally administered exogenous melatonin on oral temperature and subjective mood states was tested in a placebo-controlled, double blind design. Subjects were tested from 0800 - 1700. At 0915 subjects ingested either 0 mg, 10 mg or 100 mg of melatonin. Serum melatonin for both of the treatment conditions raised rapidly and remained well above physiological levels for the entire testing session. Exogenous melatonin administration yielded significant dose-dependent decreases in oral temperature. Exogenous melatonin treatment also significantly increased subjective ratings of fatigue.

ASSISTING AIR FORCE INSTRUCTIONAL DESIGNERS

Tricia Jones
Graduate Student
Educational Studies
University of Michigan

Abstract

The Instructional Design Branch (HRTC) of the Training Research Division at Brooks AFB is committed to providing Air Force instructional designers with tools that support a high level of design efficiency and quality. One of the primary thrusts is a project known as AIDA, the Advanced Instructional Design Advisor. Two short-term projects represent portions of the final project. XAIDA is the Experimental Instructional Design Advisor; it represents a limited prototype of the lesson content specification process. GAIDA stands for the Guided Approach to Instructional Design Advising. This is a case-based system which provides guidance to novice designers about lesson design and delivery, based on Gagné's Nine Events of Instruction (Gagné, Briggs, & Wager, 1992)

During the course of my summer research tenure, I was able to apply a broad range of my own expertise. I was able to combine knowledge of human factors and interface issues with instructional design expertise in order to evaluate XAIDA. Furthermore, I again used my instructional design expertise as well as my skills in software development to refine the design of GAIDA, implement a case for it, and write instructional design commentary for other cases.

XAIDA and GAIDA represent different approaches to advising instructional designers. XAIDA attempts to shield Air Force designers from the need to know principles of instructional design. GAIDA, on the other hand, presents the designers with a particular model and expects them to understand it and incorporate it into their own lessons. Furthermore, XAIDA represents a particular theory of learning and knowledge structure; GAIDA, on the other hand, represents a model of lesson delivery. The design of AIDA combines a variety of tools in order to provide support for novice instructional designers. The complementary strengths and weaknesses of XAIDA and GAIDA reinforce the need for such a structure.

THE ASSESSMENT OF BIOLOGICAL VARIABILITY

Robert Craig Kundich, M.A.
M.S. /Ph.D. student
Department of Biomedical Engineering
University of Tennessee at Memphis

Abstract

The enhancement of the operational envelope of high performance aircraft has led to intensified physiological stresses being applied to the aviator. Much emphasis has been placed on combating and understanding the effects of sustained, elevated +Gz stress. While Combat EDGE has sought to extend the level of G tolerance, the G-LOC effort has attempted to understand the mechanisms of gravity induced loss of consciousness. A more complete analysis of the autonomic nervous system (ANS) under gravitational stress may aid in enhancing operator capability in hostile environments, and contribute to the G-LOC and Combat EDGE efforts. Computer algorithms were programmed using LabVIEW on a Macintosh IIfx computer to assess ANS regulation of biological variability (heart rate, blood pressure, and respiration). Implementation of these algorithms will include the assessment of biological variability in individuals during varying workloads, an orthostatic tolerance test, and potentially during human centrifuge studies.

MULTIPLE PHYSIOLOGICAL MEASURES OF PERFORMANCE
ON A MULTIPLE TASK BATTERY

Scott H. Mills
Graduate Student
Department of Psychology
University of Oklahoma

Abstract

Most studies of human performance and workload have been limited to single or dual task paradigms. Recent advances in desktop computers have made possible the development of multiple task batteries, which are more applicable to many real-world tasks. One such battery, the Multi-Attribute Task Battery (MATB), was investigated. Psychophysiological measures combined with performance data may provide useful information about workload, especially when used with multiple task batteries. The Psychophysiological Assessment Test System (PATS) can simultaneously present tasks and collect numerous channels of psychophysiological data. A demonstration study was designed to evaluate the feasibility of using the MATB and the PATS together to explore performance and workload. Two subjects performed different combinations of tasks from the MATB while EEG and heart rate data were collected by the PATS. Subjective ratings of workload and performance measures were also recorded. Both the MATB and the PATS were found to be powerful, user-friendly systems that should lead to new avenues of research in human performance and workload.

A NONRADIOACTIVE ASSAY FOR THE DETECTION OF AP-1 COMPLEXES IN THE SCN OF HAMSTERS

Heather Panek
Graduate Teaching Assistant
Department of Biology
University of Scranton

Abstract

The primary pacemaker generating circadian rhythms is located in the suprachiasmatic nuclei (SCN) of the hypothalamus. Light and the circadian pacemaker interact to regulate a specific set of immediate early genes in the SCN that may participate in the entrainment of the circadian clock. Specifically, c-fos related proteins interact with a member of the Jun family to form the transcription factor complex AP-1 that can bind to a particular DNA sequence (TGACTCA). This DNA-protein complex interaction can be isolated in a gel mobility shift assay. To detect the AP-1 complex, a nonradioactive system, based on previously described radioactively labeled DNA probe protocols, has been researched. DNA probes labeled nonisotopically with fluorescein-11-dUTP can be detected with antibody-enzyme conjugates and enzyme substrates. This technique is desirable for several reasons including; short exposure times, long storage of labeled probes and the added safety of nonisotopic systems.

GROWTH OF MICROBUBBLES AT ALTITUDE

Joseph Pellettiere
Graduate Student
Department Of Mechanical Engineering
Case Western Reserve University

ABSTRACT

The exact cause of decompression sickness (DCS) is not known. Several theories try to predict the risk of DCS through bubble growth models. These models describe the mechanics of bubble growth based on diffusion of gas from a tissue into a bubble due to a change in pressure. To assess the validity of these theoretical bubble growth equations, an in vitro experiment was performed to simulate a subject going to altitude. The experiment was set up to eliminate unknowns in the growth equations. A model altitude chamber containing water was subjected to various pressure differentials and the resulting microbubbles were observed through a microscope connected to a video camera. A computer based image analysis system was used to determine the growth rate from the video recordings. Three pressures 500 mmHg, 380 mmHg, and 250 mmHg, and 2 surface tensions 72 dynes/cm and 40 dynes/cm were used for growing bubbles. Although the solution with the lower surface tension produced more small bubbles, 5 µm in diameter, there was no significant difference in the bubble growth rate. When the data was compared to the theory, the theoretical dr/dt differed by a factor of 2 - 4. The bubbles that grew were preexisting in the fluid; only bubbles that could be seen with the microscope were measured for their growth rates. Some bubbles, 15 µm or less, did not grow in the time frame observed, while other bubbles that were slightly larger, 30 µm, did grow.

ANALYSIS AND SYNTHESIS OF WHISPERED SPEECH USING A FORMANT SYNTHESIZER

Edward L. Riegelsberger
Graduate Student
Department of Electrical Engineering
The Ohio State University

ABSTRACT

Whispering is a common mode of communication which has been overlooked in current speech synthesis research. Whispered speech is less affected by the complications inherent in voiced speech such as dynamic source-tract interaction, variability in phonation modes, and source-based speaker dependent differences. These properties simplify the analysis/synthesis task. Investigation of whispered speech should provide insights about vocal-tract dynamics without the complications of source dynamics and source-tract interactions. Much can be also be learned from the comparison of whispered speech and their phonated speech counterparts. This documents illustrates some of the potentials of whispered speech synthesis research and describes the initial stage of our investigation of whisper synthesis: the development of an analysis/resynthesis system for whispered speech. The basic system consists of a formant tracking algorithm interfaced to a formant synthesizer. Performance results are fair, although not as good as desired. Complications encountered during the developement process are discussed along with potential solutions and inherent limitations of the system.

AN APPROACH TO ON-LINE ASSESSMENT AND DIAGNOSIS OF STUDENT TROUBLESHOOTING KNOWLEDGE

Nancy J. Cooke
Assistant Professor
and
Anna L. Rowe
Graduate Student
Department of Psychology
Rice University

Abstract

Intelligent tutors have the potential to enhance training in avionics troubleshooting by giving students more experience with specific problems. Part of their success will be associated with their ability to assess and diagnose the students' knowledge in order to direct pedagogical interventions. The goal of the research program described here is to develop a methodology for assessment and diagnosis of student knowledge of fault diagnosis in complex systems. Along with this broad goal, the methodology should: (1) target system knowledge, (2) provide rich representations of this knowledge useful for diagnosis, (3) be appropriate for real-world complex domains like avionics troubleshooting, and (4) enable assessment and diagnosis to be carried out on-line. In order to meet these requirements a general plan for mapping student actions onto system knowledge is proposed and research from one part of this plan is presented. Results from a Pathfinder analysis on action sequences indicate that action patterns can be meaningfully distinguished for high and low performers and that the patterns reveal specific targets for intervention. Short- and long-term contributions of this work are also discussed.

Development of a Research Paradigm to Study Collaboration in Multidisciplinary Design Teams

Maryalice Citera
Assistant Professor
Department of Psychology
Wright State University

Jonathan A. Selvaraj
Graduate Research Assistant
Department of Psychology
Wright State University

Abstract

The purpose of this research project was to develop a research paradigm to investigate the collaborative process of design in multidisciplinary teams. Two phases of task development are described. The initial phase involved identifying a design problem that could be used to create the experimental task. The problem selected was the design of a navigation system for an automobile. The second phase involved collecting knowledge about the problem to make the task as realistic and interesting as possible. Knowledge was collected from design experts using a concept mapping technique. The results highlighted many tradeoffs and design issues that could be integrated into an experimental task. Future steps necessary for producing the design paradigm are described.

EVALUATION OF ASTRONAUT PRACTICE SCHEDULES FOR THE INTERNATIONAL MICROGRAVITY LABORATORY (IML-2)

Robert E. Schlegel, Associate Professor
Randa L. Shehab, Graduate Student
School of Industrial Engineering
The University of Oklahoma
Norman, Oklahoma 73019

Abstract

The National Aeronautics and Space Administration (NASA) is currently conducting a series of space shuttle launches to enable scientists to study the effects of microgravity on a variety of factors. Included in the second International Microgravity Laboratory mission (IML-2) will be an extensive study of the effects of microgravity on astronaut cognitive performance ability. The Sustained Operations Branch of the USAF Armstrong Laboratory (AL/CFTO) has primary responsibility for this effort. This large collaborative study will include the training and testing of astronauts on a battery of human cognitive performance tests prior to launch, periodically during the space mission, and after the flight.

To permit an accurate identification of performance decrements caused by microgravity in space, it is essential to collect stable pre-flight baseline data. A preliminary investigation was conducted to determine the impact on baseline performance stability of less than optimal practice schedules and testing lapses due to such factors as launch delays.

A total of 21 subjects were trained on the NASA Performance Assessment Battery and then assigned to one of five practice schedules. Two groups practiced each day for 15 consecutive days. Two other groups followed a schedule of 5 days testing, 2 days off, 5 days testing, 3 days off, 5 days testing. The fifth group followed a schedule of 2 days testing, 5 days off, 2 days testing, 5 days off, 2 days testing. Then, either three days or five days after the last practice session, subjects returned for five days of retesting to represent mission days.

The study confirmed the overriding importance of providing an adequate number of practice sessions to achieve performance stability. By comparison, occasional missed sessions (i.e., the 5-on, 2-off schedules) had little impact on ultimate performance at the end of practice. The data indicated a possible performance difference between those subjects with only a 3-day gap between practice and "mission days" vs. those with a 5-day gap. High levels of differential stability and reliability were observed for at least one measure on all tests but the Critical Tracking test. Excellent software reliability was demonstrated by less than 0.02% missed data collection points.

PC Based Cardiovascular Model for Displaying Acceleration Stress

Frank C. Smeeks
Medical Student
Meharry Medical College

Abstract

Acceleration on the human body is known to cause several physiological effects. A PC based interactive computer model of the cardiovascular system was developed for studying the system response to acceleration stress. The PC model can be used in educating pilots of high performance aircraft and visualizing acceleration stress tests without physically performing them. The model consists of simulations of the heart, arterial vasculature, venous system, and peripheral circulation. The calculations for each component of the model include the effects of gravitational acceleration and compensatory mechanisms(both physiological and externally applied). Using this model, pressures and flows at different points of the cardiovascular system can be calculated and displayed. By observing pressures and flows at different points of interest(e.g. the ophthalmic artery pressure), protective techniques can be investigated. The observations allow pilots and scientists to experiment on optimizing these protective procedures without performing unnecessary testing. Thus, the model saves undo stress on pilots and experimental costs. The model is useful in the identification of pilot dysfunction and in the development of new protective maneuvers in response to acceleration stress on the cardiovascular system. The availability and affordability of the PC make this model scientifically and educationally indispensable.

CHOICE BETWEEN MIXED AND UNMIXED GOODS IN RATS

Alan Silberberg
Professor
Department of Psychology
The American University

John Widholm
Graduate Student
Department of Psychology
The American University

Abstract

Twelve food- and water-deprived rats chose between two levers. A multiple fixed-ratio 49 fixed-ratio 1 schedule was associated with one lever and a multiple fixed-ratio 25 fixed-ratio 25 was associated with the other. In Phase 1 for both levers, one of the two components defining the multiple schedule delivered access to 0.1-cc of water while the other component delivered a single 45-mg food pellet. The order of food and water presentations was counterbalanced across subjects. To prevent absolute preference for an alternative from developing, the values of each multiple schedule were adjusted according to a titration schedule: If a multiple schedule was selected four times in succession, its ratio values were incremented. In Phase 2, half the rats were exposed to only water reinforcement, while the other half received only food reinforcement. In all other ways, the experiment was unchanged from Phase-1 conditions. There was no reliable change in preference, an outcome incompatible with the economic notion that organisms prefer mixtures of goods over unitary presentations of a good.

SITUATIONAL AWARENESS CORRELATES
(A PILOT STUDY)

Lorraine C. Williams
Graduate
School of Human Behavior
United States International University

Abstract

The relationship between female and male situational awareness (SA) was studied. The test battery administered was comprised of the following: Armed Services Vocational Aptitude Battery (ASVAB), Space Fortress (SF), and Hartman Test (HT). Male Ss scored slightly higher than female Ss on the majority of testing however analysis measuring the significance of this was incomplete. Correlations that were significant were also quite low i.e. .1 to .4 suggesting the relationship was weak. While scores varied widely among both groups of Ss, further analyses is required to determine the potential for future pilot selection through such test tools.

Collaborative Instructional Development Environment: A Stage for the AIDA

Robert G. Main, Ph.D.
and
Andrew S. Wilson, M.A.
Department of Communication Design
California State University, Chico

Abstract

Computer-based media production tools have matured sufficiently to enable the Air Force to readily provide very powerful curriculum materials development tools based on the existing Workstation III or IV. However, providing instructional designers and developers with a multimedia development workstation is not equivalent to providing them the power to use them well. While an Automated Instructional Design Advisor will certainly aid designers and developers in choosing appropriate media to solve instructional problems, provision of such powerful media production tools will require a commitment within the Air Force to provide technical and creative support. Only this will ensure effective, motivational media design.

An examination of matured computer-based media production technology was undertaken and a group of ISD experts was impaneled to discern which available tools hold the most promise and value for instructional design. This study presents the findings of the Delphi panel as well as considering the impact of providing such tools to designers and developers. We make the recommendation that implementation of a computer-mediated communication system be concurrent with the emplacement of computer-based media production tools to create a collaborative instructional development environment that will improve media creativity and dynamism especially with respect to computer-based training. In addition, such a system will provide for centralized archiving of reusable and repurposed media, effective formative and summative evaluation, increased collaboration between instructional designers, developers, subject matter experts and media production experts, thus increasing instructional quality, employee productivity and job satisfaction.

PHILLIPS LABORATORY

EXPERIMENTAL INVESTIGATION OF HOMOGENEOUS AND HETEROGENEOUS NUCLEATION/CONDENSATION PROCESSES AND PRODUCTS IN COIL.

Philip D. Whitefield
Research Associate Professor
and
W. Mark Barnett
Graduate Student
Department of Chemistry Cloud and Aerosol Sciences Laboratory,
University of Missouri - Rolla.

Abstract

This paper describes the preliminary results of an ongoing study to characterize the nature and sources of sub-micron aerosols in the Phillips Laboratory small scale supersonic COIL device and other COIL devices. Aerosols from both sub- and supersonic flow regimes were sampled and characterized using the University of Missouri-Rolla, Mobile Aerosol Sampling System (MASS). Under all operating conditions where the oxygen generator discs were rotating, significant concentrations of aerosols were detected. Typically these aerosols had peak dry diameters of <0.05microns and nascent wet diameters of <0.08microns. Their total number density increased with increasing rotating disc velocity and with the addition of chlorine. A maximum number density of <3000/cc was observed at maximum chlorine flow rates when the initial generator mixture had been heavily depleted (i.e.neutralized with chlorine). Experiments to observe homogeneous nucleation of aerosols in simulated supersonic laser gas flows were unsuccessful. The critical supersaturation spectra for a KOH, KCl, I_2 have been measured and compared to theoretical calculations.

ION-MOLECULE REACTIONS AT HIGH TEMPERATURES

Melani Menéndez-Barreto
Graduate Student
Department of Physics
University of Puerto Rico at Mayaguez

Jeffrey F. Friedman
Assistant Professor
Department of Physics
University of Puerto Rico at Mayaguez

Thomas M. Miller
Professor
Department of Physics and Astronomy
University of Oklahoma

Abstract

A flowing afterglow apparatus designed for the measurement of ion-molecule reaction rate coefficients at temperatures higher than any previous work was debugged and put into operation during the summer of 1992. Ion-molecule reaction rate coefficients were measured for a variety of systems in the temperature range 300-1200 K: $O^- + H_2$, D_2, N_2, CO, NO, and CH_4; $Ar^+ + H_2$, O_2, CO, NO, and CH_4; $O_2^+ + CH_4$; and $Cl^- + CH_3Br$ and CH_3I.

SOME MODELS OF THERMAL BLANKETS ON SATELLITES

RODNEY L. BATES
DEPARTMENT OF MATHEMATICS
UNIVERSITY OF MISSISSIPPI

ABSTRACT

For a variety of reasons, satellites often have a thermal blanket placed on their exterior. This causes the surface of the satellite to be rough, which has a definite impact on the imaging of the satellite. The goal of this project was to model this behavior, so that the reflectance properties of the surface could be determined. Beginning with a surface with a random height distribution, several surfaces were developed using discrete Fourier transform filtering design techniques. In this report, these techniques are discussed; and the filters are given explicitly. In addition, computer generated 3-D plots of some of the resulting surfaces are included.

OPTICAL AND ATMOSPHERIC TURBULENCE

submitted by

MAYER HUMI, Professor
DEPARTMENT OF MATHEMATICAL SCIENCES
Worcester Polytechnic Institute
Worcester, MA 01609–2280

with

MARY AGNES BEALS
DEPARTMENT OF MATHEMATICS
Virginia Polytechnic Institute
Blacksburg, VA 24061–0123

Abstract

For many important applications it is imperative to estimate correctly the spectral density of atmospheric turbulence. To this end one must collect meteorological data and "detrend" it to obtain the turbulent residual. The objective of this project was to experiment with different detrending (= filtering) strategies and gauge their impact on the computed spectral densities of the flow variables. To help accomplish this objective a general purpose software package was written and used.

A METHOD TO SOLVE NEAR-MINIMUM TIME MANEUVERS
OF FLEXIBLE SPACECRAFT USING PARAMETER OPTIMIZATION

Michael T. Carter
Graduate Student
Department of Aerospace Engineering
Texas A&M University

Abstract

Determining the control to maneuver a large flexible space structure in minimum time is investigated using *Sequential Quadratic Programming* (SQP), which calculates the near-minimum time maneuver by optimizing a parameter set. The researcher chooses parameters which adequately describe the control profile predicted by the optimal control from calculus of variations theory. Control shaping is added to the profile to prevent discontinuous control jumps from exciting vibrations in the flexible structure; the parameter optimization method can use the shaped profile in its solution process. The SQP algorithm is tested on the ASTREX (Advanced Structure Technology Research Experiment) test article at Phillips Laboratory, Edwards AFB, CA.; the ASTREX structure is modeled with a complex rigid body motion which includes gyroscopic and gravitational effects as well as damping from attached cabling. Since the ASTREX test article has a limited volume of pressurized air to generate thrust, a maximum fuel constraint must be imposed on the problem; however, the SQP algorithm can include inequality as well as equality constraints. Using this algorithm, numerical analyses showed that the optimal control for large angle rotations of the ASTREX structure is closer to the optimal minimum fuel solution than the optimal minimum time solution due to the fuel constraint. Parameter optimization has obvious computational speed advantages by solving for the near-minimum time control rather than the exact optimal control; however, the researcher should carefully choose the control profile to be parametrized to ensure a near-minimum time solution if parameter optimization is used when control or state constraints are added to the problem.

HIGH TEMPERATURE ABSORPTION SPECTROSCOPY
OF NA/LI MIXTURES
FOR APPLICATION TO SOLAR PLASMA PROPULSION

Paul S. Erdman
Candidate
Doctor of Philosophy
Department of Physics and Astronomy
University of Iowa

Abstract

The solar plasma propulsion concept involves absorbing solar energy directly into the propellant of the rocket. Materials which would work well as solar absorbers and high specific impulse propellants would be high pressure hydrogen gas seeded with alkali metals such as lithium and sodium. To study the absorption characteristics of the various alkali metal candidates under high temperature and pressure the Plasma Spectroscopy Cell (PSC) has been constructed. The PSC has been operated up to 2100 Kelvin at one atmosphere to study the optical absorption of sodium/lithium mixtures in the range of 330 to 900 nm. Strong absorption features have been observed and have tenatively been assigned to various atomic and molecular transitions.

LAGRANGIAN FORMULATION OF LAGEOS'S SPIN DYNAMICS

Christopher Fuchs
Institute of Field Physics
Department of Physics and Astronomy
University of North Carolina at Chapel Hill

Abstract

The LAGEOS-III experiment is designed to verify the "magnetic components" of the earth's gravitational field predicted by General Relativity by precisely measuring the orbit and spin parameters of two satellites with complementary orbit inclination angles. In particular, the experiment will make use of a previously launched satellite (LAGEOS) and require the launching of another (LAGEOS-III, scheduled for 1993). This experiment is a component in the Air Force's effort to formulate and improve precise global timing and positioning requirements. One difficulty encountered in the project is the theoretical uncertainty in the late-time behavior of LAGEOS's spin dynamics due to the satellite's oblateness and interaction with the earth's magnetic field. Repercussions of this uncertainty surface when attempting to formulate recommendations for the LAGEOS-III orbital injection parameters. Thus a reevaluation of (at least a simple model of) LAGEOS's spin dynamics would appear advisable. Preliminary work in this direction and a more detailed discussion of the motivating issues can be found in the report of A. Kheyfets[1] in this volume.

Here we carefully derive the Lagrangian governing the spin dynamics of a slightly oblate spheroidal conductor in an almost circular earth orbit. This Lagrangian takes into account both gravitational and magnetic effects and gives rise to equations of motion valid out to first time derivatives in the magnetic field. The term "slightly oblate" refers to the gravitational interaction only; as far as the magnetic interaction is concerned, the conductor is treated as perfectly spherical. We then use the resulting Lagrange equations of motion to ascertain information concerning certain time-asymptotic behaviors of LAGEOS. In particular, we show that the satellite's spin precession rate within its orbital plane is bounded even at late times. This contradicts the opposing result of Bertotti and Iess[2].

LARGE-SCALE METHODS IN COMPUTATIONAL ELECTROMAGNETICS USING SYNCHRONOUS OUT-OF-CORE TECHNIQUES

Michael C. Governale
Research Associate
Department of Physics
Utah State University

Abstract

A Finite Difference Time Domain algorithm for computational electromagnetics was studied using synchronous out-of-core methods. The technique was developed for use on objects which are too large to be stored conventionally in the computer's RAM. Results showed a trade-off between increased sizes of problems that can be modeled and increased run-time from the technique's disk input and output. With today's massively parallel supercomputers the technique was found feasable on three dimensional objects gridded up to 10^{10} cells.

A STUDY OF COUPLED OSCILLATORY NEURAL NETWORK MODELS

John A. Greenfield
Graduate Student
Department of Electrical and Computer Engineering
University of New Mexico

Abstract

Oscillatory neural network architectures were studied. Three different algorithms for artificial oscillatory neural networks, based on research by Freeman and Baird at the University of California at Berkeley, were examined, and two of the models were implemented as programs under the Khoros system. A study of these models shows that they may prove promising for some applications.

HIGH TEMPERATURE HEAT PIPE MODELING
AND
CRYOGENIC PHASE CHANGE MATERIAL DEVICES

Steven E. Griffin
Department of Mechanical Engineering
University of Texas at San Antonio

Abstract

An experimental and analytical investigation into the effects and duration of low power throughput in liquid metal heat pipes is under study by Phillips National Laboratory and Los Alamos National Laboratory. The current study indicates that low-temperature and low-power throughput heat pipe modeling will provide a substantial basis for evaluating failure due to local evaporator dry-out. Failure occurs when the working fluid migrates to a cold region in the pipe where it freezes and fails to return to the evaporator section. Eventually, a sufficient inventory is lost to the cold region causing a local evaporator dry-out condition.

Devices incorporating a cryogenic phase change material are being considered for their high thermal effectiveness in satellite thermal control of infrared sensors at temperatures near 120 K. The approach is to evaluate the overall performance of several designs based on both canister type and conduction enhancement methods. The goal is to improve the low thermal conduction and retain the high latent thermal storage characteristics of the working phase change material: 2-methylpentane.

DESIGN AND CHARACTERIZATION OF A MAGNETOPLASMA-DYNAMIC THRUSTER AND OPTICAL DIAGNOSTIC SYSTEM

Mohanjit S. Jolly
Graduate Student
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology

Abstract

For the past two decades, there has been considerable theoretical and experimental research in the field of Magnetoplasma-dynamic (MPD) thrusters to prove their viability as a practical and cost effective space propulsion concept for satellite station keeping and orbital transfer. The physics of these electric propulsion systems stay are still not fully understood. The MPD performance is significantly hindered by the Onset phenomenon which occurs at a certain current level (onset current) at which point the thruster efficiency and thrust decrease substantially accompanied by an increase in electrode ablation. To further understand Onset and the underlying physics, a self field MPD thruster was designed and manufactured for the study of plasma parameters such electron temperature, electron density and ionization fraction at Onset. The Onset level for the 3 inch long, 2 inch diameter cylindrical thruster was determined to be at the Pulse Forming inductor-capacitor Network (PFN) voltage level of 280 volts and at approximately 5.8 kiloAmps current level.

DESIGN OF A DIGITAL LOOP COMPENSATION FILTER OF AN ADAPTIVE OPTICS SYSTEM FOR ATMOSPHERIC TURBULENCE COMPENSATION

Kurt W. Kunzler
Graduate Student
Department of Electrical Engineering
University of Utah

Starfire Optical Range, Phillips Laboratory/LITE
Kirtland Air Force Base, Albuquerque, NM 87117

ABSTRACT

This report describes the design of a digital loop compensation filter of an adaptive optics system. The adaptive optics system allows one to correct aberrations the light wave encounters on its travel through the atmosphere to an astronomical telescope. A wavefont sensor measures the optical distortions whereby the deformable mirror can be formed to nullify these distortion effects. An overall system model was derived in order to model the system and design a digital or discrete-time control system. The motivation for controlling the deformable mirror via a digital controller as opposed to an analog controller is due to the advantages of easily performing complex control calculations, easily changing controller characteristics, and having far superior characteristics from the viewpoint of internal noise and drift effects. The digital controller is essentially a digital loop compensation filter. It was thought that one might want to change the characteristics of the digital loop compensation filter during one evening in order to enhance performance due to changing environmental conditions. Consequently, a generalized single pole / single zero filter was designed using a bilinear transformation with frequency prewarping in order to have the ability to change the characteristics of the filter. In order to employ higher order infinite impulse response filters, an adaptive scheme was used to automatically adjust a variable number of feedforward and feedback coefficients so that the filter transfer function is a best fit to a set of design specifications. Due to the inherent time lag in the adaptive optics system a steady-state error occurs. A theoretical optimal control scheme was found that exhibited minimum settling time with zero steady-state error. Using this optimal control scheme, several adaptive control algorithms were attempted. The adaptive control scheme consisted of an adaptive filter directly modeling the deformable mirror and the overall electronic time delay in terms of phase. Then the characteristics of the adaptive filter would be used to adjust the digital loop compensation filter in real-time. Resulting in an adaptive controller which optimally reduces the steady-state error and possess a minimum settling time response given a specific input to the system. However, in order to implement this adaptive controller scheme, further research is necessary to accurately model the deformable mirror using an adaptive filter in real-time operation.

COMPACT TOROID MASS ENTRAINMENT SENSITIVITY TO INITIAL DENSITY DISTRIBUTIONS USING NUMERICAL SIMULATION

Robert John Leiweke
Graduate Research Associate
Department of Aeronautical and Astronautical Engineering
The Ohio State University

Abstract

Numerical simulation of Compact Toroid (CT) mass entrainment for the MARAUDER (Magnetically Accelerated Rings to Achieve Ultrahigh Directed Energy and Radiation) program was studied with a number of argon density distributions initially in the neutral state. The simulations were accomplished using MACH2, a two-dimensional arbitrary Lagrangian Eulerian magnetohydrodynamics (MHD) code. The baseline model, termed the Realistic Working Model, is a strong function of r and z. It was conjectured that the radial dependance was dominant, so the initial density model for argon with gradients in the poloidal plane (r-z) was collapsed into the form of a short annulus with a radial gradient. The mass entrainment for this annulus compared well with the realistic model from which it was formed, suggesting, but not proving *radial* dependance of initial density distribution. This result induced further investigations into mass entrainment which focused on radial gradient distributions. Simulations of annuli distributed as a Gaussian in z were also studied. The results suggest that for geometries with $\Delta r/r << 1$, mass entrainment is maximized by keeping the greatest densities away from the walls (electrodes). The present experimental injection distribution is *not* the most ideal for maximizing MARAUDER CT mass entrainment.

FIDELITY OF POLARIZATION RECOVERY USING A DOUBLE FIBER-COUPLED PHASE-CONJUGATE MIRROR

Darron D. Lockett, M.S.
Department of Physics
Clark Atlanta University

Abstract

Modal phase dispersion, diffusion, and polarization scrambling degrade wavefront transmission in multimode optical fibers. We report the investigation of polarization recovery using a double fiber-coupled phase conjugate mirror. A marked dependence of the polarization on the degree of fiber mode excitation is experimentally observed. Greater than 95% polarization recovery is reported.

SIMULATION OF FLUID FLOW IN TWO DIMENSIONS USING A HEXAGONAL LATTICE GAS

Francis H. Maurais
Graduate Student
Mathematical Sciences Department
Worcester Polytechnic Institute

Abstract

A "lattice gas" or cellular automata model for simulating hydrodynamics in two dimensions is implemented. The lattice gas models consist of automata which propagate along a regular, two-dimensional lattice of sites and obey global rules for collisions, which are applied using only information "local" to a particular site. A hexagonal lattice, invariant under $\frac{\pi}{3}$ rotations, is required to insure isotropy. Thus, the hexagonal lattice gas macroscopically exhibits continuum properties of two-dimensional hydrodynamics. Test simulations are reported for a seven-bit model in which shear flow develops into vorticies illustrating a Kelvin-Helmholtz instability.

PROGRESS ON THE WORKING FLUID EXPERIMENT: FORMATION OF A PLASMA WORKING FLUID FOR COMPRESSION BY LINER IMPLOSION

Jane Messerschmitt

Research Fellow

Weber Research Institute

Department of Electrical Engineering

Polytechnic University

ABSTRACT

The working fluid experiment investigates various methods of forming a medium with the plasma parameters required for its use as a working fluid for concentric solid liner implosion. Such a working fluid would make quasi-spherical implosions possible with a cylindrical driver. A hydrogen filled coaxial plasma gun is discharged into a volume simulating a solid liner. Upgrades to the experiment including pressure diagnostics and the construction of a high energy capacitor bank are described.

Correlating Injector Performance for
use as Engineering Design Criteria

Michael P. Moses
Graduate Student

Department of Aeronautical and
Astronautical Engineering
Purdue University

Abstract

Liquid jet atomization is dependent on flow conditions such as Reynolds Number, Weber Number and both liquid and gas phase properties. The L/D ratio, a variable describing injector geometry, also strongly influences the atomization process. In order to develop liquid rocket engine injector design criteria, a correlation of spray characteristics (cone angle and breakup length) to the net circulation of the liquid jet is proposed. The development of this correlation will be conducted as part of an in-house research effort of the United States Air Force Phillips Laboratory Propulsion Directorate.

ANALYSIS OF ONYNEX AND MSRP SEISMIC REFRACTION DATA IN NEW ENGLAND

John Ebel
Associate Professor
Department of Geology and Geophysics

Andrew Paulson
Graduate Student
Department of Geology and Geophysics

Abstract

Using interactive two-dimensional seismic raytracing techniques, seismic velocity models of the crust and upper mantle in New England were constructed from data collected jointly by Phillips Laboratory and Boston College from two seismic refraction experiments. One was from the 1984 Maine Seismic Refraction Experiment (MSRP), with the shotpoints in southcentral Maine and the receivers stretching from Rumford, Maine into the White Mountains in New Hampshire. The second was from the 1988 Ontario-New York-New England Seismic Refraction Experiment (ONYNEX) along a 200 km profile from western New York through Vermont and into southern New Hampshire. From the MSRP data the lower crust and Moho discontinuity in Maine were found to vary noticeably across the Norumbega Fault, with a significantly deeper Moho to the west of the fault. From the ONYNEX data the previously reported ramp feature, separating the Grenville basement in the Adirondack Mountains and the Paleozoic basement in the Northern Appalachians, was found. The ramp is inferred to dip from the surface near the Vermont-New York border to 17 km depth beneath the Vermont-New Hampshire border. The configuration of the ramp indicates that it controlled the emplacement of the geology above it during Paleozoic and Mesozoic time. The results of this study suggest models for ancient continental zones which may be applicable to those in other parts of the world.

ESTABLISHMENT OF AN ARCJET OPTICAL
DIAGNOSTICS FACILITY AT PHILLIPS LAB

Daniel A. Erwin, John H. Schilling, and Jeff A. Pobst
Department of Aerospace Engineering
University of Southern California

Abstract

An arcjet optical diagnostic facility was established at the Phillips Laboratory. This facility is expected to provide accurate measures of flow properties in the plume and nozzle region of arcjet thrusters to assist in the development of more efficient arcjet thrusters for spacecraft stationkeeping and orbit-raising applications. A 30-kW arcjet was mounted and successfully operated in a vacuum test chamber capable of accurately duplicating the space environment. Optical elements were installed to allow active or passive measurement of flow properties using the techniques of emission spectroscopy and laser-induced fluorescence. A tunable ring dye laser pumped by a 20-watt CW argon-ion laser were installed and aligned for LIF experiments. Finally, an automated control and data-acquisition system was installed and software developed to conduct a variety of experiments.

A Computational Model of the Magnetospheric Boundary Layer

David W. Rose
Graduate Student
Department of Mathematics
New York University

Abstract

A two-dimensional magnetohydrodynamic model of the magnetospheric boundary layer was studied. The partial differential equations of the model written in magnetic potential-kinetic streamfunction form were discretized by means of a Fourier-Chebyshev series in the two dimensions. This discretization permits both modelling of plasma velocity boundary conditions as well as efficient computation of the quasi-linear differential operators. Physical reasons are given for including both viscosity and resistivity dissipation effects in a model even though the magnetospheric plasma is collisionless. These dissipation effects permit the establishment of uniform boundary conditions on connected components of the boundary for mathematical and numerical well-posedness.

A STUDY OF AERO-OPTICS

Brian Staveley
Graduate Student
Department of Mechanical Engineering
University of New Mexico

Abstract

A study of previous work in aero-optics was conducted. An attempt was made to modify a computer program developed by Jumper and Hugo [1] which modeled the passing of a single optical beam through a simulated turbulent boundary layer and measuring the deflection of the beam as it passed though the flow field. The modification was to pass two beams through the scale field at a given distance apart and then compare the two beam deflections. As part of a future study in aero-optics initial design considerations and drawings were produced for a turbulent channel flow facility to be built and operated at Phillips Laboratory.

A BRIEF STUDY OF PASSIVE VISCOUS DAMPING FOR THE BULKHEAD STRUCTURE

Thomas J. Thompson
Graduate Research Assistant

Joseph R. Baumgarten
Professor

Department of Mechanical Engineering
Iowa State University

ABSTRACT

The SPICE Testbed at Phillips Laboratory is being used to evaluate the effects of structural vibration on line-of-site error for this strut built structure. A design incorporating active control and passive damping techniques is suggested to reduce the optical path distortion created in the vibrating structure. The passive viscous damping applied to the structure serves to aid the active control system stability in the cross-over and spill-over frequency range by producing a specified magnitude of damping in specified critical modes. This magnitude of damping is to be achieved by replacing the standard filament wound undamped struts with optimally placed D-struts which contain series and parallel combinations of springs and viscous dampers and produce damped vibration response from in-line strut deflection. This D-strut must replace standard struts in a tear-down of the bulkhead. The present study proposes to provide the requisite damping by adding on viscous damping at diagonal nodal locations in the bulkhead, circumventing the need to disassemble the SPICE bulkhead. The study shows specific increase in loss factor and improved damping ratio provided by the diagonal dampers when compared to in-line D-struts for specific modes and frequencies.

VIBRATION AND COMPRESSION TESTING
OF COMPOSITE ISOGRID PANELS

Sean A. Webb
Graduate Student

Dr. Christopher A. Rotz
Associate Professor
Department of Manufacturing Engineering and Engineering Technology
Brigham Young University

Abstract

Experimental vibration and compression tests of a composite isogrid panel have been successfully carried out. The first four natural frequencies and mode shapes were successfully identified. A simple analytical model developed in the study provided good estimates of the natural frequencies of the bending modes. Bending and torsional modes were analyzed with a simple finite element model. The predicted mode shapes agreed very well with those observed experimentally. Failure loads in the compression test were lower than predicted. This may have been caused by problems with the fixtures used to hold the specimen. Predicted strains were in good agreement with the average values measured in the test. The strains varied more with location on the panel than anticipated in the model, resulting in some strains being higher and others lower than predicted.

ROME LABORATORY

Photonic Transversal Filtering for Microwave Systems

Charity A. Carter
Graduate Student
Department of Electrical Engineering
Stevens Institute of Technology

Abstract

Previous papers have shown that it is possible to realize optical processors that can be used in wideband transmit and receive systems which would otherwise be restricted to narrowband use [1,2,3]. The continuously variable time delay supplied by these processors makes them ideal for use in systems, such as phased arrays, which employ transversal filtering. This report discusses the implementation of acousto-optic based and fiber optic based optical processors in these systems. In addition, non-uniform sampling, arising from the availability of a continuously variable delay, is presented. Finally, it is shown that a wavelet transform can be used to perform the correlation required for a matched filter used to extract information from a radar signal.

IMPLEMENTATION OF THE ITT MULTIPLE PARAMETER SPEAKER RECOGNITION ALGORITHM ON THE SUN SPARC

Robert L. Gorsegner
Graduate Student
Department of Electrical Engineering
University of Alabama

Abstract

I intend to research how speaker recognition systems work by implementing the ITT multiple parameter speaker recognition algorithm in 'C' on the Sun Sparc workstation. I will test the accuracy by using the KING database. I also intend to change the algorithm in different ways to see how accuracy is effected.

MATHEMATICAL DESCRIPTION, COMPUTER SIMULATION AND ANALYSIS OF A POINTING, ACQUISITION AND TRACKING SYSTEM FOR OPTICAL INTERSATELLITE CROSSLINKS

Carl R. Herman
Graduate Student
Department of Electrical Engineering
Binghamton University

Abstract

The mathematical model of a pointing, acquisition and tracking (PAT) optical intersatellite crosslink system is developed. It describes a laboratory prototype, created to demonstrate various aspects of rapid-retargeting bi-directional laser communications between independent space-based stations. The model, obtained by the detailed analysis of system hardware, represents the dynamic properties of the major optical, electrical and electro-mechanical system components. A computer simulation program, utilizing the mathematical model, is developed. The validity of the model is assured by comparing the experimental and simulated system responses to various operational conditions. The developed model provides a versatile and cost-effective alternative for verification of novel concepts in optical intersatellite crosslinking, and specifically, advanced control strategies.

CONGESTION CONTROL FOR ATM NETWORKS IN A TACTICAL THEATER ENVIRONMENT

Benjamin W. Hoe
Department of Electrical Engineering
Polytechnic University

Abstract

Rome Lab is currently developing a next-generation experimental network known as the Secure Survivable Communications Network (SSCN), based on broadband Asynchronous Transfer Mode (ATM) technology. In ATM, all types of information (data, voice, video, message) are placed in 53 byte long packets (ATM cells) and transmitted over available media. In the commercial arena, the primary transmission medium for ATM is fiber, with rates beginning at OC-3 (155.56 Mbps), using the STS-3C SONET protocol. Because of its high transmission speed and switch architecture, congestion control and queue management in ATM networks becomes an important and complex research issue, especially when complicated by the low-throughput, high bit-error transmission links encountered in the military tactical environment. This issue is further complicated in military conditions where traffic patterns are dynamically changed by jamming, degradation of communications resources and security requirements. There is much literature on and many techniques for congestion control in "normal" traffic conditions; however, congestion control in dynamic environments (tactical theater environment) is a poorly documented area in ATM networking. The congestion control and queue management techniques used in the SSCN project should not only be capable of handling traffic at OC-3 rates (155.56 Mbps), but should be able to evolve to support rates in the OC-12 (622 Mbps) range and beyond in the future. First, this paper presents an analysis of congestion control techniques to be used in the SSCN program. Then, potential research issues related to congestion control in a tactical environment are discussed and future research issues are identified.

MAXIMUM LIKELIHOOD BASED IMAGING
OF PRECESSING RADAR TARGETS

Kenneth E. Krause
Doctoral Student
Department of Electrical Engineering
Washington University

Abstract

The Maximum Likelihood approach is described and applied to the imaging of radar targets undergoing cooperative precessional motion under narrowband millimeter wave radar signal illumination. A comparison with conventional processing is made when simulated Gaussian noise is added to the measured data. With the maximum likelihood algorithm, useful images are generated from relatively small amounts of noisy data. The measured data used in the image reconstructions were measured at the Rome Laboratory Prospect Hill Facility in Waltham, MA.

User-Based Requirements for Large-Scale Distributed Information Management Systems: Representation for System Designers

Michael S. Nilan
Associate Professor
School of Information Studies

and

R. David Lankes
Doctoral Student
School of Information Studies

<u>Abstract</u>

This report describes our efforts this summer to generate a method for translating our user-based information system requirements into a representation form that would be readily interpretable by system designers and system analysts. Typically, the kind of requirements specification that we produce from our user requirements analyses are text-based descriptions of problem solving processes as perceived by a group of users. In the past, these text-based descriptions have proven to be difficult for system designers and analysts to interpret. Since our long term research agenda is oriented towards large-scale information management systems which are more complex than traditional applications, we felt that we needed some systematic and easily interpretable format that we could use for communicating our user requirements. Using a combination of hypertext-like representations and a 3-dimensional virtual reality display, we have been able to create a representation system that not only provides for effective interpretation of our user requirements on the part of system designers and analysts, but the virtual reality graphic display configuration also allows us to represent system components (e.g., display devices, databases, network linkages, etc.) in the same graphic environment. We believe that this combination of hypertext descriptions and virtual reality graphic displays will facilitate the accurate representation of user perspectives in large-scale information resource management systems.

X-BAND T/R MODULE
CONDUCTED INTERFERENCE SIMULATION AND MEASUREMENT

Final Report

John P. Rohrbaugh
Senior Research Engineer
and
Randall H. Pursley
Graduate Research Assistant
Georgia Institute of Technology
Georgia Tech Research Institute
Atlanta, GA 30332

Abstract

Conducted electromagnetic (EM) interference measurements and analyses were performed on X-band Transmit/Receive (T/R) modules built by Raytheon and Texas Instruments. The T/R module's Clock, Mode[1], +5 and -7 volt dc supply input lines and the Output Built-in-Test and Evaluation (OBITE) line were evaluated. The Clock and Mode differential input pins are connected within the T/R module to a CMOS gate array through DS8820/7820 differential line receivers. EM interference effects were simulated using PSPICE, and verified through measurements, to determine if the model of a DS8820/7820 provides accurate EM interference simulation results at very high frequencies. The objectives of performing measurements and simulations on the DS8820 were to demonstrate that interference effects can accurately be determined on simpler devices and models prior to developing more complex and costly products, such as T/R modules.

Limited simulations were also performed on the OBITE driver IC (54ALS03 NAND gate) and Power Condition Monitoring (PCM) circuits that are connected to the +5 and -7 volt dc supply lines. The PCM circuits are used to monitor over-voltage conditions on the +5 supply and over-temperature on the transmit power amplifier and to disable receive and transmit modes in the event of over-voltage or over-temperature conditions occur. All interference effects, with the exception of receiver low noise amplifier (LNA) gain compression, could be simulated. Effects that were duplicated during simulation included Mode words not received properly by the T/R module, and the T/R module receiver LNA cycling off and on with the application and removal of interference to the OBITE, +5 and -7 volt supply lines.

Damage effects that were observed while performing the interference mesurements could not be simulated. Two T/R modules and two DS7820 IC's were damaged over the course of this effort.

[1] The Data lines were not tested on this effort. The Mode lines are used to send commands to the T/R module to place the module in transmit, receive, etc., mode-of-operation, hence the nomenclature Mode. The Data lines are used to place the T/R module in a particular state-of-operation once the mode-of-operation has been selected. The default state-of-operation was selected, and thus the reason for not testing the Data lines.

Calculating Clock Drift Rates

David L. Sims

September 3, 1992

Abstract

In a collection of physically distinct computers. each one having its own clock, it is often necessary to know how each clock is related to the others and how that relationship changes over time. This relationship is commonly composed of an initial *offset* and a *drift rate*. This summer's project calculated the drift rate between two Encore Multimaxes and two local area network protocol analyzers. Some of the result are graphed that give an approximate drift rate, but no strong conclusions were reached nor was a good drift rate found.

CENTRAL ISSUES IN PERFORMANCE EVALUATION OF HETEROGENEOUS DISTRIBUTED COMPUTING SYSTEMS WITH C3 APPLICATIONS

WALEED W. SMARI
Department of Electrical & Computer Engineering
Syracuse University
121 Link Hall
Syracuse, NY 13244-1240

ABSTRACT

The principal objective of this research is to contribute to the efficient use of distributed computing systems by identifying some of the major issues that affect the performance of these systems. These major issues are discussed under six categories, namely: system architecture and environment, workload specification and characterization, constraints, service disciplines, performance measures, and finally optimality criteria and strategies. Additionally, this work is aimed at specifying and surveying some key problems and their solutions which we consider crucial to improving the performance - problems such as control, partitioning and mapping, scheduling, synchronization, memory access, among others.

These issues and problems may serve as a crude classification scheme for comparison of distributed computing systems.

THE EFFECTS OF ARRAY BANDWIDTH ON PULSE RADAR PERFORMANCE AND TIME-DELAYED SUBARRAY COMPENSATION

Charles T. Widener
Department of Electrical and Computer Engineering
Syracuse University

ABSTRACT

The basic principles governing phase scanning of array antennas are briefly outlined. Examination of these principles shows that a frequency dependence in the phase steering equation leads to an inability of a phase scanned array to radiate all frequencies in a single direction. Using this fact the concept of array bandwidth is introduced and an appropriate definition given. By adopting a linear system representation for the antenna, it is illustrated how the resulting loss of signal energy at the receiver can be conveniently calculated. Having defined the problem and its major effect on radar performance, the compensation technique of time-delay subarraying is discussed. Special consideration is given to systems employing linear frequency modulation pulse compression. Plots of the number of subarrays required to maintain a certain level of radar performance vs maximum scan angle are given for various system parameters.

METAMODEL APPLICATIONS USING TERSM

Michael A. Zeimer
Graduate Student

and

Dr. Jeffrey D. Tew
Assistant Professor

Department of Industrial and Systems Engineering
Virginia Polytechnic Institute and State University

and

Dr. Robert G. Sargent
Professor

Simulation Research Group
L. C. Smith College of Engineering and Computer Science
Syracuse University

Abstract

Tactical simulation models are often used to assess vulnerabilities and capabilities of combat systems and doctrines. Due to the complexity of tactical simulation models, it is often difficult to assess the relationship between input factors and the performance of the simulation model. To facilitate this type of assessment, simulation analysts often use the simulation model to emirically construct a *black-box* approximation of the causal and time dependent behavior of the simulation model. This type of approximation is known as a *metamodel* and can be viewed as a summary of the behavior of the simulation model. We demonstrate this technique in the context of an example using TERSM (Tactical Electronic Reconnaissance Simulation Model). The results indicate that metamodeling is applicable to tactical simulation models and that the technique has a wide range of uses.

WRIGHT LABORATORY

POINT SPREAD FUNCTION CHARACTERIZATION OF A SCOPHONY INFRARED SCENE PROJECTOR

Terri L. Alexander
Graduate Research Associate
Center for Research in Electo-Optics & Lasers (CREOL)
University of Central Florida

Abstract

A Scophony Infrared Scene Projector (IRSP) is being used at Wright Laboratories Armament Directorate, Guided Interceptor Technology Branch, Eglin AFB, for evaluation of thermal-imaging guidance systems. This is a hardware-in-the-loop testing system which reduces the number of necessary field trials and has unlimited potential for in-laboratory simulation where the performance of entire seeker systems can be analyzed. The performance of an optical system in terms of such characteristics as wavefront error, resolution, and transfer factor, can be measured with knowlege of the system's MTF and PSF performance. A slow scan calibration system was used to measure the image plane of the IRSP under three separate configurations of the system. MTFs and PSFs were derived for the IRSP without the use of the scatter screen, with the scatter screen in place, and with the scatter screen rotating.

THE EFFECT OF NONHOMOGENEOUS INTERPHASES AND GLOBAL/LOCAL VOLUME FRACTION ON THE MECHANICS OF A LAYERED COMPOSITE

Vernon T. Bechel
Graduate Student
Department of Mechanical Engineering
University of South Florida

Abstract

A general layered composite model was developed which could be used to study three families of cracked composite problems. Normalized stress intensity factor (SIF), load diffusion, and stresses versus variation of mechanical properties in a nonhomogeneous interphase region, global volume fraction, or local volume fraction (simulating a defect) could be found.

Results for the global volume fraction parametric study were obtained. Normalized stress intensity factor for E_f/E_m ratios greater than unity decreased as global volume fraction increased in the perfect bond case. For the same configuration load diffusion improved with increasing volume fraction.

Preliminary results were also found for linear and quadratic variations of Young's Modulus in a nonhomogeneous interphase. For E_f/E_m ratios less than one, normalized stress intensity factor decreased as the concentration of the stiffer matrix material near the fiber increased.

VELOCITY AND TEMPERATURE MEASUREMENTS
IN A HIGH SWIRL DUMP COMBUSTOR

Dr. Richard D. Gould and Mr. Lance H. Benedict
Mechanical and Aerospace Engineering
North Carolina State University
Raleigh, NC 27695

ABSTRACT

Successful two component laser Doppler velocimetry (LDV) and single point temperature measurements were made in the highly swirling flow field of a model dump combustor. A type S Platinum/10 % Platinum-Rhodium thermocouple probe was used to make temperature measurements. A lean propane-air diffusion flame with an overall equivalence ratio of $\Phi = 0.45$ was stabilized in the combustion chamber by the flow pattern of the Wright Laboratory/Rolls Royce (WL/RR) swirler. The reacting flow case was found to have higher axial and tangential mean velocities than the isothermal flow case throughout most of the flow field due to heat release. A shorter central recirculation bubble was found in the reacting flow case due to the pressure gradients produced by these higher mean velocities. Turbulent normal stresses were found to be larger while the maximum value of the $\overline{u'w'}$ turbulent shear stress was found to be less in the reacting flow case when compared to the isothermal flow case. Maximum mean temperatures occurred were maximum turbulent stresses occurred thus suggesting that gradient transport modeling may be successful in predicting this flow field.

DEVELOPMENT OF AN ENHANCED POST RUN DATA ANALYSIS PROGRAM FOR THE INTEGRATED ELECTROMAGNETIC SYSTEM SIMULATOR (IESS)

Benjamin F. Bohren
Graduate Student
Department of Computer Science
The University of North Carolina at Charlotte

Abstract

The ability for engineers to accurately evaluate the output signals generated by the Integrated, Communication, Navigation, and Identification Avionics(ICNIA) Advanced Development Models (ADMs) while in the IESS testing environment is a crucial factor in determining if ICNIA is operating correctly. Before this contract, IESS only generated an immense, difficult to evaluate text file. The enhanced post run data analysis program, called SLICK (Signal Listing IESS Critiquing Knowledge information processor), enables the engineer to select specific output data to be placed in a spreadsheet. Consequently, the engineer is able to graph selected data items; hence turning a chaos of numbers into a meaningful picture.

HARD TARGET CODE ASSESSMENT AND A QUALITATIVE STUDY OF SLIDE LINE EFFECTS IN EPIC HYDROCODE

Thomas C. Byron
Graduate Student
Aeronautical engineering, Mechanics and Engineering Sciences
University of Florida

ABSTRACT

As part of an ongoing Wright Laboratories experimental program to investigate the validity of hydrocodes for massive concrete structures subjected to an internal explosion, the problem was modeled and then analyzed using the research version of EPIC91. Two different models with substantially different mesh shapes and sizes were generated to study the effects on the computed results as well as the required CPU time. The concrete and explosive material properties where obtained from the existing EPIC materials library.

A study was also conducted into the effects of slide lines versus no slide lines in EPIC calculations where two or more materials of vastly different densities come into contact with one another. This was accomplished using a simple one dimensional impact setup to analyze the pressure wave as it moved through the model.

LASER IMAGING AND RANGING (LIMAR) PROCESSING

Jack S.N. Jean
Assistant Professor
Department of Computer Science and Engineering
Wright State University

Louis A. Tamburino
Avionics Directorate
Wright Laboratory

Ahmet A. Coker
Department of Computer Science and Engineering
Wright State University

Abstract

The LIMAR (Laser IMaging and Ranging) project is a Wright Laboratory effort to develop an advanced imaging and ranging system for robotics and computer vision applications. LIMAR embodies a concept for the fastest possible three-dimensional camera. It eliminates the conventional scanning processes by producing a registered pair of range and intensity images with data collected from two video cameras. The initial prototype system was assembled and successfully tested at Wright Laboratory's Avionics Directorate in 1992. This prototype LIMAR system used several frame grabbers to capture the demodulated LIMAR image signals from which the range and intensity images were subsequently computed on a general purpose computer The prototype software did not address the errors which are introduced by differential camera gain, misalignment, and distortion. The tasks performed during this Summer Research Program include (1) modeling and developing algorithms to correct the distortion introduced by using two cameras and (2) design of special purpose hardware to convert, in real-time, the outputs from the two cameras into a fully registered range and intensity image.

NEURAL ON-LINE LEARNING IN MISSILE GUIDANCE

Jeffrey S. Dalton
Graduate Student
Department of Electrical Engineering
University of Missouri-Rolla

Advisor:
S. N. Balakrishnan
Professor
Department of Mechanical and Aerospace Engineering and Engineering Mechanics
University of Missouri-Rolla

Abstract

In this work we investigate the use of neural networks in providing control signals to solve the target intercept problem. The approach taken here is based on an architecture that contains an adaptive critic network which evaluates previous control actions and produces a complementary control to counteract target acceleration. In previous work we used a linear optimal control law to produce the primary missile command accelerations. In this work we replace the optimal control law with a neural network approximation of the optimal control law and modify network weights on-line to react to target acceleration. We show a series of simulations which compare current results with those obtained previously. Results of this study are encouraging, however, they show that proper network training is a key issue. Analysis of the proposed control system with respect to stability, convergence, and robustness remain to be done and further work is in progress.

Optimal Detection of Targets in Clutter using an Ultra-Wideband, Fully-Polarimetric SAR

Ronald L. Dilsavor
Graduate Research Associate
Department of Electrical Engineering
The Ohio State University

Abstract

This report presents the results of work accomplished during the 8-week AFOSR summer research program at the AARA lab of Wright Patterson Air Force Base. The goal of this research is to design and analyze optimal detectors for targets in a clutter-filled environment using a low-frequency, ultra-wideband, fully-polarimetric synthetic aperture radar (SAR). In this report, we focus on optimal techniques for combining information across polarization to detect point targets. It is realistic in many cases to assume that the target of interest will have an unknown amplitude, unknown orientation about the radar line-of-site, and unknown absolute phase. These unknown parameters lead to a detection problem with composite hypotheses and nuisance parameters. We develop a GLRT detector which is designed to accomodate these unknown parameters. The first phase of this research is to obtain a realistic model of the clutter statistics by analyzing clutter data which was measured in the field. This clutter statistical analysis and some preliminary results in the GLRT design were accomplished during the AFOSR summer research program and are presented here. The clutter statistics were found to be well-modeled by the K-distribution and the maximum likelihood (ML) estimates of the target amplitude, orientation, and absolute phase are obtained through a bounded two-dimensional search.

EFFECTS OF INTENSITY THRESHOLDING ON THE POWER SPECTRUM OF LASER SPECKLE

Alfred D. Ducharme
Graduate Research Assistant
Center for Research in Electro-Optics and Lasers
University of Central Florida

Abstract

Spatial-frequency filtering of laser speckle patterns has proven to be a useful tool in the measurement of MTF for focal plane arrays. Intensity thresholding of the laser speckle patterns offers nearly an order of magnitude savings in digital storage space. The effect of this thresholding on the spatial-frequency power spectral density of the speckle pattern is investigated. An optimum threshold level is found that minimizes distortion of the power spectrum for the classes of speckle data used for MTF testing.Effects of Intensity Thresholding on the Power Spectrum of Laser Speckle

USING X WINDOWS TO DISPLAY EXPERIMENTAL DATA

David E. Frink
Graduate Student
Department of Aerospace Engineering and Engineering Mechanics
University of Cincinnati

Abstract

The following report describes the interactive colormap program written in C for X windows. The program is intended to be an alternative to a program already in existence which was not able to be executed with X windows. The purchase of X made a new program necessary.

VLSI SYNTHESIS GUIDING TECHNIQUES USING THE SOAR ARTIFICIAL INTELLIGENCE ARCHITECTURE

Joanne E. DeGroat
Assistant Professor
Department of Electrical Engineering
The Ohio State University

Lindy Fung
Graduate Student (Master's Degree)
Department of Electrical Engineer
The Ohio State University

The design of VLSI circuits is a very complex problem. As such, there are numerous computer aided design (CAD) tools to assist the designer in the generation of VLSI circuits. These tools range from layout editors, physical design tools, to high level synthesis tools. In all of these tools the design style and architectural structure are very constrained to limit the complexity to a manageable level. These constraints result in circuits that require more area and are slower than circuits produced manually by a skilled VLSI designer. The application of SOAR to the problem of VLSI creates the possibility of relaxing some of these constraints. The design of VLSI circuits is a design process. Existing tools and methodologies are incapable of capturing any of the essence of this design process and therefore must severely limit the design methodology. This research is a first step in the application of the SOAR Artificial Intelligence Knowledge Based Architecture developed at Carnegie-Mellon University to the synthesis of VLSI circuits. This first step is the application of SOAR to the VLSI placement problem. Findings, limitations, and recommendations for future research are presented.

CHEMICAL INVESTIGATION OF THE OXIDATIVE BEHAVIOR OF AVIATION FUELS

Ann Phillips Gillman
Research Associate
Department of Chemistry
Eastern Kentucky University

Abstract

Methods to simulate time/temperature history of aircraft fuel systems have been studied. Jet fuel surrogates have been thermally stressed using a flask test. The resulting fuels were analyzed by gas chromatography-mass spectrometry (GC-MS) and gas chromatography-atomic emission detection spectroscopy (GC-AED). Deposits formed were tested for solvent characteristics, quantitatively measured and analyzed by thermal desorbtion and pyrolysis/GC-MS.

Through spectrometric analysis, two generalizations were found. Rapidly oxidizing fuels formed products high in low molecular weight aromatics, no higher than naphthalene. Their solids are primarily gummy and acetone soluble. Other fuels behave quite differently when stressed. These fuels oxidize slowly, forming flocculant, mainly acetone insoluble deposits. GC-MS analysis indicate these fuels to be high in phenols. GC-AED analysis of these different fuel types show the presence of sulfur in fuels that form insoluble deposits while "oxidizing", soluble deposit forming fuels do not indicate sulfur.

In general, the flask test produces results quickly and with repeatibility. However, to adequately assess fuel stability, the availability of oxygen must be both limited and controlled. The general theory of oxidation of hydrocarbons is based on observed oxygen dependences. This theory has been slightly modified based on the presence of naturally occurring antioxidant molecules which are proposed to play an important role in both inhibiting the oxidation of fuels as well as being precursosrs to deposit formation.

FINITE ELEMENT ANALYSIS OF INTERLAMINAR TENSILE TEST SPECIMENS

Diane Hageman

Abstract

To use carbon-carbon composites correctly, the interlaminar strengths and stiffnesses must be measured experimentally. The test procedures, however, can cause stress concentrations within the test specimens that make measurements inaccurate. To help in designing test specimens that produce uniform stress distributions within specimens, the stress distribution of composite test specimens having different geometries was studied through finite element analysis. The interlaminar shear stresses were also analyzed to confirm that test specimen failure occurs due to the normal stresses; shear stresses are insignificant.

The model was first analyzed in three dimensions and later as an axisymmetric problem. The interlaminar shear stresses were found to be insignificant compared to the normal stresses in the thickness direction. The normal stress in the thickness direction was found to be the most constant along the midplane for test specimens with a slightly smaller radius at the mid-plane than at its upper and lower surfaces.

A second problem was analyzed by finite element analysis to understand the dependence of stiffness measurements on test specimen size for rectangular specimens. For this analysis, the specimen was modelled in plane stress and plane strain. The results showed that finite element analysis is a good prediction of Young's modulus for both thick and thin test specimens. It also showed agreement with analytical calculations of interlaminar stiffness for thick specimens, and experimental measurements for both thin and thick specimens.

THE DESIGN OF A NO_2 CHEMILUMINESCENCE TEST CHAMBER

Andrew P. Johnston
Graduate Student
Department of Mechanical and Aerospace
Engineering and Engineering Mechanics
University of Missouri-Rolla

Abstract

The design of a test chamber to aid in the investigation of the use of NO_2 chemiluminescent radiation as a new diagnostic tool for hypersonic flows is presented. The reaction of interest is nitric oxide reacting with atomic oxygen to yield nitrogen dioxide plus a photon. The initial theory and design work has been completed earlier, and a proof of principle experiment is to be performed to answer remaining questions. The conditions within the continuous flowing cryogenic vacuum chamber will approximate typical conditions found in the free stream of a Mach 12 to Mach 14 hypersonic wind tunnel. The flexible design will allow for studies of the chemiluminescent reaction rates, nitric oxide depletion, ultraviolet laser beam penetration, and required nitric oxide concentration. The design includes the necessary equipment needed for safe delivery of the nitric oxide, dry air, and nitrogen to the test cell.

JACOBIAN UPDATE STRATEGIES FOR QUADRATIC AND NEAR-QUADRATIC CONVERGENCE OF NEWTON AND NEWTON-LIKE IMPLICIT SCHEMES

Daniel B. Kim
Graduate Student
Department of Aerospace Engineering and Engineering Mechanics
University of Cincinnati

Abstract

Evaluation of several Jacobian matrix simplification ideas for Newton and Newton-like implicit Navier-Stokes solvers were performed. It was found that simplifications to the Jacobian matrix can result in dramatic CPU time savings. The Jacobian simplifications were accomplished by approximating the entries of the Jacobian matrix. These approximations include updating only selected parts of the matrix with the most recently computed values of the conserved variables. The updating strategy of the matrix was based on a percentage of the maximum density residual or on a specific region of the flow-field. "Global freezing" of the Jacobian matrix for a specified number of sub-iterations was also tested. It has shown that both, partial updating of the Jacobian matrix and "global freezing" of the Jacobian matrix, can give quadratic or better convergence rates. The Jacobian simplification ideas were tested for a flat plate geometry.

Impact of Quasi-isotropic Composite Plates by 1/2" Steel Spheres

John T. Lair
Graduate Student
Department of Civil Engineering
University of New Orleans

ABSTRACT

Plates of quasi-isotropic composite materials are impacted with 1/2" steel spheres. The initial velocity and residual velocity of the projectile are recorded. Panel and plate initial and final weights are recorded.

UNIVERSAL CONTROLLER ANALYSIS AND IMPLEMENTATION

Shawn H. Mahloch
Graduate Research Assistant
Department of Electrical Engineering and Computer Science
Arizona State University

Abstract

The universal controller, a method of controlling an "unknown system" via on-line deconvolution, was evaluated and implemented. This method of control was developed in [YBL] in contrast to the many other methods where controllers are designed based on the off-line approximate of the plant to be controlled. Preliminary simulations of the controller showed that on-line deconvolution was feasible and resulted in tracking of a reference command as close as the numerical accuracy to the instrumentation would allow. However, more in-depth evaluation using computer simulations showed that the controller consistently diverged. Numerical precision has been isolated as one of the causes of the divergence but it is believed that there exists another intrinsic cause of the divergence. A method has been developed to circumvent the controller divergence. There exists several controller variables that affect the controller performance, previously no methods to select these variables have been given. Thus based on computer simulation of many "unknown systems," methods to select these variables have been developed. Lastly, the controller was implemented to control a small motor. The controller diverged due to limited accuracy of both the motor input voltage and the measurement of the actual motor velocity.

Process Migration Facility for the QUEST Distributed VHDL Simulator

Dallas J. Marks
Graduate Student
Department of Electrical and Computer Engineering

University of Cincinnati
Cincinnati, OH 45221

Abstract

The QUEST VHDL Simulator is a DARPA-supported distributed simulator written for execution on an ES-Kit multiprocessor by researchers at the University of Cincinnati [5]. A recent Air Force funded project ported the simulator and its compiler to a network of Silicon Graphics 4D workstations shared among several research groups at Wright Patterson Air Force Base. High performance simulation is achieved by the distribution of VHDL simulation objects [10] and the use of local shared memory, ethernet, and Scramnet, a high-speed shared memory networking system. [4] The QUEST VHDL simulator was needed due to the sheer size and complexity of simulations soon to be required by the Air Force. The Cockpit Avionics office will use the QUEST VHDL simulator during the design of specialized hardware for cockpit display generators to be used in next-generation transports and fighters and in a retrofit to the Advanced Tactical Fighter [11]. A full simulation will often take several hours or even days to complete. Because the machines are shared, a long-running simulation creates unacceptable machine loading for other groups in the lab that must perform real-time flight simulations.

The thrust of summer research has been focused toward the design and development of a graphical network management tool to allow dynamic reconfiguration of the network. When complete, this work will provide the lab with the ability to control and restrict the machines available to the VHDL simulation. Specifically, this utility has the ability to checkpoint a running process on one machine, migrate it to another machine already in use, and restart it without any apparent interruption to the user or other simulation objects.

This research draws from similar work at the University of Wisconsin with the Condor Distributed Batch System [6]. However, the Condor system can only migrate single-process, non-communicating programs. In addition, Condor provides no support for shared libraries, which are quite useful in reducing the size of simulation objects.

This report highlights background work and summarizes the research completed during the summer research period.

PRELIMINARY WORK ON THE DESIGN OF AN IMAGE ALGEBRA COPROCESSOR

Trevor E. Meyer
Department of Electrical Engineering and Computer Engineering
Iowa State University

Abstract

This paper discusses preliminary work in the design of a coprocessor for performing image algebra generalized convolution operations. Based on a decomposition of the generalized convolution which simplifies the sliding window procedure into shifts of the source image, two processor designs have been proposed. One design is a systolic array which processes regions or even complete images in parallel. The other design is a serial pipeline which processes an image a pixel at a time. At least one of the two designs is in the process of being simulated.

This paper presents the current progress in the design of image algebra C++, the target language for this coprocessor. We then look at the two designs, comparing and contrasting, and discuss a few important details that have yet to be resolved. Finally, we examine some existing architectures and discuss features that might be useful in the design of this coprocessor.

DETECTION AND ADAPTIVE FREQUENCY ESTIMATION FOR DIGITAL MICROWAVE RECEIVERS

Arnab K. Shaw
Assistant Professor
Electrical Engineering Department
Wright State University

Stven Nunes
Graduate Student
Electrical Engineering Department
California State University, Chico

Abstract

Detection of presence of targets and estimation of Angles-of-Arrival (AOA) are two of the important tasks of a digital EW receiver. In this report, the time-domain detection problem and an adaptive frequency/AOA estimation scheme have been studied. For the detection problem, detection thresholds have been derived for square-law detectors in cases of single and multiple observation samples. The adaptive frequency/AOA estimation scheme has been stud'ed to analyze its behavior at various noise and input conditions. Simulation results indicate that the use of higher estimation model order than the actual order improves the bias and variance of the estimates at the cost of longer convergence time.

EFFICIENT ANALYSIS OF PASSIVE MICROSTRIP ELEMENTS FOR MMIC'S

Krishna Naishadham, Assistant Professor
Todd W. Nuteson, Graduate Associate
Department of Electrical Engineering
Wright State University

ABSTRACT

Passive microstrip elements such as meander lines are analyzed by the full–wave, space domain moment method at microwave and millimeter wavelengths. Redundant calculations in the moment matrix are eliminated by utilizing various symmetries. At lower microwave frequencies quasi–static approximations of the Green's functions are invoked to simplify the analysis. The Green's functions are in general Sommerfeld–type integrals, which are computationally intensive. In this paper, closed–form analytical approximations of the integrals, recently developed by Chow et al., Aksun and Mittra, are utilized to increase the efficiency of the algorithm such that a circuit of moderate electrical size can be analyzed in reasonable time. Sample computed results are presented for the scattering (S) parameters of meander lines and multi–turn spiral inductors. Computed results compare reasonably well with measurements on a vector network analyzer.

BUILT-IN SELF-TEST DESIGN OF PIXEL CHIP

R. Frank O'Bleness

1. INTRODUCTION

Presented within is a progress report summarizing work completed (and subsequent conclusions drawn) over the twelve weeks of our research period at Wright Laboratories, Electronics Directorate, Wright Patterson Air Force Base, Dayton, Ohio.

A brief preliminary evaluation of the COMPASS design tools is presented in section 2. Section 3 is devoted to an evaluation of the ALU and Linear Tree elements of the PIXEL graphics chip and their suitability to Built-In Self-Test techniques. Section 4 discusses an initial plan to implement BIST to the ALU and Linear Tree elements. Section 5 discusses the updated BIST plan. Section 6 offers a brief conclusion and presents an overview of the Circular BIST study.

A STUDY OF DAMAGE IN GRAPHITE EPOXY PANELS SUBJECTED TO LOW AND HIGH VELOCITY IMPACT

Mohammed A. Samad
Graduate Student
Department of Mechanical Engineering
University of New Orleans

Abstract

The Effect of Graphite Epoxy composite panel layup on damage was studied using constant angle change between adjacent plies. Use 4 different type of layup, constant angle change used, A) 0/90 B) 0/45 C) 0/22.5 D) 0/11.25. The composite panels were impacted at a series of velocities from 400 ft/sec to 6000 ft/sec with a 1/2 inch diameter steel sphere. The loss in weight due to impact, initial and residual velocity were measured and latter by deplying method the damage for each ply were analyzed. The total delamination area is correlated with the initial velocities. The ballistic limit (V50) also measured for all 4 layup. The ballistic limit is correlated with constant angle change between the plies, as the angle decreases between the plies and the ballistic limit increases.

LOW VELOCITY IMPACT DAMAGE
OF COMPOSITE MATERIALS

Rob Slater
Graduate Teaching Assistant
Department of Mechanical, Industrial,
and Nuclear Engineering
University of Cincinnati

Abstract

Damage of composite materials due to low velocity impact was studied. Tolerance to low velocity impact damage is a critical consideration in design of aircraft structures because the damage is very difficult to detect by visual inspection but may have severe effects on the residual strength and stiffness of the composite laminate. Low velocity impact is fundamentally different than ballistic impact associated with battle damage. A review of published literature has demonstrated that there is no acceptable theory available which can predict damage for a given set of impact parameters. The use of a discrete laminate plate theory has been suggested as a possible area for future research which may make damage prediction possible. Finite element modeling of impact events using commercial codes was also investigated. Several researchers have shown the capability to predict post-impact properties of composites if the damage state is known. If the state of a composite laminate subject to foreseeable impacts such as tool drop can be predicted, a set of design criteria for low velocity impact can be established.

MONITORING OF DAMAGE ACCUMULATION FOR THE PREDICTION OF FATIGUE LIFETIME OF CORD-RUBBER COMPOSITES

Jeffrey A. Smith, Graduate Student
Department of Engineering Science and Mechanics
The Pennsylvania State University

Abstract

This study attempted to monitor fatigue damage in angle plied cord-rubber composites by measuring dynamic creep, temperature changes, and acoustic emission (AE). In addition to real-time monitoring damage accumulation, non-destructive evaluation of damaged specimens was performed using ultrasonic C-scan and x-ray techniques. Two types of composites were used: steel cord-reinforced model composites and nylon cord-reinforced composites representing the actual aircraft tire carcass. Results showed that the rate of AE changes when debonding and delamination appear. However, the location of the damage with respect to the sensor seemed to effect the intensity and the accumulation rate of AE. Dynamic creep was found to be a good indicator of the remaining fatigue lifetime of composite coupons. X-ray testing clearly showed the areas of delamination in model composites. In the case of nylon cord composites, the effect of frequency was examined in detail with a special attention to temperature rise characteristics. The relationship between temperature and fatigue life was not straightforward. On the other hand, a power law relationship between frequency and fatigue life could be established. Hysteresis curves show that energy dissipation per cycle did not change for specimens tested at different frequencies, meaning that energy dissipation per unit time is proportional to frequency.

Effects of Intermolecular Interactions
in a
Cyclic Siloxane Based Liquid Crystal

Edward Peter Socci
Graduate Student
Department of Materials Science and Engineering
University of Virginia

Abstract

A substituted cyclic penta(methylsiloxane) liquid crystal containing combinations of pendant biphenyl-4'-allyloxybenzoate {B} and cholesterol-4'-allyloxybenzoate {C} mesogens was examined using computer molecular modeling. These compounds are of interest for possible use in the fabrication of laser resistant optical devices. Molecular mechanics (MM) and dynamics (MD) calculations were undertaken to assess the conformation and mesophase structure of this material.

The Gibbs free energy of likely interactions of {B} and {C} mesogens was calculated. Dissociation temperatures for pairs of {B} and {C} mesogens were also calculated. Results suggest possible models for the structural ordering of the mesophase based upon strong interactions between mesogens in certain preferred orientations. These interactions could lead to the formation of a supramolecular, pseudo main chain polymer from this low molecular weight liquid crystal, which would account for the unusually good fiber forming characteristics of this material.

A LITERATURE REVIEW OF THE REACTION KINETICS OF THE PYROLYSIS OF PHENOLIC/GRAPHITE COMPOSITE MATERIALS

Kimberly A. Trick
Ph.D. Candidate
Department of Materials Engineering
University of Dayton

Abstract

The material property/process parameter relationship knowledge base required for expert process control of the carbonization of phenolic/graphite composite materials has been found to be very limited. Specifically, a basic fundamental knowledge of the pyrolysis reaction kinetics does not exist. A review of three incomplete and/or contradictory proposed mechanisms has been made and a research plan for studying the reaction kinetics of the pyrolysis of phenolic/graphite composite materials using thermogravimetric analysis, gas chromatography/mass spectrometry, and infrared spectrometry has been proposed.

A STUDY OF THE CHEMICAL VAPOR DEPOSITION OF A SINGLE FILAMENT

Rose Marie Vecchione
Graduate Student
Department of Chemical Engineering
University of Dayton

Abstract

The application of carbon coatings onto ceramic monofilaments using chemical vapor deposition (CVD) was investigated. The conditions for depositing smooth, dense, uniform coatings of variable thicknesses onto ceramic monofilaments were determined. The microstructure of pyrolytic carbon coatings as a function of the process variables including gas flow rates, gas composition, CVD reactor temperature, and position within the CVD coating chamber was examined. Several experiments were conducted to determine the optimum conditions. The results of these experiments are interpreted and recommendations given.

A Switched Reluctance Motor Drive Using MOSFETs, HCTL-1100, and MC6802 Microprocessor

Shy-Shenq P. Liou
Assistant Professor

Lawrence Vo
Graduate Student

Division of Engineering
San Francisco State University

Abstract

A switched reluctance motor drive is designed, built, and tested using the MOSFETs as the power switches. The control function of this drive is done by a general purpose motion control chip HCTL-1100 from Hewlett Packard. The interface between the HCTL-1100 and the user is through a Motorola microprocessor MC-6802. A bang-bang current control circuit is also built into the drive to limit the motor current to be less than or equal to the rated motor current. Simple assembly program can enable the user to input the command velocity, command position, and command profile to the HCTL-1100 motion control chip. The test run of this drive is very successful.

INVESTIGATION OF THE COMBUSTION CHARACTERISTICS OF SWIRLED INJECTORS IN A CONFINED COANNULAR SYSTEM WITH A SUDDEN EXPANSION

Paul O. Hedman, Professor
David L. Warren, Master Candidate
Departments of Chemical and Mechanical Engineering
Brigham Young University

ABSTRACT

This report contains a brief summary of work done during the 1992 AFOSR summer faculty research program to investigate the flow and combustion characteristics of a burner designed to "specifically reproduce recirculation patterns and LBO processes that occur in a real gas turbine combustor." The Pratt & Whitney Task 150 Combustor uses a swirling fuel injector from an actual turbojet engine installed in a sudden expansion combustor which closely simulates the geometry of a jet engine combustor. The Task 150 burner has been configured so the geometry around the injector is nearly axisymmetric, but incorporates quartz windows permitting optical (laser-based) measurements to be made in the flame.

The primary effort during this summer's AFOSR sponsored research program for faculty and graduate students was to use OH^- laser induced fluorescence (LIF) imaging to investigate OH^- ion concentrations and laser Doppler anemometry (LDA) to make gas velocity measurements. These two techniques were employed in both the Task 100 and Task 150 combustors. Preliminary analysis of the Task 150 OH^- images, combined with flow split information obtained during last year's summer research program, revealed basic mixing patterns. The images also further defined characteristic flame shapes previously measured. LDA measurements have quantified the axial, radial, and tangential velocity components in the combustor. Preliminary analysis of iso-axial velocity contours have identified the major recirculation zones. This data will allow streamlines to be determined which will give a good understanding of the flow field within the combustor. This data is also useful for model validation. Measurements of the fuel equivalence ratio at lean blow out as a function of air flow rate with nitrogen dilution were also obtained with the Task 100 burner.

ARNOLD ENGINEERING DEVELOPMENT CENTER

EXPERIENCES USING MODEL-BASED TECHNIQUES FOR THE DEVELOPMENT OF A LARGE PARALLEL INSTRUMENTATION SYSTEM

Ben Abbott
Csaba Biegl
Research Faculty
Theodore A. Bapty
PhD. Candidate
Department of Electrical Engineering
Vanderbilt University

Abstract

Experience using a *model-based* approach to develop an 83 processor parallel instrumentation system for turbine engine aeromechanic stress analysis is described. The approach includes using a graphics based editor to describe the structure of the desired signal flow graph as well as the target hardware architecture. Program synthesis techniques are used to automatically transform these models into an executable system.

AN OVERVIEW OF THE BEHAVIOR OF ALUMINUM
IN SOLID PROPELLANT ROCKET MOTORS

Robert J. Geierman
Graduate Research Assistant
Department of Aeronautical Engineering
University of Tennessee Space Institute

Abstract

An extensive literature search was conducted in order to provide an adequate understanding of the processes which aluminum undergoes at several locations in a solid rocket motor. This paper describes the phenomena which occur at the propellant surface, the combustion chamber, the rocket motor nozzle, and the exhaust plume. These descriptions include a discussion of previous models and experiments that have been conducted. Although several of these models make very accurate performance predictions, much of their basis rests on emperical data instead of analytical models. Due to this fact, some of the previous models may have several shortcomings(in the analytical sense). Some of these shortcomings include: -1) the lack of an adequate analytical agglomeration model, -2) the neglection of agglomerate radiation heat transfer to the propellant surface, -3) the neglection of particle collisions and fragmentations, -4) no predictions of slag accumulation versus nozzle geometry, and -5) the lack of an accurate description of the particle distribution and nozzle ablation at the nozzle throat. An effort to remedy these shortcomings will be presented in a thesis at a later date.

SOLID PARTICULATE DISPERSION IN TURBULENT ATMOSPHERIC BOUNDARY LAYERS

William Kvasnak
Department of Mechanical and Aeronautical Engineering
Clarkson University, Potsdam, NY 13699

Abstract

The simulation of turbulent and Brownian dispersion of solid particles in an atmospheric boundary layer requires the analysis of a Lagrangian trace of particle trajectories. A computer program for analyzing the motion of solid particles in the turbulent atmosphere is developed. The code is capable of providing near-field or far-field mass concentrations of particles from continuous, finite duration, and instantaneous point source emissions. The fully implicit integration of the particle equation of motion provides particle velocities induced by Stokes drag, Saffman lift, Brownian diffusion, and gravity. A maximum particle concentration of less than 0.02% by weight ensures that there is no modification of the air flow conditions by particle motion. Concentrations of this order allow for the omission of all particle-particle interactions. Three sample test cases are presented for illustrative purposes

CAD AND ACOUSTIC BEM APPLIED TO THE MODELLING OF THE AEDC ASTF EGMS

Richard A. Marschall
Ph.D. Candidate
Department of Engineering Science and Mechanics
University of Tennessee

Abstract

CAD input and display packages were interfaced to acoustic boundary element codes. These codes were examined with respect to accuracy of amplitude, phase, and frequency, as well as the rates of convergences as functions of element resolution. Sound pressure level distributions were calculated at two resolution levels for geometries and boundary conditions corresponding to certain AEDC ASTF EGMS diffusers. A full-scale acoustic boundary element model of the AEDC ASTF segment containing the EGMS was constructed.

A MULTIGRAPH IMPLEMENTATION OF A DISTRIBUTED IMAGE PROCESSING SYSTEM

Michael S. Moore
PhD. Candidate
Department of Electrical Engineering
Vanderbilt University

Abstract

At Arnold Engineering and Development Center, videos of rocket plumes are used in analysis. The videos are inherently noisy, so they must be digitally processed before they are useful. Processing the video frames on normal digital computers can require days or even weeks. Thus, there is a need for a high speed image processing system. It has been seen that the speed of image processing operations can be greatly increased by distributing the computational load over several workstations, PCs, or transputers using Multigraph. Multigraph, a system integration tool developed at Vanderbilt University, allows the building of complex algorithms from simpler processing blocks. Multigraph is capable of distributing processes over a network to a variety of computer architectures, and the network does not have to be homogeneous.

This report presents the results of the 1992 Graduate Summer Research Program: a Multigraph implementation of a distributed image processing system. The system utilizes a non-homogeneous network of workstations to gain a considerable increase in the execution speed of image enhancement, noise reduction, and analysis algorithms. The flexibility and speed of the system have been demonstrated. The overall results of the summer research are very promising.

A CELL AVERAGED APPROACH TO THE SOLUTION OF INTEGRAL CONSERVATION LAWS

Blair H. Rollin
Graduate Research Assistant
Department of Mathematics
The University of Tennessee Space Institute

Abstract

An analytical cell averaging approach is applied to the Local Lagrangian Finite Volume method developed for computing solutions to the compressible flow equations. This approach eliminates the need for pointwise evaluation of fluxes and coupled with nonoscilatory interpolating functions yields a highly accurate, conservative, stable scheme. This is done without the addition of any terms not present in the original equations, such as artificial dissipation terms. Nor are the equations split into characteristic fields. The scheme is derived and then demonstrated on two different fluid flow problems.

ANALYSIS OF ACOUSTIC OSCILLATIONS IN CAVITIES WITH SPOILER ATTACHMENTS

Daniel E. Schatt
Master of Science Candidate
Department of Aerospace Engineering
University of Tennessee Space Instsitute

Abstract

An attempt was made to predict the amplitude of acoustic oscillations in cavities with various types of spoilers being used as suppression devices. A computer code was written for this purpose. The basic approach was to represent the spoiler as a thicker initial boundary layer, which would have the same effect in suppressing the acoustic oscillations. With this equivalent boundary layer, each spoiler configuration could be assigned a certain drag coefficient, which served as the primary input device for the code. The prediction was made over a wide range of Mach numbers, from subsonic to supersonic. The results of the computer code were compared with experimental data, and also with empty cavity cases (no spoiler).

Numerical Modelling of Mixing and Reacting Flowfields

Paul Vitt
Graduate Student
Department of Mechanical and Aerospace Engineering and Engineering Mechanics
University of Missouri – Rolla

Abstract

The computational fluid dynamics (CFD) modelling of complex mixing and reacting flowfields is the goal of the current research. The mixing and reacting modelling has been broken up into several parts to evaluate their individual contributions to the solution. This fits into the general framework of evaluating the computational code GASP for engineering design purposes. The first part of the study involves qualitatively evaluating the effect of turbulence on chemical kinetics within the numerical modelling. A brief look at the effects of turbulent Schmidt number is also presented. The selection of an appropriate chemistry kinetics model is very important for flowfields where capturing the flame and ignition point are important, as is shown through a comparison of shock-induced combustion numerical experiments. The code is also used to predict the flowfield of premixed hydrogen air burner, which involves subsonic flow over a back step with an ignition torch. This case is to provide a comparison with another code which is modelling the same problem. The mixing part of the physics modelling is addressed through two low angle wall jet injectors, in which the GASP predictions were compared with experimental and other CFD results. The main conclusion from this part of the research is that the accuracy of the numerical simulation in GASP needs to be improved before more complex flowfields can be modelled with confidence. The chemistry turbulence interaction needs further attention, as does the selection of an efficient, accurate chemistry model. Finally, the turbulent diffusion model needs to be tuned before the modelling of swept ramp scamjet injectors (the final part of this research) is undertaken.

MULTIDIMENSIONAL CONJUGATE HEAT TRANSFER ANALYSIS FOR THE ARNOLD ENGINEERING DEVELOPMENT CENTER HEAT-H1 TEST UNIT NOZZLE

Michael A. Weaver, MSAE
Graduate Student
School of Aerospace Engineering
Georgia Institute of Technology

Abstract

A method for unsteady, axisymmetric, conjugate heat transfer analysis was developed. The conjugate heat transfer domain comprises coflowing high temperature air and subcooled water coolant on opposite sides of a copper-zirconium, converging nozzle. Heat transfer through the nozzle wall is characterized by solid body conduction with convection boundary conditions along the air side and water side of the nozzle wall. The air side heat transfer is characterized by forced convection with a turbulent boundary layer. The water side heat transfer is characterized by forced convection, subcooled, nucleate boiling. Convective heat transfer coefficients on each side of the nozzle wall are functions of the wall temperature and the respective flow properties, thus coupling the three regions of the domain. The solution method marches in time, solving at each time step for the nozzle wall temperature distribution, the flow properties on each side of the nozzle wall, and for the convective heat transfer coefficients. The algorithm terminates when either the steady state is achieved or nozzle wall failure conditions are reached. Preliminary results are shown for run conditions at which nozzle wall survival has been experimentally verified.

CIVIL ENGINEERING LABORATORY

A SIMPLIFIED MODEL FOR PREDICTING JET IMPINGEMENT HEAT TRANSFER

MARK E. KITHCART

ABSTRACT

The effects of high temperature ($\cong$ 1000 $^{\circ}$F) jet blast on runway surfaces has become a significant concern, particularly with the increasing prominence of V/STOVL (vertical/short take-off and landing) aircraft. In an attempt to model vertical jet impingement heat transfer, a computer code has been developed based on the Hiemenz solution of the Navier-Stokes equations. The primary use of the code would be to provide values of heat flux and wall temperature for use as input to finite element solid mechanics modeling codes, which are currently being used by the Jet Blast Research Group at Tyndall AFB Florida, to predict stresses in pavement materials as a result of high heat flux. Preliminary results show the code to be in good agreement with experimental data and analytical calculations. A research project is being proposed which would continue development of the computer program.

VORTICITY AND VELOCITY MEASUREMENTS IN TRANSIENT OSCILLATORY SEPARATING BOUNDARY LAYER FLOWS

B. Terry Beck
Associate Professor

Paul K. Berg
Graduate Student

Department of Mechanical Engineering
Kansas State University

Abstract

The velocity and vorticity distribution within a transient oscillatory separating boundary layer was investigated using a single-component Laser Doppler Velocimeter System. The flow was initiated above a flat plate test model by means of a computer-controlled rotating spoiler (flap), mounted above the model surface. The tests were conducted in a water tunnel test facility, and dye injection was also utilized for visualization of the flow separation phenomena. The rotating spoiler subjected the plate below to a time-dependent spatial pressure gradient, inducing periodic flow separation and vortex shedding from the region near the plate and downstream of the spoiler. Measurements of both horizontal and vertical velocity components were made by rotating the optics of the LDV system. These profile measurements were obtained for discrete angular flap positions, thus mapping out the spatial and time-dependent flow field downstream of the flap. From the separate velocity component profiles, a computerized scanning algorithm was implemented to obtain both scan-averaged velocity and velocity gradient fields. Using this technique resulted in remarkably smooth results, in spite of the limited spatial resolution of the transient measurements. Clear evidence of reverse flows and flow bifurcation is indicated from the measurements near the region of boundary layer separation. The effect of flap frequency on the separation phenomena was also investigated.

MULTIVARIABLE TRANSFER FUNCTIONS AND OPTIMAL PASSIVE DAMPING FOR A SLEWING PIEZOELECTRIC LAMINATE BEAM [1]

Thomas E. Alberts & Travis V. DuBois
Department of Mechanical Engineering and Mechanics
Old Dominion University
Norfolk, Virginia 23529-0247, USA
Phone: (804) 683-3736
Email: talberts@mem.odu.edu

Abstract

This report presents the development and experimental verification of a distributed parameter model for a slewing beam system with piezoelectric actuators and sensors. The beam is pinned at the proximal end, an endpoint motion sensor is attached at the distal end, and patches of thin piezoelectric laminates attached to its surface. The differential equation of motion for this system is transformed to Laplace domain transfer functions after application of the appropriate boundary conditions. Transfer functions relating the various actuator/sensor pairs are developed. The transfer functions are rationalized using a Maclaurin series expansion so that there is no need to assume mode shapes. Experimental results, which verify the model, are presented using a beam experiment at the US Air Force Academy, Frank J. Seiler Research Laboratory. The existing clamped beam experiment was modified through the addition of a hinged joint and appropriate instrumentation to carry out this work.

The transfer functions are eventually to be used to develop and experimentally validate a simultaneously optimal active and passive damping design for the experimental system. A preliminary damping design is discussed and initial experimental results presented.

[1] This work performed in collaboration with Dr. H.R. Pota of the Australian Defence Force Academy.

A NEURAL NETWORK MODEL
OF THE UNSTEADY AERODYNAMICS ON A PITCHING WING

William E. Faller
Research Associate
BioServe Space Technologies
University of Colorado, Boulder

ABSTRACT

A straight wing having a NACA 0015 cross-section and rectangular planform was attached to a circular splitter plate. Starting at 0 degrees this configuration was pitched to an angle of 60 degrees which exceeded the static stall angle. During the pitch history surface pressure readings were obtained from 15 pressure transducers spaced between 0 and 90% chord. A total of 54 data records were obtained which covered 6 non-dimensional pitch rates (α^+) ranging between 0.0001 and 0.2 and 9 span locations ranging between 0% and 80% span. These unsteady, vortex dominated flows were used to develop an artificial neural network (ANN) model of the unsteady flow field. The ANN model was then used to mathematically quantify the three-dimensional, vortex dominated, unsteady aerodynamics of the phenomenon. A linear equation system (LES) was derived from the weight matrices of the ANN. The results indicated that the derived ANN/LES yielded a predicted pressure field over time which was within 1% of the experimental data for all the α^+ cases at all the span locations. Further, the results indicated that the ANN/LES could accurately extrapolate to any non-dimensional pitch rate between 0.0001 and 0.2 and to any span location from the wing root, 0%, to near the wing tip at 80% span. And, in all cases, the linear equation system yielded identical results to those obtained using the ANN. Thus, it was possible to mathematically quantify the unsteady flow fields obtained experimentally. The techniques described contribute significantly to the computational methods available for modeling three-dimensional unsteady flow fields.

NMR Relaxation Studies of Microdynamics in Chloroaluminate Melts

Pamela A. Shaw
Graduate Student
Department of Chemistry
Wichita State University

Abstract

The microdynamics of $EtAlCl_2$ containing melts are examined by ^{13}C NMR relaxation methods as a function of melt composition and temperature. Application of the Dual Spin Probe (DSP) method to these systems reveals interaction between (1) the MEI^+ methyl group, (2) the terminal CH_3 of the MEI^+ ethyl group, and various $EtAlCl_2$ containing species. Unlike MEICl-$AlCl_3$ room temperature melts, there is no indication of interaction between the MEI^+ ring CH's and $EtAlCl_2$.

WILFORD HALL MEDICAL CENTER

ENHANCED PHYSIOLOGIC MONITORING OF CLOSED HEAD-INJURY

Michael L. Daley
Associate Professor
and
Brian Carter
Graduate Student
Department of Electrical Engineering
Memphis State University

Abstract

The aim of this study was to develop both a laboratory model of closed head-injury and an analytical model of venous blood flow from the brain to test the *hypothesis that variations in venous pressure associated with the respiratory cycle can have a dominant influence on venous flow from the brain during elevated intracranial pressure.* A young adult pig with an implanted intracranial balloon designed to manipulate intracranial volume was used as a laboratory model. An analog electrical circuit model was used to provide a theoretical analytical description of cerebral venous blood flow during elevated intracranial pressure. Both experimental and theoretical results indicate that during intact autoregulation of cerebral blood flow, respiratory induced venous pressure changes systematically influence intracranial blood volume. Specifically, intracranial blood volume increases during inhalation and decreases during expiration. Furthermore, the difference in change of intracranial volume between the two phases of ventilation, inhalation and expiration, increases with increasing mean intracranial pressure. However, during loss of regulation of cerebral blood flow, venous blood flow and the resulting changes of intracranial blood volume are not systematically influenced by respiratory induced venous pressure changes.

APPENDIX J:

HSAP REPORT ABSTRACTS

ARMSTRONG LABORATORY

CROSS OVER POINT STUDY FOR THE PANASONIC UD-716 THERMOLUMINESCENT DOSIMETER READER

Katherine M. Arnold
Research Associate
Radiation Dosimetry Function
Armstrong Laboratory/Brooks Air Force Base

Abstract

The accuracy of a photon counter versus the accuracy of a frequency counter in measuring radiation exposure is an integral part of ensuring quality control. Quality control is necessary to maintain the standards set forth by the National Voluntary Laboratory Accreditation Program. A cross over point study provides a check of accuracy as well as precision in reporting data. In order to analyze the cross over point of the photon and frequency counters, eighty-five Panasonic UD 802 AT thermoluminescent dosimeters were exposed to various levels of gamma (Cesium-137) radiation. Results from a Panasonic UD 716 thermoluminescent dosimeter reader indicated that the crossover point is near 2400 millirem.

THE STUDY OF GAS CHROMATOGRAPHY: VOLATILE ORGANICS

Esteban Arredondo

Abstract

Several uses and applications of gas chromatography were explored. The most explored application of gas chromatography was the sampling and analyzing of volatile organic compounds in potable water, non potable waste water, and soils (through specific Environmental Protection Agency extraction methods). The gas chromatagraph used was connected with other equipment required to perform a complete analysis as described by the EPA. Throughout the study, much knowledge about volatile organics and gas chromatography was obtained. Many problems were encountered making maintenance corrections necessary and allowing new insight about the gas chromatagraph and how it works.

Dermal Penetration of
Dibromomethane

Sara Berty
Carroll High School

Abstract

The absorption rate of dibromomethane was measured. This was accomplished by inserting a cannula into the external jugular vein of each anesthetized rat to be studied, and a glass cell was fixed to its back with adhesive. After 24 hours of recovery from surgery a solution of dibromomethane and mineral oil was injected into each cell. Blood samples were drawn through the cannula immediately before dosage and again after 1/2 hour, 1 hour, 2 hours, 4 hours, 8 hours, and 24 hours. The extracted blood was added to hexane,which removed the dibromomethane from the blood. The vials containing blood and hexane were put in the vortex evaporator for 15 minutes. After 15 minutes the hexane and dibromomethane were extracted off the blood and injected into autosampler vials. The samples were then analyzed on the gas chromatograph to determine the concentration of dibromomethane in the hexane. This concentration value depicts the amount of dibromomethane that was absorbed into the bloodstream.

PATHOLOGY LABORATORY OVERVIEW

LEAH ELENA BROWN
HIGH SCHOOL SUMMER APPRENTICE
COMPARATIVE PATHOLOGY
ARMSTRONG LABORATORY

ABSTRACT

The three laboratories included in the Comparative Pathology Branch interpret and calculate all protocol results involving tissue samples. Necropsies, tissue processing, and staining procedures are performed by the Anatomic Pathology Laboratory. Clinical Pathology provides diagnostic results from blood and culture samples. Electron Microscopists process and prepare tissue for the transmission and scanning electron microscopes. Comparative Pathology is a major contributor to the completion of studies. Only these highly trained specialists are able to interpret, and to some degree predict the changes in tissue structure and function future environments may cause.

DIETARY INTAKE PATTERNS AND CARDIAC EVALUATIONS OF UNITED STATES AIR FORCE PILOTS

Carmen Casares
Internal Medicine Branch
Clinical Sciences Division
Armstrong Laboratory

ABSTRACT

The dietary intake patterns of pilots at Randolph Air Force Base are the focus of this study. Dietary intake was obtained to determine the consumption of calories and fat as compared to the National Cholesterol Education Program. In addition to this, the cardiac evaluations that pilots undergo were observed. Surveys and 24 hour dietary recalls were sent to two flying squadrons at Randolph AFB. The information returned by the pilots was reviewed and results were sent to those who requested them. Appointments were made for different days to observe actual cardiac evaluation procedures on patients.

Experimental results show that although the presence of coronary heart disease in the flying population is low, initial or additional dietary counseling and awareness could be sought. Pilots are grounded if their health is questionable and sent to the United States Air Force Armstrong Lab Clinical Consultation Service (AL/AOCI) for further evaluation. The cardiac evaluations benefit both the life and career of a pilot.

DOMESTIC TRENDS TO THE YEAR 2015

Deborah A. Case
High School Student
Archbishop Alter High School

Abstract

The following is a summary of the document prepared for the Army 21 project by the Library of Congress. The purpose of this document was to project domestic trends for the United States in the next 25 year time frame. The following areas were covered: demography, the economy, resources, education, society, technology, military science, and geopolitics and threat.

An infinite number of scenarios will affect future trends, many of which were discussed. However, this document assumes that there will be no world wars, nuclear wars, deadly viruses, or any type of crisis that could destroy a large portion of the Ui States population.

The United States is expected to go through a number of changes in a number of areas in the next 25 years. Without these changes, the United States could suffer drastically. Foreign competitors are emerging, and the United States is being challenged more that ever before. However, the United States has always been able to meet challenges of difficult situations, and come out on top.

ANALYSES OF VARIOUS METALS FOR THE PRESENCE OF METALS

Kara L. Ciomperlik
High School Student
11th Grade
East Central High School

ABSTRACT

The main function of the Metals Section of the Armstrong Laboratory is to provide support for bases worldwide in the analysis of environmental and occupational samples for metal content. These samples include, but are not limited to, drinking water, wastewater, soils, sludges, biologicals, and air samples. The section analyzes an average of 10,000 samples per year with the average of four or five different analyses. The sample load is almost evenly split between occupational and environmental samples. Analysis of the sample is accomplished by using several varieties of spectroscopic instruments including Inductively Coupled Plasma (ICP), Flame Atomic Absorption (FAA), Graphite Furnace Atomic Absorption (GFAA), and hydride generator for the analysis of mercury. This section also utilizes robotics in the preparation of samples for mercury analysis and in microwave digestion of samples.

STUDY OF RADIATION AND ENVIRONMENTAL MONITORING PROCEDURES

Maria A. De la Cruz
Randi L . Reynosa
Student Aides
Department of Radioanalytical Services
Brooks Air Force Base

Abstract

The preparation and analysis of environmental potable and non-potable water samples for the presence of radiation was studied. To prepare the water samples, they are treated with 8N nitric acid and sit for at least 18 hours. They are dehydrated under infrared lamps and a sediment of 200ml of sample is taken and placed in a planchet. The sediment is analyzed for emitted alpha particles in the MICRAD. If beta particles or gamma rays are thought to be emitted, the sample is also analyzed for these.

A STUDY OF THE EFFECTS OF ONE NIGHT'S SLEEP LOSS ON PHYSIOLOGICAL DATA

By Lisa E. Dillhoff
High School Student
Archbishop Alter High School

Abstract

Physiological data were collected during a sleep deprivation experiment in order to discover physiological changes produced in humans by lack of sleep. Eleven male subjects were given a series of tasks to perform on several days. On each of these days, physiological data were collected and stored on the Psychophysiological Assessment Test System (PATS). Analysis of this data, also performed on the PATS, indicates a decrease in heart rate with an increase in heart rate variability after the period of sleep loss. Although the eyeblink analysis is not quite as clear-cut as that of the heart rate, after 24 hours' loss of sleep the subjects tended to blink more often and for longer durations. The electroencephalographic (EEG) data have yet to be analyzed. Knowledge of physiological reactions to this stressor might help in the anticipation and reduction of negative effects to sleep loss.

THE VELOCITY DEPENDANT VARIATIONS IN THE MAGNETIC AND ELECTRIC FIELDS OF A CHARGED PARTICLE MOVING AT A CONSTANT VELOCITY IN ONE DIMENSION

Mark Eslinger
Judson Senior High School
San Antonio, Texas

PURPOSE

This research is meant to explore the relationship between the velocity of a non-accelerating charged particle and the strength of its magnetic and electric fields. It has the additional purpose of acting as the base for further research into the shape of the fields generated by the particles and, later still, exploration of the fields of accelerating charged particles.

A RESEARCH STUDY OF HOW ALCOHOL AND AVIATION MIX

Christine Fern

Abstract

In order to get the best overall perspective of alcohol and aviation, the past as well as the present must be recognized. Alcohol causes many mental and physical impairments. Low Blood Alcohol Levels (BALs) as well as high BALs result in impairments. There have been studies dealing with hangover effects 14 hours after alcohol consumption, which gathered evidence proving a reduction of memory and processing capacity. Some of the major concerns of alcohol and aviation are that pilots' posses a lack of awareness of hangover effects, of laws and regulations dealing with alcohol and aviation, and of their own performance under the influence. Pilots' self-evaluations are dangerous.

A STUDY OF THE TRANSFER OF PERCHLOROETHYLENE IN THE MILK OF LACTATING MOTHERS

D. Joshua Finch

Abstract

The amount of perchloroethylene in the milk of exposed female rats was studied. The amount of protein and triglyceride present in human milk samples was measured. Partition coefficients for the chemical were also established for each sample. The results indicate that the partition coefficient increased with the amount of triglyceride in each sample. The findings from the rat kinetic studies along with the partition coefficients found from the human milk samples can then be used to generate a computer model that will predict the amount of perchloroethylene that is transferred from a human mother's milk to her nursing infant.

EFFECT OF HYPOXIA ON RESPIRATORY FREQUENCY, HEART RATE, AND OXYGEN SATURATION IN HUMAN MALES

Stephanie J. Garcia
High School Summer Apprentice
Flight Motion Effects Branch
Crew Technology Division
Armstrong Laboratory
Brooks AFB, TX 78235-5000

ABSTRACT

During flight, crew members are exposed to the potential stressors of high sustained G (HSG) and hypoxia. Because the changes in respiratory frequency (RF), heart rate (HR), and arterial oxygen saturation (SaO2) are thought to be similar for both HSG and hypoxia, it is important to determine the effect of these stressors individually. RF, HR, and SaO2 changes were measured in 7 human male subjects who breathed, in series, 6 different gas mixtures (FIO2): 12%, 14%, 16%, 18%, 20%, and 60% oxygen. The results indicate that RF was not consistently altered by changes in FIO2. HR was consistently and significantly ($p<0.05$) increased between the time the subjects began breathing the gas mixture (i.e., begin-gas, baseline) and 15 min later (i.e., end-gas) for all FIO2 groupings, but there were no significant differences within baseline or end-gas values for any FIO2. Changes in SaO2 were inversely related to FIO2 and significantly different between FIO2 groupings between 12% and 20%. No significant change in SaO2 was detected between 20% and 60% FIO2.

MEASURING NON-LINEAR TRANSMITTANCE PROPERTIES OF 1-PHENYLAZO 2-NAPTHALENOL LASER ABSORBING DYE

Michael D. Gavornik
High School Student
Department of Education
Theodore Roosevelt High School

Abstract

A standard organic dye marketed across The nation as a safe, cheap, economical laser shielding exhibited optical bleaching when safety was put to the test. the dye, 1-Phenylazo 2- Napthalenol, conformed to its marketing when subjected to the relatively minuscule intensities of a spectrophotometer. Yet, the same dye transmitted laser light at higher intensities, intensities it is produced to shield against. An experiment was constructed to observe and to take data on this phenomenon. The majority of the project consisted in the production of an environment that adequately produced and recorded the non-linear effects. When the data was plotted approximately three phase shifts were found during the bleaching, or reverse photo saturation, process. This occurrence is yet unexplained and is under continuing research in the Armstrong Laser Laboratory at Brooks AFB.

The Air Force Dosimetry Program

Jennifer C. Gonzales
Research Associate
Occupational, Environmental, Health
Bioenvironmental Engineering Division

Abstract

Radiation dosimetry is the technology of detecting radiation dose to human beings. The Air Force dosimetry program has been established to monitor the Air Force employees for any abnormal or overexposure to radiation as well as to minimize their liabilities. One specific group they monitor is pregnant female workers. I helped create the tracking board to insure records were reported in a timely fashion to base radiation safety officers (RSO) at 225 bases world wide. This board helps to protect all pregnant females in the Air Force that are employed in occurations in which exposures to ionizing radiation are a possibility.

THE USE OF COMPUTER TOOLS AND SEMANTIC NETWORKS FOR KNOWLEDGE ACQUISITION

Margaret J. Hahn
Michael S. Nancarrow

Abstract

Various tools exist for the aquisition and organization of knowledge, including a process known as concept mapping. Concept mapping was used to organize and interpret data concerning human factors engineering, electronic interfaces, and collaborative processes. Two different computer tools were used to organize and analyze the composite data. Because one tool was still in the design phase, researchers also served as troubleshooters and constructed a user's guide for the tool.

THE DEVELOPMENT
OF INTELLIGENT TUTORING SYSTEMS

BRYAN HAVEL
SUMMER APPRENTICE
ARMSTRONG LABORATORY/HUMAN RESOURCES DIRECTORATE
BRACKENRIDGE HIGH SCHOOL

ABSTRACT

During my eight week tour as a summer apprentice at Armstrong Laboratory I was able to take part in the Fundamental Skills Training (FST) project which is designed to transfer government developed technology to education and industry. Through this project I was able to gain a better knowledge and understanding of Artificial Intelligence (AI), the idea this project is based upon, and Intelligent Tutoring Systems (ITS), the devices used in this project. While researching these fields I was also able to become more experienced in areas related to and a part of the FST project such as Computer Based Instruction, software design and development, computer graphics, and Virtual Reality Systems.

Thermoregulation in the Human Head

Marsha Gayle Henke

Student, Alamo Heights High School

Abstract

A fortran model was developed to simulate thermoregulation in the brain. By entering data on cerebral blood flow, the diminsions of the brain, core temperature, temperatures of the carotid artery and jugular vein, sweat rate, metabolic rate of the brain, and thermodynamic constants, temperatures at certain brain sites were calculated. The outer superficial tissue layer was cooler than the inner white and grey matter layers. In addition, we modeled the effectiveness of counter-current heat exchange in the neck. The heat exchange between the carotid artery and jugular vein proved to be physiologically insignificant.

THE OPTIMIZATION OF HCFC-123 REDUCTIVE METABOLISM

Vandana Khurma
High School Apprentice

Abstract

The optimal conditions of substrate concentration, time, and protein concentration for the microsomal reductive metabolism of HCFC-123 was studied. Incubations varying these conditions were conducted using rat liver microsomes, and metabolite formation was determined using gas chromatography. Experimental results indicated that a linear rate of metabolite formation could be established under 36% substrate concentration, an incubation time of 3 minutes, and a protein concentration of 4 mg/ml. These conditions could then be applied in a study comparing the effects of various chemicals on the microsomes' metabolism of HCFC-123.

A STUDY OF THE SPRING AND DAMPING CONSTANTS IN THE WIRE ROPES OF PARACHUTES

Jennifer M. Kim
Student Researcher
Armstrong Laboratory Crew Systems Directorate
Biocommunications and Bioengineering Division
Escape and Protection Branch
Wright Patterson Air Force Base

ABSTRACT

The spring and damping constants of the wire ropes of a parachute were studied. With the use of a drop tower, the stresses during a parachute drop were simulated, using a 66lb. lead weight as the test subject. Accelerometers were placed on the left and right sides of a boomerang structure, from which the wire ropes were suspended. Another accelerometer was placed on the center of the top surface of the lead weight. The Z axis accelerations were used for this study. The average of the boomerang accelerations were entered into an equation involving spring and damping constants and were compared to the acceleration reading from the lead weight. The data was run through the model and trial and error were used to determine C (damping constant) and K (spring constant) in a graph comparison. Nine trials were used to collect the data.

MULTIMEDIA UPGRADE SUGGESTION FOR HRG
AND
LISTING OF OTHER AREAS STUDIED BY STUDENT

Benjamin A. Kuperman
Summer Student

Abstract

Rapid changes in computer technology has provided for the development of a new form of presentation, multimedia. Multimedia is a buzzword that refers to the incorporation of audio, video, and/or touch elements into a presentation or training. In an attempt to stay on the cutting edge of computer technology, HRG asked me to do some background research and propose suggestions for acquiring a multimedia system. Following my report on this subject is a listing of the other areas I have learned about or worked with over the past eight weeks.

PROCESSING AND PREPARING A PROTOCOL
CASE FOR FINAL PATHOLOGIC ANALYSIS

April Marie Lopez
High School Summer Apprentice
Comparative Pathology Branch
Brooks Air Force Base

Abstract

The Comparative Pathology Branch consists of three sections: Anatomic Pathology, Clinical Pathology, and Electron Microscopy. Each section plays an important role in processing and preparing specimens for analysis. The Anatomic Pathology section provides necropsy, tissue processing, staining, and microscopic examination. Clinical Pathology performs all diagnostic tests on blood and fecal samples. The Electron Microscopy section provides tissue processing and prepares specimens for the transmission and scanning electron microscopes.

A STUDY IN COMPUTER APPLICATION
USING WORD PERFECT AND (ORACLE) SPREADSHEET

Raul L. Lopez
Student Apprentice
Air Quality and Hazardous Waste Branch
Brooks Air Force Base

Abstract

The bioenvironmental engineering division provides environmental support to the Air Force worldwide. Through support ranging from water and waste environmental monotoring to hazard abatement and pollutant control, the division provides expertise extending to virtually all types of toxic or radiological agents found in soil, water, air, and associated ecosystems with potential pathways of human exposure or impact. The division solves these Air Force environmental concerns through professional consultation, specialized laboratory services, applied research or on-site technical support using organizational, host installation, and contractor resources.

A Study of a Personal HSAP Experience Involving Laboratory Technician Work and Observation

Andrew Malone

HSAP Apprentice

Abstract

RDL's HSAP was participated in. The author was allowed to observe a few other laboratories during the course of the program and was assigned a few simple tasks at the focal point laboratory. The lack of a formal project precluded the writing of a more substantial, meaningful report, and it made the overall experience less valuable than it could have been.

A Test of Feature Conjunction and Feature Disjunction Tasks in Three Dimensional Space.

Virginia Miksch

Both a feature conjunction task and a feature disjunction task were developed in three dimensional space on Silicon Graphics 3130 IRIS computer system and a Hitachi 60-hz color video monitor. Six subjects volunteered to run in the study. The study was two-fold in scope. First, it was conducted to reaffirm Treisman's concept on the serial process, and secondly, to prove or disprove Previc's hypothesis regarding the preattentive task also as a muted serial process. Both Treisman's concept and Previc's hypothesis were confirmed. But further studies must be conducted on a greater scale to prove Previc's hypothesis.

INVESTIGATION OF ITEM FACETS FOR THREE WORKING MEMORY TESTS

Rebecca C. Mortis
Student
Incarnate Word High School

ABSTRACT

Items in many cognitive tests are described by facets which may influence item difficulty. A preliminary item facet analysis was conducted on three working memory tests. One test was a numeric based test, one was a verbal test, and one was an alphabet test. Seven item facets were investigated. In general, the item facets determined item difficulties as expected. It was concluded that for these three tests it is possible to make harder or easier tests by developing items through using facets.

A STUDY OF THE BAYESIAN ANALYSIS

OF RISK DIFFERENCE

Robert J. Roche

High School Student

Department of Education

John Jay High School

Abstract

The Bayesian Analysis of a two by two table assuming Uniform, Constrained, and Beta prior risk difference distributions was studied. In order to compare the density and distribution function, a program was developed that would plot and calculate the density and distribution for any given input of a two by two table. The table represents samples from two binary populations. The density and distribution parameters are determined by this two by two table. The program was written in Fortran 77 and produced an output file for a Calcomp 1044 GT pen plotter. The program calculations indicate a plot of the density and distribution versus delta, the risk difference.

PROCEDURES USED IN THE STUDY OF THE
EFFECTS OF CATHETERIZATION SURGERY
ON THE STRESS LEVELS IN RATS

Stephanie A. Rodriguez

ABSTRACT

The effects of catheterization surgery on the stress levels in lab rats is being conducted using the carotid artery and tail vein. The animals body weight and food intake were recorded before and after catheterization, to determine whether there was any disturbance to the animals habits. The records showed an extreme drop in both food intake and body weight after carotid catheterization. Blood samples are taken from the rats which have undergone catheterization and used for lactate and glucose assays. The glucose assay showed low glucose levels while the lactate assay showed no significant changes in the lactate levels. The samples were also processed by High Pressure Liquid Chromatograpy (HPLC) to detect the catecholamines, epinephrine and norepinephrine. Due to insufficient time the results from the HPLC are unable to be recorded at this time.

THE EFFECTS OF MELATONIN ON DIURNAL FATIGUE LEVELS

Carol A. Salinas

Abstract

In this study, the ability of melatonin to induce measurable levels of both physical and mental fatigue was examined. Also, the question of whether salivary melatonin levels are reliable measures of overall melatonin levels was addressed. A final goal of this study was to prove that smaller doses of melatonin (i.e. 10 mg) produce fatigue just as effectively as the larger, pharmacologic doses (i.e. 240 mg) now being tested. Three subjects each received two cumulative oral doses of placebo or melatonin during the course of a 9 1/2 hour session. Their oral temperatures, salivary melatonin levels, and serum melatonin levels were recorded during this period. Each subject was also required to subjectively rate his/her own fatigue level in an overall sense (physically and mentally). Finally, the subjects had to record their activity levels during the testing session. The resulting data indicated that melatonin does indeed produce measurable levels of both physical and mental fatigue, even during the daytime. In addition, a close parallel between serum and salivary melatonin levels was discovered in the course of the study, establishing salivary melatonin levels as a reliable, less intrusive index of systemic melatonin.

COMPARISON OF HUMAN TEMPERATURE TRANSDUCERS

PAUL SALINAS

Abstract

The stability of human temperature measurements by 3 transducers were compared over time. An oral and 2 tympanic temperature devices were compared over a 3 day period in 5 male and 5 female volunteers. Subjects were coached in proper recording techniques and an investigator conducted the tympanic measurement. Three temperature readings were taken in succession from each device every recording trial to evaluate the reliability of each device. No statistics were obtained but visual assessment of the average recordings from all subjects indicated that all devices seemed to measure consistantly during a trial. One of the tympanic devices (First Temp) was an expensive clinical model but measured approximately the same as the inexpensive oral model designed for home use (within 0.05 degrees). All devices showed similar direction and magnitude of temperature change. A circadian pattern to the data was evident in that morning temperature was lower than afternoon temperature. Also, the average human temperature did not seem to be 98.6 as has often been cited. Average human temperature was compiled from the oral thermometer (hourly, from 0600 - 2300 hrs), and was 98.3 degrees. This study concludes that temperature may be a useful indicator of circadian patterns and that the oral device used may be regarded as sensitive a measure of temperature as some clinical models.

A STUDY ON POSTURAL IMBALANCE IN HUMANS AS RELATED TO OCULAR DOMINANCE

Sarah Schanding

Abstract

Vestibular asymmetry in humans causes an imbalance in posture. Consequently, a person's head tilts in the direction they perceive to be "straight". The direction depends on ocular dominance. A person can be right or left eyed just as they can be right or left handed. Someone who is right eyed will have a head tilt towards their left, and someone who is left eyed will have a rightward head tilt.

Pictures were taken of seventy subjects and the tilt angle of their head in comparison to straight lines on a chart behind them was measured. Not all people conformed to the general theory. In fact the theory was disproved. The percentage of subjects that followed the basic idea was only slightly higher than the percentage of those who did not conform.

BULK ASBESTOS TESTING PROCEDURES

John D. Silva
Physical Science Aide
Armstrong Laboratory
Brooks AFB Texas

Abstract

The testing procedures in the Bulk Asbestos Function at Brooks Air Force Base were studied. Different materials call for different testing procedures. The standard method of testing for asbestos containing materials is polarized light microscopy. This method of testing is used for building materials including insulation, ceiling tiles, surface coatings, asbestos board, pipe coverings, etc. This method is not used for floor tiles unless fibers can be liberated from non-friable matrix. If the fibers cannot be seperated, the vinyl asbestos tile (VAT) method is used. The VAT method can also be used with mastics and roofing material. Both methods can determine the presence or the absence of six types of asbestos: chrysotile-asbestos, riebeckite-asbestos (crocidolite), anthophyllite-asbestos, tremolite-asbestos and actinolite-asbestos and also determine the quantitative estimate of the percent of asbestos.

A STUDY ON THE EFFECT OF HYDRAULIC FLUID H-19457C ON THE REPRODUCTIVE AND ENDOCRINE SYSTEMS

Ryan Simon
High School Apprentice
Toxic Hazards Research Unit
Wright-Patterson Air Force Base

ABSTRACT

The effect of hydraulic fluid H-19457C on the reproductive and adrenal systems of male and female rats was investigated. By performing daily vaginal washes, the female rats' five day estrous cycle was determined. Both male and female rats' were repeatedly oral-dosed. At scheduled periods groups of rats were placed in metabolism cages, fasted overnight, and then killed. A sperm count and motility evaluation were completed for the male rats after the sacrifice. All rats were evaluated for changes in organ weights, lesions and deformities at necropsy. Females were evaluated for changes in estrous cycles, and male rats were evaluated for sperm count, sperm shape and motility. The H-19457C hydraulic fluid was found to alter the female estrous cycle, and cause slight irritability. The males were unaffected and no other negative effects were found.

PARTITION COEFFICIENT DETERMINATION FOR THE DERMIS AND STRATUM CORNEUM

Jill A. Solscheid
Centerville High School

Abstract

The only way to find out how much chemical a person has absorbed through the skin is by knowing the rate at which the chemical is absorbed by the skin. The skin is composed of the stratum corneum (dead tissue) and the dermis (living tissue). In this study, I measured the partitioning of three organic IRP chemicals, trichloroethylene, benzene, dibromomethane, into these portions of the skin. This was accomplished by separating the dead and living tissue of the skin using a trypsin solution. The layers can then be separated and used as different samples. The skin is placed in vials which are crimped. Reference vials are also crimped. Later air is taken out of the vials and certain chemical vapors are injected into each vial. The vials are then incubated for four hours at 32 degrees Celsius. Some of the air in each vial is put into a gas chromatograph to get the area counts. With a formula it is possible to get a partition coefficient (PC). The PCs are used in the Physiologically-Based Pharmacokinetic (PBPK) model to determine the permeability constant, a measure of the rate of dermal absorption. This model mathematically keeps track of how much chemical each part of the body receives. The information the PBPK model can supply can be used to prevent chemical exposures.

A Study of the Cytotoxic Effects of Trifluoroacetic Acid on Rat Liver Cell Cultures

Elizabeth A. Stoehr
Student
Centerville High School

Abstract

A study of the toxic effects of Trifluoroacetic acid was accomplished on a cellular level. Earlier TFA work in this lab conducted experiments at levels around 500 ug/mL. Using information from those studies as a starting point, 500 ug/mL became the baseline concentration for the cytotoxicity assays. Through these tests, the concentration that resulted in 50% cell death (EC50) was found to be 20 times greater than the baseline concentration. At 500 ug/mL, cell damage seemed minor, with cell and protein growth between control and test cells roughly equivalent. According to an LDH/AST assay, TFA seems to have little effect on the cell membrane at concentrations between 250 and 1000 ug/mL. Interestingly, LDH leakage decreased slightly with the addition of TFA.

DEVELOPING A USER'S GUIDE FOR AN
INSTRUCTIONAL DESIGN PROGRAM

Kimberly Thompson
Summer Apprentice
Armstrong Laboratory/Human Resources Directorate
Brackenridge High School

Abstract

During the eight weeks I spent as an apprentice at Armstrong Laboratory, I learned to use several computer programs including word processors, graphics editors, and course design software. My main objective, however, was to develop a user's guide for the program Guided Approach: Instructional Design Advisor (GAIDA). GAIDA is a ToolBook program which runs under Windows 3.0 on Intel 80386/80486-based personal computers. GAIDA is used to provide guidance for the development of effective computer-based instruction (CBI).

A CROSS VALIDATION OF THE CYCLE ERGOMETRY FITNESS TEST

Christopher J. Troyer

Abstract

The Air Force will be implementing a new fitness test in October of this year to evaluate the fitness of its personnel. This test will be a modification of the cycle ergometry test first developed by Åstrand in the 1950's. Many individuals who cannot pass the cycle ergometry test have complained that in past years they easily passed the Air Force's old fitness test, a timed 1½ mile run. The validity of cycle ergometry as an estimate of fitness has therefore been questioned. This study concludes that the cycle ergometry test correctly classifies individuals according to his or her true fitness. Two groups, classified as fit and low fit by previous cycle ergometry tests, were compared on the basis of performance during a maximal run and a submaximal run. It is concluded that the complaints are based on misconceptions about cycle ergometry and on difficulties in adjusting to this new method of testing. This study shows that the cycle ergometry test is a good indicator of relative fitness and that its results are directly comparable to performance on the traditional 1½ mile run that it replaces for Air Force fitness testing.

THE ANALYSIS OF INORGANIC SUBSTANCES FOUND IN WATER

Suzanne G. Weidner
student:
East Central High School
San Antonio, Texas

Abstract

This summer as a participant in the HSAP summer research program for highschool students, many different areas of an analytical laboratory were exposed. The everyday function of the lab and the many tests performed daily were presented and explained in an efficient manner. As an apprentice, real laboratory experience was gained by "hands on" participation with the facilities and equipment found in the lab. While running different tests, safety was stressed so caution was taken. At all times a lab jacket was worn and on several occasions safety gloves were worn also. The importance of being exact, and precise in sample measurements and calculations was emphasized so that accurate results could be obtained. Once the results were found, they were distributed back to the field where they originally came from. The origins of the samples came from all over the United States and the world.

MINIMUM AUDIBLE ANGLE STUDY

Amy L. Zimmerman

Abstract

The minimum audible angle technique is used to determine how well human listeners can localize sounds. In this study, subjects listened to two tones and determined if the second tone was to the right or the left in relationship to the first tone. The tones were presented from 1 to 15 degrees in either direction(right or left) from the first tone that was presented at a standard angle. The standard angle was set by moving clockwise around the head(0,30,60,90 degrees). Experimental results indicate that the minimum audible angle at 0 degrees(ie. directly in front of the person) is 5 degrees in either direction while at 90 degrees the MAA was 14.5 degrees. We concluded that the best localization occurs in front of the person.

PHILLIPS LABORATORY

THE DEVELOPMENT OF A MULTI-DIMENSIONAL FOURIER TRANSFORM TO BE USED TO PREDICT THE LIGHT SCATTERING OFF AN OPTIC

Christopher A. Browning

Abstract

Fourier Transform algorithms are used to calculate the power spectral density of an optical surface in order to predict light scattering from those surfaces. An algorithm was written to produce data files for surface plots of the optic and data files for plots of the Fourier Transform. The program can read data from a file, put the information into a file in coordinate format, compute the Fourier Transform, and put it into a file in coordinate form so that they can be plotted and examined.

THE DOCUMENTATION AND STUDY OF GROUND LEVEL ENHANCEMENTS

Melanie Carr

Abstract

Ground level enhancement (GLE) data were studied. Data from neutron monitors all over the world have been collected. In order to make further study possible, these data need to be standardized and processed. Researchers at Phillips Laboratory have been put to the task using the Cyber and GL9000 computers. Variations in data pose many questions which, when answered, will make the data more effective for scientists to use. The causes, intensity, and prediction of GLEs need to be studied in order to understand how the sun works and to insure safe space journeys for astronauts and orbital equipment.

PROGRAMMING BAR CODE READERS FOR
INVENTORY PURPOSES USING
THE INTERACTIVE READER LANGUAGE

Kyle R. Conway

Abstract

Programs were written for bar code readers for the purpose of taking inventories. The readers used were INTERMEC 9440 TRAKKER readers, and were programmed in the high-level computer language Interactive Reader Language (IRL). The programs written were: an updated version of the Automated Material Control System (AMCS), and the original version of BenchStock, a bench stock program that allowed a user to scan a label and then enter the quantity of that item. Comprehensive user guides were written for each.

High Resolution Statistical Models for Prediction of Cloud Cover.

Interpretation of an Icing event during WISP-90

Fill Program to Prepare Satellite Overlays

Jeffrey P. Cutler

Abstract

The creation of high resolution statistical weather forecasting models was studied. A statistical weather model is developed through taking large amounts of data and creating a composite equation. Data was collected from January to December of 1989 and processed by a cra2 computer in Alberque, New Mexico. From this data a statistical model will be developed by a contractor that will predict the formation of clouds.

The development of icing conditions caused by the presence of supercooled liquid water (slw) was studied. Using a numerical model modified to accept the presence of slw, a new consideration in the prediction of icing conditions was theorized.

A Fortran program was created to fill in computer maps so that they could use be used for satellite overlays. The program fills in large areas of an array by creating a massive chain of points that determine values of pixels at each point of the compass.

EXPLORING ELECTROMAGNETIC EFFECTS

Anthony W. Davis
Sandia High School

Abstract

As the the military assets of this nation become more advanced, they make increasing use of microelectronics for guidance and control. These microelectronics are very sensitive to microwave energy, and in an effort to combat this fault, most assets are shielded, or "hardened" against this threat. In an effort to assess the effectiveness of this shielding, Phillips Labs has several groups devoted to testing military equipment at various energy levels and across a large bandspread. During the summer, the testing was centered on an aircraft and its various components and acessories, including its navigation and targeting pods. A variety of test procedures were used to assess this hardening, most of which involved radiating the asset and measuring the power absorbed by the various systems. Due to the sensitive nature of the data gained, the writer of this paper has no knowledge of the specific abilities of the assets to resist damage from electromagnetic energy.

A RESEARCH LIBRARY ON YOUR COMPUTER TERMINAL

Catherine E. Downey

Abstract

Through use of a CD-ROM machine, the resources of an entire research library, and more can be at your fingertips. CD-ROM machines have brought a new age of technological advancement to scientific research. On an individual database, you are able to look up papers written on a particular subject, or by a particular author over a time frame of anywhere from one year to four or five years. With a CD-ROM connected to your network all of this research can be found without leaving your own PC. Initially it is a complicated process to connect the CD-ROMs to the network, and small problems may arise, and need to be found and corrected, so the databases will run properly. Finding these problems can be done by having certain people use the databases, and report what causes problems. Once all of these problems are solved, the CD-ROM can help people to find information in a simpler, and more convenient way than ever before available.

FORCE APPLICATIONS CONTROL VARIABLE STUDY

Brandon J. Ellena
HSAP Student
Studies and Analysis Group
Phillips Laboratory

Abstract

Air Force Space Command has recently shown a desire to deliver reentry vehicles to precise positions on Earth. Correcting for in-flight errors and atmospheric conditions in these RVs was studied. By giving the RV the ability to alter its flight path, it is able to compensate for these errors. Just by changing the angle of attack of the RV, it was possible for the RV to cover an area of about 24 square miles.

Fuzzy-C Optical Tracker

Blake Ethridge

Phillips Laboratory, PL/LIMI
Kirtland Air Force Base, N.M. 87117-6008

Fuzzy Logic

Fuzzy Logic is based on human concepts such as: mostly, primarily, partially, few, etc. It deals with the idea of uncertainty by allowing an object to be a partial member of a given group. This is unlike conventional Boolean logic which defines an object as either a member or not a member of a given group.

To illustrate the differences take the statement, "Basketball Players Are Tall People." This statement when applied to Boolean logic would mean either that all basketball players are tall people, or that no basketball players are tall people. All basketball players are not tall, and all basketball players are not short. Thus Boolean logic can not deal with the statement about basketball players height. When this statement is applied to Fuzzy logic several steps would follow, the information used in the following example is approximated and has no scientific value. The first step is to define the membership functions for height, say tall, normal, and short; next, these membership functions would be assigned values. Tall people will be defined as anyone over 6'2" and will include partial membership to people down to 5'7". People with normal height will be defined as being between 6'2" and 5'0" where 5'7" will be the center. Short people will be defined as people 5'0" or shorter with partial membership to people up to 5'7". Figure #1 is a diagram of these membership functions.

THE USE OF SCRAPERS FOR THERMAL CONTROL IN A ROTATING-DISK, WETTED-WALL CHEMICAL REACTOR

Erik B. Fleming
High School Summer Apprentice
Eldorado High School

ABSTRACT

This paper describes the rotating-disk, wetted-wall reactor, how it functions, and the use of scrapers for thermal control in the reactor. It is shown that as the exothermic reaction of gaseous chlorine and basic hydrogen peroxide takes place, much water vapor is produced. Water vapor is shown to have a first-order effect on the performance of a laser driven by a rotating disk system. Water vapor in the effluent is generated largely at the gas-liquid interface. Therefore it is the attempt of this study to try and model a way to scrape heated liquid off the rotating disks and consequently minimize water vapor production.

SETTING UP A WORK-STATION BASED COMPUTING AREA FOR DEVELOPMENT AND SIMULATION

Jeff R. Hay
Senior
Sandia High School

Abstract

The Satellite Design and Simulation Center of the Space and Missiles Technology directorate of Phillips Laboratory is a relatively new area. As such, much equipment must be installed, updated and configured to operate properly. This paper describes the set up trials of four sets of hardware: A Digital Equipment Corporation VAXstation 3, four X-windows display terminals built by Network Computing Devices, An Apple Macintosh IIsi, and laser- and thermal-type printers. It may serve as a guide for installations of similar equipment and hopefully alleviate many of the frustrations necessarily involved in setting up new computing areas of the caliber of the Satellite Design and Simulation Center.

ITERATED FUNCTION SYSTEMS
FRACTAL MODELING OF REAL-WORLD BIOLOGICAL SYSTEMS

DeLesley Hutchins
Albuquerque High School

Abstract

Iterated Function Systems are sets of points created by the random application of equations chosen from a given array of transformations. Depending on the set of transformations, the end set of points from this entirely unpredictable and seemingly-random system can describe many natural objects. Experiments were conducted to determine the exact relationship between the set of transformations and the resulting pattern. A set of trigonometric equations was written to allow precise construction of I.F.S. that could describe any fractal-based object. A program was written to implement this, and leaves, trees, clouds, mountains, and other objects were created. However, by nature all I.F.S. are mathematically perfect, and sometimes do not model nature well. More experiments were conducted to determine how several different I.F.S. could be combined to allow more varied and complex structures. It was found that by mapping different transformations of the I.F.S. to the points of other generating I.F.S. it was possible to construct extremely varied objects. It was possible, for example, to construct a tree with differing branch angles, leaves and bark, none of which was in mathematically perfect tree. A computer program was written to implement this and various objects were created to model nature extremely precisely, as well as decrease computation time for various other fractal objects.

Scientific Visualization
of a Carbon-60 Molecule

Mindee A. Jeffery
Student
Quartz Hill High School

ABSTRACT

The following is a description of the process involved in creating and animating a computer generated visualization of a Carbon-60 molecule. The process involved calculating the geometry of the fullerene and solving the problem of how to model its geometry. The Ray Tracing method of creating a 3-D picture on a 2-D screen will be discussed, as will the process of creating the animation, and converting that animation to video tape.

RESEARCH INTO THE CAUSES
OF PRE-FIRES

Brad L. Karmiol
High School Student
Albuquerque Academy

Abstract

The Shiva Star/Marauder project, which is attempting to produce high energy compact toroids, has recently suffered many problems with pre-fires. It was hypothesized that the brass electrodes which channel the current to the gas, forming a plasma, might be the problem. However, after much research and testing, it does not appear that the electrodes are the problem, but rather an engineering flaw in the set up of the hardware.

SYNTHESIS AND PURIFICATION
OF FULLERENES

Alexandra N. Kitty
Student
Good Counsel High School

ABSTRACT

A carbon arc reactor for vaporization of graphite or carbon rods was designed and used to manufacture fullerene containing soot. The soot was collected from the reactor after vaporizing 212.4g of carbon rods and Soxhlet™ extracted with carbon disulfide. This yielded 11.76g of fullerenes. A toluene solution of these fullerenes was extracted on a Shodex HPLC column.

USING FUZZY LOGIC IN THE DESIGN OF SYSTEMS TO DESTROY MISSILES BASED ON INFRARED EMISSIONS

Erik J. Krause

Abstract

Fuzzy logic is a type of logic in which values do not need to be precise. This is important when controlling a process because it allows some degree of error in positions of items without causing problems. In the case of an incoming missile, fuzzy logic makes locating the missile close enough with enough control to keep a method of destruction, such as a high power laser, aimed at a certain location for a sufficient amount of time to destroy the propellant or the warhead of the missile. By using infrared emissions data, it is possible to locate the case of the missile. By estimation from the data available, it is then possible to decide where to aim a laser, or other device to destroy the intended target.

INVESTIGATION OF NEURAL NETWORK BASED LIGHTNING WARNING SYSTEM FOR THE KENNEDY SPACE CENTER

Frank A Lasley IV

Abstract

Preliminary Macintosh C source code written by a local contractor for a neural network based lightning warning system at (KSC) Kennedy Space Center was investigated and modified in order to operate on data sets larger than three days. It was determined that modification for data sets larger that three days would not be practical without extensive knowledge of Macintosh toolbox calls and the proprietary source code for the backpropogation neural network itself. C code was written to filter lightning, wind, wind divergence, and electrical field data from KSC and generate a file suitable for implementing as input into the IBM PC based Neural Networks Professional II program.

POLYESTER SYNTHESIS AND ANALYSIS

Brad M. Lormand
Student
Rosamond High School

Abstract

Polymers were created by an acid-base reaction of terephthaloyl chloride and three different hydroquinone monomers. The three used were hydroquinone, tertiary-butyl hydroquinone, and phenyl hydroquinone. Before synthesis, the three base monomers were purifyed by crystallization and the solvents used were distilled to insure a lack of contaminants. The polymers were formed by slowly adding the terephthaloyl chloride to a solution of one the hydroquinones in pyridine and methylene chloride or diethyl ether. When completed, the newly formed product was washed with distilled water followed by acetone. Then, Thermal Analysis and Fourier Transform Infrared (FTIR) spectroscopy were performed on the three different species.

A LOOK AT THEORETICAL SPECIFIC IMPULSE IN POTENTIAL SOLUTION PROPELLANTS

Matthew W. Losey

Abstract

The theoretical specific impulses along with the chamber temperatures of various potential, environmentally compatible, solution rocket propellants were calculated and analyzed. The solution propellants consisted of oxidizer-salt combinations in conjunction with energetic polar polymer binders to give an energetic propellant with no HCL in the exhaust. Both the specific impulse and the chamber temperature calculations were obtained through the Theoretical ISP Program and then charted as a contour graph. The results are evidence that there is potential for rocket propellants that are safer to the environment and just as energetic.

MASTER OSCILLATOR POWER AMPLIFIER BASICS

Suzanne Matthews
Student
Del Norte High School

ABSTRCT

The objective of this project is to obtain the largest amount of power into an amplifier from a laser possible. Without knowledge of optics, this task is almost impossible. The first thing that needed to be accomplished was to learn basic optic theory. Then progress to ray tracing. We are trying to manipulate the beam from a diode laser into an amplifier creating a Master Oscillator Power Amplifier (MOPA).

COMING IN FOR A LANDING

Diane M. Monaghan
High School Apprentice
Phillips Laboratory

Abstract

The LEAP program (Lightweight Exo-Atmospheric Projectile) has made much progress in the past few years. Now the program is being tested for capabilities for use in space exploration as well as its original purpose. Testing for this type of application is being formulated. Landing a vehicle is the first step to this testing. The steps to find the perfect landing platform are covered.

July 1992

REDUCTION AND ANALYSIS OF SYNCHROTRON SPECTROSCOPIC DATA

Tracy R. Reed

Abstract

During Aug. 1991 and Oct. 1991, Air Force scientists used the National Synchrotron Light Source at Brookhaven National Laboratory to collect EXAFS spectra of various Liquid Crystal Polymers (LCP's) which had been synthesized at Phillips Laboratory, as well as spectra of Ammonium Perchlorate pellets treated with bonding agents. The goal of this experiment was to determine local chlorine chemical coordination by viewing the radial structure function derived from the EXAFS data after computer processing.

INTERPRETING GPS SATELLITE DATA FOR USE
IN THE STUDY OF IONOSPHERIC EFFECTS ON
RADIO SIGNALS

Jeffrey M. Roth
1992 AFOSR-HSAP Participant
Ionospheric Effects Division
Hanscom AFB, MA

Abstract

The research lab which I received the chance to work in this summer comprises itself of a small group of engineers who study and record the activity of the ionosphere. Because this research involves using data which comes from not just our site but other sites around the world, we work with such an overwhelmingly large amount of data that computers allow the only feasible way to handle it. As a result, much of the work that I have done consisted of using computers. This has included modifying and writing data analysis software, loading and processing data tapes on the lab mainframe computers, and generating data plots printouts. I greatly appreciate this opportunity to work for the summer under a technical and challenging objective. I would especially like to thank Charley Andreasen, Greg Bishop, Elizabeth Holland, and Dr. Andy Mazzella, all of whom have let me work alongside them and taught me things the hands-on, exciting way.

FIBER OPTIC CAMERA PLACEMENT
IN THE F-16C AIRCRAFT

Timothy Sanchez-Brown
Phillips Laboratory / Electromagnetic Effects

Abstract

When doing HPM (High Power Microwave) testing and LPM (Low Power Microwave) testing; a problem arises of how to visually monitor equipment inside the cockpit during testing. A camera system is needed to safely accomplish this, but now the problem is to design a system that will not reflect rf and will provide a suitable picture. A fiber optic camera set up will provide the best picture and with it's small dimensions should not cause too much skewing of the microwaves. A support must be used to direct the camera to specific instrumentation within the cockpit. Styrofoam boxes cut in different configurations will prove to be the best all the way around; no rf reflection, lightweight, inexpensive, and durable. Camera and box placement is the only question left. This report goes into detail of set for the instruments; HSI/ADI, THREAT WARNING RECEIVER, and WARNING LIGHT PANEL.

A STUDY OF RADIOSONDE DATA FOR THE VALIDATION OF ATMOSPHERIC MODELS AND FOR USE IN THE CREATION OF AN INVERSION ALGORITHM FOR THE FOURIER TRANSFORM SPECTROMETER

Adam Smith
Summer Research Intern
Phillips Laboratory
Hanscom Air Force Base

Abstract

During the summer of 1992, several related projects were undertaken by the Electro-Optic Measurements Branch of the Phillips Laboratory. Operating at the Army's Ft. Devens annex in Sudbury, MA, these projects involved such instrumentation as a TPQ-11 weather radar, a .532 and 1.06 micron lidar, various visible and IR cameras, and a Fourier Transform Spectrometer. To help validate and correlate the data gathered by these devices, radiosonde balloons were launched during periods of spectrometer operation, providing temperature and humidity profiles for the immediate area, as well as partial wind speed and direction data. These data have confirmed the MODTRAN atmospheric propagation model, especially in hot, dry conditions. Also, the combination of radiosonde data and measurements from the spectrometer will hopefully lead to an inversion algorithm for producing atmospheric temperature and humidity profiles from spectrometer data.

THE DEVELOPMENT OF A NETWORK MONITORING PROGRAM

Robert N. Tarr
Student
La Cueva High School

Abstract

The previous network monitoring program, PONG, was studied to learn how to contact the other computers on the network; and how to display the results to the screen so that the program would be usable on any machine on the network. A plan was then made for how the new program, Prowler, was to be different from the old program. It was decided, that to keep as much traffic off the network as possible that there would be two programs to Prowler. One program, Prowler_Main, that would constantly check the network and determine the status of links between different sites; and another program, Prowler, that people would use to display the information found by the program, Prowler_Main. This was done by having Prowler_Main write the data that it found to a file. Prowler would then access this data and display it on the users screen.

DEVELOPING THE VISTA USER'S GUIDE

Matthew J. Wick

Abstract

The Phillips Laboratory Management Information System (PLMIS) is being replaced by a renewed system called VISTA. The new system is designed to incorporate personnel's suggestions and further facilitate use of the system. To exploit the potential of the new system, Major John J. Gill and I were asked to write and design a new user's guide to supplement the creation of VISTA.

ROME LABORATORY

The Effectiveness of Advanced Identification System and Lecroy Digitizer

Stephen A. Antonson

ABSTRACT

The effectiveness of the Advanced Identification System (AIS) and the Lecroy Digitizer was studied. To collect raw data, several excursions were made to Florida. Both systems were installed in a small plane and readings were taken and recorded. This data was then returned to Rome Lab where it was compiled and organized to make it computer presentable for automated input.

SOLID MODELING USING NETWORK II.5

Matthew J. Bauder
Student
Sauquoit Valley Central School

ABSTRACT

Solid modeling is using computer graphics to represent the complete geometry of a product. Network II.5 is a solid modeling program that allows the user to model networks. This summer, I verified an already modelled network, with Network II.5, checking for data and simulation problems. This paper will describe solid modelling in more detail, describe Network II.5, and discuss the work I did and the network I worked on.

THE INFLUENCE OF MODULATION ON THE SPECTRAL PURITY OF LASER EMISSION

Michele A. Bielby
Research Apprentice
Department of Space Communications
Laser Comm.
Rome Laboratory

Abstract

The influence of modulation on the spectral purity of the GaLa laser diode was studied. Optical spectra are classically measured using dispersive media such as prisms or diffraction gratings. These are characterized by dispersion and wavelength. For the measurement we make, we require dispersion sufficient to resolve slightly separated modulation sidebands about a carrier in the optical range. We made our measurements using three techniques. We used a prism, grating, and a pulsed spectrum laser analyzer to get our measurements. Experimental results indicate that when the laser is modulated the original peak decreases in height and widens out and sidebands are produced on both sides of the orginal peak.

ANALYSIS OF F-16 SHIELDING EFFECTIVENESS

Michael Decker

ABSTRACT

The objective of this research project was to evaluate electromagnetic (EM) shielding effectiveness characteristics for two different F-16 aircraft, determine their maximum and minimum shielding effectiveness levels and establish a relationship between them. These Shielding Effectiveness measurements were performed on two F-16 aircraft during a previous Rome Laboratory research program, at the Newport Research Facility. The first aircraft was a F-16 empty shell which did not include any avionics equipment or wiring harnesses. The second aircraft was an operational F-16 ground test bed which was configured as close as practical to an operational F-16 Block 30. This aircraft included avionics equipment and wiring harnesses. These aircraft were instrumented with B-dot field probes to measure the EM field levels inside the equipment bays of both aircraft. These measurements were performed with the aircraft mounted on a 32 foot tower while the aircraft was rotated through a variety of azimuth and elevation angles.

THE TESTING OF VARIOUS OPTICAL LOGIC DEVICES

Andrew Gerrard
Stuart Libby
Michael Parker

Abstract

This paper deals with the testing of Broad-Area Laser Memory elements and Surface-Emitting Laser Logic units, both of which will eventually be used in an optical processor. The devices were driven with direct current in a controlled environment in order to initiate lasing within the device, and therefore give off a measurable luminescence. The tests involved measuring response to varying voltages and currents, obtaining L-I and I-V characteristics, and characterizing the intensity vs. facet position. Equipment was controlled via the Asyst and Viewdac GPIB programs, both of which played an important role in the collection of data.

Understanding C
and UNIX Networks

Todd C. Gleason
Student (High School Graduate)
ERDA/Electronics, Reliability & Diagnostics (Analog)

Abstract

This year's study focused on the theory of the C programming language under SunOS 4.1.1, in comparison with the accepted ANSI C standard. Additional study of the operation of UNIX, as well as in communicating with foreign hosts and in the understanding of USENET style domain names, was made. Many compatibility issues had to be resolved in order to transfer source code from books on the subject of C to an executable form on the Sun. Among these were function prototype reformatting, extraneous variable elimination, voided function location, location of libraries and include files, structure declarations, and memory allocation code portability. All problems except the last two were resolved to satisfaction.

The Study of Crystals

Venus-Victoria Hammack
High School Apprentice
Rome Laboratory

Abstract

At my time at Rome Laboratory, I learned a variety of interesting things. I learned how to grow, cut, polish, examine, and take pictures of crystals. When examining a crystal, you can use a number of different machines, and methods. And each one will show you a different aspect of crystals. I also learned to improve the quality of a machine, by making a new design for it by removing and/or adding parts to it.

Study of Crystal Growth

Eileen Harrington
Student Apprentice
Hanscom Air Force Base

Abstract

In this report I will try to sum up my last eight weeks at work. In thinking about my project and in putting the pieces together, I have come to realize the connections between each experiment. This report will hopefully carry you clearly and accurately through my experiences from crystal growing to analysis which when put together make a crisp picture.

PROGRAMMING OF THE C3 BACKUP UTILITY

Jason D. Kowalczyk
Student
Engineering Science
Mohawk Valley Community College

Abstract

The design, development and programming of the C3 Backup Utility, was performed, for the RL/C3 Directorate. Programming the utility included the knowledge of BATCH file processing and NETWORKING experience. It was written to backup the C3 network to conform to the RISK requirements.

Is Multi-Media The Answer?

Ray A. Liuzzi Jr.
Summer Apprentice
Rome Lab, Griffiss AFB
Rome, NY

Abstract

The power of the personal computers is resulting in a new era of software development, an era dominated by Multi-Media. The Macintosh II represents one of the best platform available today for Multi-Media *creation* and interaction. The usefulness of Multi-Media presentations for training purposes was studied and tested during my tenure as a summer Apprentice at Rome Laboratory. The results showed that with the access of modern Multi-Media technology, Multi-Media training can provide the neccessary advancements for effective learning. After working with Multi-Media productions for six weeks I would highly recommend it to anyone wishing to create a training document with high quality.

Artificial Neural Networks

Sean Menge
Communications Technology Branch
Rome Laboratory

Abstract

Artificial Neural Networks were studied over the term of the research period. Areas of study included, what an artificial neural network is, the history behind it, explanations of several general problem domains, and a discussion of possible applications of Artificial Neural Networks. Research was conducted in Rome Laboratory's Technical Library. This report gives a general introduction to Artificial Neural Networks and discusses several potential applications for future research. The research performed over the course of this eight week apprenticeship has generated a better understanding of what Artificial Neural Systems are and how they may be applied to future military communications development programs.

A MULTI-MEDIA ENVIRONMENT
IS IT FOR EVERYONE?

Michael J. Panara
Summer Apprentice
Rome Laboratory
Rome, NY

Abstract

The goal of this project was to evaluate and demonstrate if available multi-media technology, including hardware and software could create a multi-media environment.

To test this, a multi-media video tutorial for using the Excel Spreadsheet was created on a Macintosh Computer using the MacroMind Director and the MacroMind MediaMaker software. The project, like all true multi-media productions incorporated text, graphics, sound and animation into a single project.

The overall report describes the multi-media environment created, the interfaces that were utilized and specific actions taken to incorporate and use multi-media in the environment. In addition, results were evaluated, recommendations for additional tools were made and a multi-media architecture is described. Results using the multi-media environment indicated that this technology will influence the use of computers in the next decade.

A STUDY OF PARALLEL
DISTRIBUTED PROCESSING

Anne E. Pletl
Engineering Assistant For Software
Exercises and Verification
Rome Laboratory
Optical Processing and Communications
Griffiss Airforce Base

Abstract

Parallel distributed processing (neural networks) was the topic that was studied and demonstrated. To understand this program some basic knowledge of the brain is required. An artificial neural network is a massively parallel array of simple computational units or neurons that model some of the functionality of the human nervous system and attempts to capture some of its computational strengths. Neural networks learn on their own to make judgements the way human beings do. In other words it's like trying to create a computer to mimic the way the brain reacts to certain stimuli and how it actually thinks. The following report will discuss the differences between neural networks and digital computers, what distinguishes the neural network program from any other, what we've learned from the human brain, network structures, and the future of the neural network program.

The Research of Different Samples Using the Scanning Electron Microscope

Anthony M. Richards
Student at Bedford High School

Abstract

A material was studied under high magnification to find out what materials it was made of. To observe the sample, it was placed in an electron scanning microscope. With a magnification of between 10x and 300,000x, the microscope could see what the naked eye or light couldn't. The sample could be seen through a TV screen, which is part of the microscope. After being focused, a picture was taken of the image on the TV screen. This was done with a Polaroid camera hooked up to the microscope. A computer program was now used to identify the elements in the sample in the form of peaks, and at what percent they were in.

LASER DIODE ARRAY TESTING

Eugene C. Salerno

Abstract

The purpose of the work was to be able to control the temperature and bias current of a laser diode array and then make measurements of its output power, far field pattern, and wavelength. This would be controlled by the LabView software package installed on a Macintosh IIfx.

ADVANCED RADAR CORRELATION ALGORITHMS

Andrew G. Sega
Rome Laboratory/C3AA

Abstract

The problems of large radar networks were studied. Specifically examined was the problem of clutter and how it can be minimized with the least loss of data. The algorithms presented have shown to be helpful in correlating scans together, and predicting where a scan object could possibly be at during a scan. The main solution was a toroid-shaped probability ring drawn around each scan, to simulate all of its possible movement between sweeps of the radar.

RUNNING SOLID MODELS

Joseph C. Senus
Student
Rome Free Academy

Introduction

During this summer's tour our main goal was to establish, run,and check solid models. These models were supposed to be initiated on a DEC 5000/240 by way of magneto optical disc. Unfortunately, some problems quickly arose and we were not able to achieve the final goal.

NOISE MEASUREMENT OF INTERCONNECTING COAXIAL CABLE

Max Shapiro & William J. Walsh
Rome Laboratory
Electromagnetics and Reliability Directorate
Hanscom A.F.B. Massachusetts

Abstract

To measure the noise figure of the superconducting phased array antenna accurately, the noise figure of each component must be measured individually. In this paper we will describe the procedures for determining the noise figure of the coaxial cable connecting the antenna to the measuring device while encapsulated inside a cryostatic cooler.

WRIGHT LABORATORY

SUMMER RESEARCH
INCLUDING HYPERMEDIA DOCUMENTS

Lori L. Anderson

Abstract

The following report is a description of the work I performed during my participation in the Air Force Office of Scientific Research (AFOSR) High School Apprenticeship Program. During my second summer of employment at Wright-Patterson Air Force Base (WPAFB), I worked with a number of software packages, including word processors, spreadsheets and graphics packages. These software packages were hosted on a Gateway 2000 80486 personal computer. In addition, I utilized hypermedia software packages on both the 486 computer and a Macintosh IIx and evaluated the usability of these packages. I also resumed an empirical study of the Ada programming language which I had commenced during my previous summer of employment at WPAFB. The Ada compiler I used for this effort was the Digital Equipment Corporation (DEC) Ada Compiler, hosted on a DEC VAX computer.

Monte Carlo Star Detectability & Micro-G Calibration Studies

Eric A. Apfel
High School Apprentice
Guided Interceptor Technology Branch
WL/MNSI

Abstract

Several programs were written to determine whether various startracker sensor designs, at any point in their orbit around the earth, will be able to detect a sufficient number of stars. The known locations of these stars would then be used to correct the heading of host guided projectiles if necessary. Another program was developed to calibrate an accelerometer in a micro-gravity environment with the aid of a Kalman filter. The program filtered out measurement noise and random acceleration noise to determine the actual accelerometer bias error. Both tasks serve to aid the guidance and navigation of interceptors such as a ground-based kinetic energy weapon. The positive results received from the programs provides incentive for further studies.

Video Documentation of EPIC Capabilities

Jennifer R. Bautista
High School Apprentice
Warheads Branch
Wright Laboratory Armament Directorate

Abstract

I spent the summer working as a high school apprentice in the Computational Mechanics Section of the Warhead Branch (WL/MNMW) at the Wright Laboratory Armament Directorate on Eglin Air Force Base. I worked with Mr. Mike Nixon, my mentor, and a fellow apprentice, Elliot Moore II. My project for the summer was video documentation of EPIC capabilities. Using a Silicon Graphics Iris Indigo, I ran the EPIC code, created graphics using the RSCORS graphics program, captured the .rgb files, and then animated the files to create simulation videos of what the EPIC code is capable of representing and simulating.

EVALUATION OF THE SENSITIVITY AND PERFORMANCE OF INSENSITIVE COMPOSITE BOOSTER EXPLOSIVES

BRAD BLANCHARD

PBX-9502 is an insensitive composite booster explosive that has been used for years in both conventional and nuclear weapons applications. This explosive is a composite of 2,4,6-trinitro-1,3,5-triaminobenzene and KEL F 800 at a 95/5 weight percentage (95% Explosive/5% KEL F). PBX-9502 was originally developed for use in nuclear applications, but since it allows weapons to be handled with much greater safety, and has recently been adapted for use in conventional applications. Test results have shown TATB to be an extremely safe explosive, but it does have one major disadvantage-cost. Because this explosive is expensive and its supply is less abundant, attempts are being made to replace PBX-9502 as an insensitive booster explosive.

7-Amino-4, 6-dinitrobenzofuroxan (ADNBF); 7-,5-diamino-4, 6-dinitrobenzofuroxan(CL-14); and 1,4-dinitroglycoluril (DINGU) are possible replacements for PBX-9502. ADNBF, CL-14, and DINGU, which are high density, high energy explosives, contain several advantages over PBX-9502. In order to utilize these explosives as insensitive boosters, characterization and performance tests must be conducted.

First the explosives were coated with a polymer binder to allow pressing of the materials. Characterization of the explosives was then conducted by thermal analysis and sensitivity tests. Fabrication of the materials was done with a hydraulic press. The main objective was to determine the proper pressing conditions for each composite explosive, enabling small scale performance tests to be run.

EXPANDED STUDY OF COMPUTER SOFTWARE

AND INVENTORY CONTROL

J. Stacey Bond
Summer Apprentice
Wright Laboratory, W.P.A.F.B.

Abstract

This summer I worked on two different types of projects. First, I learned many various types of computer software. I was introduced to most of them for the first time, and the others I expanded my knowledge of them. The other major project I did included taking inventory of all the computers in the entire WL/EL, the electronics department.

Inventory Control For The Solid State Electronics Directorate

Helen Chou
Summer Apprentice
Division: ELA-Operations
Wright Laboratories, WPAFB

Abstract

The main project was to devise an efficient method of bar coding all Air Force equipment in the Solid State Electronics Directorate. The main purpose of this project was to be able to inventory all equipment in the lab, select a responsible party for each piece of equipment, and to make the data file able to update quickly and efficiently whenever a change is needed. The approach plan is to first collect all the necessary information and then input it into a spreadsheet. Next, generate bar codes from the data in the spreadsheet and post on each corresponding piece of equipment. Lastly, program the bar code reader to display the individual data listings whenever the bar code on the equipment is scanned.

THE CREATION OF AN AUTOMATIC ELECTRONIC MONITORING SYSTEM

Claudius W. Christmas, Jr.
High School Apprentice

Abstract

A computer system that would electronically monitor and control electric current during experiments was created. To accomplish computer-controlled monitoring, it was necessary to find a program that would meet the requirements and demands of such a system. Upon finding such a program, the problem of deciding which type of computer system (80286, 80386, or 80486) to run the application software on had to be solved. In solving this problem, the efficiency of the final system had to be taken into consideration. The final result was a slightly modified Zenith 20286 computer system that quickly and effectively regulated the various electrical activity used in conducting experiments.

WRAP-AROUND FINS

Theresa J. Cook
High School Apprentice
Aerodynamics Branch
Wright Laboratory Armament Directorate

Abstract

The computer-simulated aerodynamics of missiles with wrap-around fin configurations were studied. The fins were modeled both with and without thickness on an infinitely long cylindrical body . The thick fins were bi-convex airfoils with a thickness of ten percent of the chord and the thin fins were infinitely thin. Computed trends of the thick-finned models closely resembled the trends of experimental data. The wrap-around fin configuration caused a roll reversal through Mach 1, a side force at angle of attack, and a roll moment at zero degrees angle of attack. The thick fins also created a lift force that was a constant amount more than the force created by the thin fins.

A STUDY OF HEAT TRANSFER SIMULATION AND SIMULATION SOFTWARE USER-FRIENDLINESS

Gerald Dalley
Student

Abstract

In the course of studying the user-friendliness of the Kappa-PC expert-shell software, simulations for two heat exchanger systems were produced. The first, part of the AHXE (Advanced Helical-loop eXchanger Evaluation), simulates a new high efficiency heat exchanger. Originally designed for use on NASP (National Aerospace Plane), the exchanger will be used to absorb high levels of heat quickly and efficiently. Specifically, it is designed to cool hypersonic aircrafts' leading edges. The actual testing of the heat exchanger is scheduled for later this year.

The second project, micro-encapsulated PCM(Phase Change Material), studies the use of microscopically encased globules of paraffin in a coolant. The simulation, nearing completion, will help determine the increased efficiency and possible weight reductions for cooling systems aboard advanced aircraft. The results found the Kappa-PC program, used to create these two simulations, to be a powerful simulation shell capable of building highly user-friendly simulations. The software itself, in creating simulations, lacks some of the elements of user-friendliness that its simulations hold.

DEVELOPMENT OF A PRESSURE TRANSDUCER CALIBRATION DEVICE

Elizabeth C. Day
Summer Apprentice
Technology Branch
Turbine Engine Division
Aero Propulsion and Power Directorate
Wright Laboratory
Wright-Patterson Air Force Base

Abstract

In order to obtain the most accurate measurements possible, a measuring device must be compared to a standard, or calibrated. The measuring device cannot be calibrated to an accuracy greater than that of the standard. Generally, the calibration standard should be at least ten times more accurate than the instrument being calibrated. It is imperative that pressure transducers used in axial compressor research be carefully calibrated in order to allow for accurate experimental results, as the results may affect expenditures, new design plans, and even human lives. A device used to calibrate pressure transducers for the Air Force Aero Research Lab was needed. A thorough description of the design process is presented.

August 1992

FRACTAL GEOMETRY: AN EXPLANATION AND APPLICATION

Lesha Denega
High School Apprentice
Advanced Guidance Branch
Wright Laboratory Armament Directorate

Abstract

Increased awarness of the study of chaos in the past twenty years has brought into focus a new and different type of geometry. Fractal geometry is a product of chaos study and the study of turbulent systems. The pratical applications of fractal geomentry and fractal dimension have also found an use in seeker sytems as a means of detecting man-made objects in clutter. We discovered that it was possible to write code to prefrom this function on the ATLAS LADAR system.

Automated Testing of High Performance
Heterojunction Bipolar Transistors

Christopher Dodsworth

Abstract

In order to speed up the research and development process, the use of automated computer testing of transistors was studied. Five major tests were developed, along with an interface program to help the user control the computer. When tests were performed, an 80% increase in speed was found. Moreover, the accuracy of the results was 100%. Researchers were able to start testing, work on another project, and come back, their testing completed.

GEOMETRIC MODELING AND FINITE ELEMENT MESH GENERATION USING PATRAN

Thomas J. Fraites, Jr.
High School Apprentice

Abstract

The mission of the Technology Assessment Branch (WL/MNSA) is to assess the lethality of hypervelocity kinetic energy weapons (KEWs) against foreign aerospace threats. To fulfill this mandate, WL/MNSA uses various analytical tools. Among these tools are Eulerian finite difference codes (hydrocodes), which are useful for initial impact results, and finite element codes, which are better for late-time structural response analyses. The goal of WL/MNSA, then, is to combine these two codes to provide a good representation of a hypervelocity impact event from start to finish (or critical time step). In order to accomplish this goal, an efficient finite element modeler is required to set up finite element problems based on hydrocode results. One such modeler is PATRAN. During the summer of 1992, the usefulness of PATRAN in comparison to code-specific model generation techniques was studied, and the results of that study are the basis for this report.

Reflections of Ramjet Research

Kimberly A. Frank
Research Apprentice
Advanced Propulsion Division
Wright Laboratory
Wright-Patterson Air Force Base

Abstract

The objective of Test Cell 22 currently is to test the performance of various ram components for a ramjet engine, such as the combustor or nozzle. In order to test the accuracy of the ram rig, data was taken at two different states: the natural state (nothing was being done to the rig-- no pressurized air, no vacuum pulling on the rig) and the simulated high altitude, high flight speed state (high pressurized unheated air being passed through the rig and/or an exhauster vacuum pulling on the engine components). The results of the data taken at both states were closely studied and compared. Through studying the data from the experiment it was learned that there were vibrations in and on the ram equipment that influenced the force reading from the load cell. True mechanical solutions to eliminate the problems found in the ram rig are very complicated and not practical; for now, electrical filtering has been found to solve the problems. Vibration frequencies on the thrust stand were easily identified using a special instrument that measures both the amplitude and frequency of the disturbance. A series of capacitors were attached across the load cell to filter higher frequency vibrations. The experiments proved very valuable because it identified both the frequency and amplitude of the vibrations, as well as identifying solutions that could be made practically.

A MODEL OF THE OPERATING TEMPERATURE RANGE OF ESTER-BASED LUBRICANTS

Erin Lynn Glaser
High School Apprentice Program
Research and Develepment Laboratories

Abstract

The densities and viscosities of four Mobil ester-based lubricants were measured at four different temperatures. The data points obtained were then used along with Walther's viscosity equation to create a mathematical model which could be used to predict the kinematic viscosity of any of these four lubricants over a wide range of temperatures. The models were then graphed, and the graphs were used to determine the operating temperature range of each of the four lubricants based upon a 2-cSt to 20,000-cSt operable viscosity range.

STRESS GAGE ALGORITHIM DEVELOPMENT

Daniel R. Grayson
High School Apprentice
WL/MNGI
Eglin Air Force Base

ABSTRACT

Research this summer centered on the creation of an algorthim for certain piezoelectric stress gages. The algorithim's function was to give accurate output values for shock velocity, particle velocity, and pressure from time of arrival data. Project work included range tests, use of scientific graphical software, mathematical calculations, and software development. The algorithim will be used to measure the effectiveness of the tested piezoelectric gages as stress sensors.

FLOW VISUALIZATION OF A JET IN A CROSSFLOW

Amy Hancock

Abstract

A qualitative study of the mixing of a jet in a crossflow, or freestream, was conducted using a flow visualization technique known as Reactive Mie Scattering. To visualize this mixing process, the jet is seeded with titanium tetrachloride ($TiCl_4$) vapor and the freestream is seeded with water vapor. The $TiCl_4$ and the water vapor react at the interface of the two streams forming micron-sized titanium dioxide (TiO_2) particles. The particles are small enough to follow the gaseous flow and are illuminated by a light sheet from a pulsed Nd:YAG laser. Piezoelectric actuator blades are located on the four inside surfaces of the square jet conduit to provide a means of imparting energy disturbances into the jet to enhance mixing. The blades are driven at their natural frequency of 500 Hz. The piezoelectric actuators were found to significantly enhance mixing of the jet with the freestream. This study provides preliminary qualitative data for use in establishing a more complete test matrix for characterization of a driven jet in a crossflow.

HIGH SURFACE AREA CONDUCTIVE POLYMERS

Deanna Harrison
High School Apprentice
Fuzes Branch
Wright Laboratory Armament Directoate

Abstract

Most polymers are insulators, such as plastics, but a few that have been recently developed are conductive. In the past few years there has been much research done on conductive polymers because of their many practical applications.

There are some significant advantages to using conductive polymers instead of metals. They are very light weight and relativly easy to make. It is also possible to alter their physical and electrical properties by changing the conditions at which the polymer films are deposited [3]. The focus of this project was to find ways to increase the surface area of conductive polymer films. A textured anode proved to increase the surface area of the PPY/DBS films without making them brittle. Although this is an effective way of creating high surface area films, the use of a pulsed current was also investigated. Depositing a base coat of smooth PPY/DBS allows there to be more flexibility, thus it is an essential part of this process. A base current of 40 mA was used for the first 45 minutes of deposition. After this period the current was pulsed for 15 minutes. It is still to be determined what type of effect these films will have when used in capacitors.

A STUDY OF THE FRAGMENTATION OF GRAPHITE/EPOXY PANELS UNDER HIGH VELOCITY IMPACT

Steven R. Hart
West Carrollton Senior High School
5833 Student Street
West Carrollton, Ohio 45449

Abstract

The fragmentation characteristics of unidirectional composite panels was studied. The composite panels were impacted at a range of high velocities with half inch diameter steel spheres to cause fragmentation. The fragments were collected and later analyzed. Results from this analyzation were then used to establish a quantitative description of the fragmentation characteristics of the composite panels. Specifically, the size distribution of the fragments and the mean fragment size.

A STUDY OF AN UNBALANCED SHAFT DUE TO OIL LEAKAGE

DAVID B. HARTSOCK

STUDENT

BELLBROOK HIGH SCHOOL

ABSTRACT

At the Compressor Research Facility fans to be used in jet engines are tested. On May 11, 1992 oil from a PRATT & WHITNEY test article leaked into the jackshaft which runs the compressor, which powers the test article. This oil sat in the bottom of a coupling that is connected to the jackshaft. Eventually, enough oil collected in the coupling that it caused uneven rotations of the shaft. This unbalance of the shaft caused the shaft to vibrate while rotating. Due to the vibration, the seals surrounding the shaft were broken. No major damage was done to the shaft or the test article. Fortunately the engine was shut down before any serious damage could occur.

INFRARED LASER POLARIMETRY

CHAD D. HOUGHTON

HIGH SCHOOL APPRENTICE

WRIGHT LABORATORY ARMAMENT DIRECTORATE

WL\MNGS

ABSTRACT

A polarimeter is an optical instrument used in testing and calculating various polarization and retardance properties of light and different materials. The field of laser polarimetery has been advanced by improvements made in calibration techniqes, alignment, accuracy, as well as the further testing of optical materials. The infrared polarimeter was realigned and recalibrated using enhanced softare and a new sample mount was prepared to test the material Gallium Arsenide.

Development of a Graphical User Interface for the AVATAR/ESP Simulation

John H. Kahrs
High School Apprentice
Guided Interceptor Technologies Branch
Eglin AFB

Abstract

The AVATAR/ESP is a simulation for almost any Kinetic Kill Vehicle. The simulation is in the process of being put into the Xwindows environment. Several utilities are also being incorporated into the simulation. The scope of this study centered around utilities for managing the variable database that is read into the ESP aspect of the simulation. The first being a program to sort feasible interceptors by a selected engagement parameter, and the second, a program for alphabetizing a selected database by variable name. Finally, the database for the Brilliant Pebbles scenario was converted to a database for the Ground-Based Interceptor scenario.

AN INVESTIGATION OF THE APTAS SYSTEM

Daniel A. Kelley

Abstract

The Automatic Programming Technologies for Avionics Software (APTAS) system was studied. This system's purpose is to streamline the process of target tracker design by making it possible for a tracking expert without programming expertise to do computer-based prototyping.

The system's current structure and functionality were investigated. This process included the creation of test programs with APTAS. Modifications were made in order to judge the amount of labor required to make meaningful expansions to the system. Current problems with the system were identified as well as possible solutions and improvements.

Evaluation of Hydrocode Strain Contours by *Microhardness Testing*

Jason A. Kitchen
High School Apprentice
Warhead Branch
Wright Laboratory Armament Directorate

Abstract

For this research project, microhardness plots of metal test specimens were compared to hydrocode strain contour plots. The microhardness values of copper, aluminum, and steel Taylor-Anvil specimens were measured by the use of a microhardness testing apparatus. The apparatus consists of a microscope for viewing the metal test specimen and a diamond tipped indentor placed under a load for determining the hardness value for a specific point in the specimen. The diamond indentions were repeated at regular intervals across the specimen, and a microhardness value plot for the specimen was created. This plot of values was analyzed for trends where values significantly changed. The trend lines were then compared to hydrocode strain contour plots.

The results of microhardness testing were encouraging. While the range of hardness values on copper and aluminum Taylor specimens did not vary enough to exhibit trends, the wide-spread values of the steel plots allowed trends to be observed. These trend lines were compared to steel strain contour plots from hydrocodes and similarities were seen in the hardness values and corresponding strain contours. While the validity of hydrocode predictions cannot yet be determined by microhardness testing, future work is planned to further investigate microhardness testing as a means for hydrocode evaluation.

A STUDY OF THE C AND BASIC COMPUTER LANGUAGES AS WELL AS AN IN DEPTH DISCUSSION OF CERTAIN MATHEMATICAL CONCEPTS

Barry J. Koestler
Valedictorian
Beavercreek High School

Abstract

My summer apprenticeship entailed first reviewing some difficult BASIC programming, and then applying this knowledge to neural networks and matrices. Next I began learning and researching the C programming language and its mathematical implementations. Included in my study of these applications was the examination of the use of C to describe and work with sets and set theory. I also studied matrices and their properties in conjunction with neural networks. After becoming somewhat familiar with these two languages and their uses in mathematics, I examined several model programs (figs. 1-2 from Rietman 156-7, 164-5) written in BASIC and also looked at some mathematical C code (fig 3).

ELECTRICAL ANALYSIS OF $YBa_2Cu_3O_{7-x}$ SUPERCONDUCTING THIN FILMS AND BULK SAMPLES

Peter G. Kozlowski
Centerville High School

Abstract

High temperature superconducting thin films and bulk samples of the Y-Ba-Cu-O system were studied in order to characterize their electrical properties. The preparation of high critical temperature $YBa_2Cu_3O_{7-x}$ films on single crystalline $SrTiO_3$ and Al_2O_3 was done by laser ablation. In all cases, c-axis oriented films with critical temperature of about 90 K were obtained. On patterned films we obtained a critical current density of 10^6 A/cm^2. Bulk samples, having a much larger cross-sectional area, exhibit lower critical current densities, approximately 10^3 A/cm^2. Both thin films and bulk samples were measured by a four point technique and were tested through a range of temperature from 77 K (liquid nitrogen) to 300 K (room temperature).

COMPUTER RESOURCES
EXAMINING THE WORKINGS OF A COMPUTER NETWORK

Daniel J. Kramer

Abstract

This investigation involved the study and experiences of operating and maintaining a large computer network at a government facility such as Wright Patterson Air Force Base. The work was as varied as assembling computer hardware, to installing computer software, and to backing up computer file systems and disk partitions. While this is just a small part of the overall operations in this facility its importance in keeping the computers running and up to standards is a key to complete performance.

FORCED LIQUID COOLING OF A NON-FLUSH SIMULATED ELECTRONIC CHIP

Joel Kulesa
Archbishop Alter High School
Kettering, OH

and

John Leland
Wright Laboratory
Wright Patterson AFB, OH

Abstract

The properties of forced liquid semiconductor cooling were studied. Previous experiments have shown how the elevation of a semiconductor into a flow channel caused a cooling efficiency change. Initially, when the chip was raised from flush, the efficiency dropped. After a few more millimeters were exposed the efficiency started rising. Eventually the efficiency rose to a higher level than the flush model. To further study this effect and to isolate the physical forces involved, a new heater design was implemented. The new prism shaped foil heater was designed to eliminate the increased surface area caused by the elevation of the IC. Due to the continuing nature of this experiment, results and conclusions have not been reached as to how the new heater affects cooling efficiency.

USING MATHEMATICAL CONCEPTS TO PRODUCE THREE DIMENSIONAL COMPUTER GRAPHICS

Allen L. Lefkowitz
High School Student
Dayton Christian High School

Abstract

My summer apprenticeship in the Avionics Laboratory involved both the generation and analyzation of three dimensional data. Using *Mathematica* - a system for calculating and graphing numerical, symbolic, and algebraic operations - I first plotted a three dimensional curve showing a shift in the data and then displayed the data in a graphical image. Also at this time I recorded planes landing and taking off so that another apprentice, Eric Powers, could use this data in his project. After learning the principles of *Borland C*, I determined a way to write Mathematica data to a file for later use. My first set of Mathematica programs created and converted cylindrical data into rectangular or xyz coordinates. The next set of programs entailed the creation and conversion of spherical coordinates into rectangular coordinates. Once I stored rectangular coordinates of a cylinder and a sphere in data files, I reconstructed a graphics project written by my mentor, Greg Power, so that the data could be plotted onto a screen in a recognizable pattern. My apprenticeship ended with processing longitude and latitude data of a scanned engine into rectangular coordinates so that it could be plotted.

August 1992

IMAGE ANALYSIS: A FRACTAL APPLICATION

Jason Eric Lindsey
High School Apprenticeship Program
Advanced Guidance Branch
Wright Laboratory Armament Directorate

ABSTRACT

Through intense research into the nature and applications of fractals and fractal geometry, it was theorized that fractal geometry may have a useful application to image analysis. By analyzing an image for fractal dimension, areas in the image with low dimension or areas with integral dimension may be isolated. In this way, man-made objects may be isolated from natural background clutter. Code was written to perform this task. The code utilized the Hurst Dimensional Estimation Method and was rendered on Turbo Pascal. The method is intended for use on several types of imagery (LADAR, SAR, IR, etc.) and is a possible candidate to aid in sensor fusion for more efficient, more effective autonomous seeker technology.

Analysis of Fractal Image Compression and Decompression

Daran J. Mason
High School Apprenticeship
Guided Interceptor Technology Branch
WL/MNSI, Eglin AFB

Abstract

Fractals are a form of higher mathematics and Benoit Manelbrot described it in it's simplest form. He coined the term "fractal" to mean a broken structure possessing similiar-looking forms of many different sizes.(Anson) The problem associated with this project was not one that I had to solve, but was given to Iterated Systems Incorporated (ISI) of Atlanta, Georgia. The problem is that image storage on a computer' takes up massive amounts of memory. A method was needed to somehow "compress" the storage process to use less space. This was the task of ISI. The exact process of Fractal compression and decompression cannot be released, because it is proprietary to ISI. I didn't have a problem to solve, but two tasks. Task one was to process images through a hardware compression board and decompress images using software. Task two was to validate the results ISI reached and follow-up on some of the conclusions.

VIDEO DOCUMENTATION OF THE
PATRAN TO EPIC LINK

Elliot Moore II
High School Apprentice
Warheads Branch
Wright Laboratory Armament Directorate

ABSTRACT

My summer was spent working as an apprentice in the computational mechanics section of the warheads branch in WL/MNMW on Eglin Air Force Base. My mentor was Mike Nixon and my project centered around the video representation of EPIC (Elastic Plastic Impact Computations) hydrocode capabilities. The graphics capabilities of PATRAN was used as a post processor. Through the use of various "session" files, several different EPIC sample simulations were demonstrated. Through the use of Silicon Graphics machines, these sample simulations were comprised of various "picture frames", known as RGB files. These files were put together and used to animate the EPIC simulations on videotape.

CONSTRUCTION AND DESIGN OF A REGULATED POWER SUPPLY

Robert Baird Murray, IV

Abstract

A +/-15 volt 150 milliampere, +5 volt 1.0 Ampere power supply was designed and constructed. In designing the power supply, the circuit schematic was drawn and the values for the necessary components were calculated. After acquiring the components from various sources, the container was chosen and the exterior customized. The components were soldered to the circuit board with high precision and leads were connected to their terminals. The circuit board was then mounted to the customized metal container and output terminals installed for convenient use. After complete construction, the power supply was tested, using a multimeter to determine voltage and amperage output, and an oscilloscope to determine voltage ripple. The power supply's input was from a standard 115 volt, 60 cycles per second output, and is equipped with a lighted switch and fuse to safeguard against a possible short circuit.

PREPARING HIGH TECH AIRCRAFT FOR TESTING

Thomas M. Owsley
Student
Alter High School

Abstract

For my eight week tour at Wright-Patterson Air Force Base, I worked in building 65, the Structures Test Branch of the Flight Dynamics Directorate. In this building, high tech aircraft and pieces of high tech aircraft are instrumented and then submitted to heat and stress loads that simulate the expected conditions that will exist in flight. I had the opportunity to help instrument an F-15, the Air Force's current duel role air superiority fighter, a section of the 1995 Supportable Hybrid Fighter, which is a joint effort next generation fighter aircraft, and a piece of the National Aero Space Plane (NASP) X-30 which will carry passengers to the edge of space and yet take off and land on conventional runways.

Using Computer Applications

M. Cristina Pacheco

Abstract

The Structural Dynamics Branch at WPAFB uses many different types of software programs to aid in data presentation. Therefore, by learning to use Harvard Graphics and Microsoft Excel, data processing was made much easier. By putting information collected in experiments into a spreadsheet, calculations could easily be made. When this information was later transfered to Harvard Graphics using a Lotus Data Worksheet, which allowed information from the spreadsheet to be read into Harvard Graphics, it became very easy to make plots.

THE CREATION OF A GRAPHICS WORKSTATION

Eric J. Powers
High School Student

Abstract

The C programming language along with a special graphics card were used to analyze video of moving objects. Microsoft C v7.0, and compatible libraries were used to write the code. Since the functions required of the application were not totally known, tests were continually conducted. When test results proved to be very encouraging, a demo program was created to graphically display the capabilities of the graphics card and application written. In final, the program consists of around eighty functions.

A Comparison of
Concept Recognition Skills

Melvin K. Richardson

Abstract

The abilities of humans and computer software to learn concepts were studied. Patterned after the well-known Minnesota Card Test, ten concepts of four different categories were selected. Fifteen people were tested to determine their ability to learn these concepts; ten random files for each of the ten concepts were ran on two different computer pattern decomposers. The results indicate that no direct correlation exists between the skills of the people and the skills of the decomposers. The results do show, however, that humans are clearly better at recognizing a certain type of concept, while the decomposers are better at others.

CHARACTERIZATION AND ANALYSIS

OF

1,3,5,5-TETRANITROHEXAHYDROPYRIMIDINE

DAVID A. ROSENBAUM

1,3,3-Trinitroazetidine (TNAZ) is a heterocyclic compound (energetic material) under investigation as a melt cast base for high energy insensitive explosive applications. TNAZ has a high density and high performance level making it suitable for high energy applications. Although TNAZ has a high density and performance level it also has a few disadvantages. It has a high vapor pressure and a moderate melt point of 101 degrees Celsius. The heterocyclic compound 1,3,5,5-tetranitrohexahydropyrimidine (DNNC) is also under investigation. By adding DNNC to TNAZ the vapor pressure, melt temperature, and processing temperature can be lowered. Calculations indicate that TNAZ/DNNC form a low melt eutectic with a 70/30 weight percent and a melt point of 89 degrees Celsius. DNNC was characterized and its compatibility with TNAZ was investigated. The structures of DNNC were verified, its density was determined and its morphology was studied. Thermal analysis was conducted to determine its melt point, heat of fusion, and exothermic onset. Sensitivity of DNNC to impact, pinching, and extrusion was also determined. Calculations were conducted to estimate the performance parameters of DNNC including detonation velocity, detonation pressure, and Gurney energy using Kamlet Finger, Hardesty and Kennedy, Doherty, Short and Kamlet, and Gurney methods.

A Study of the Importance of Sled Tests
To Crew Escape Engineers

Kimberly D. Royalty
High School Apprentice
Aircrew Escape Group

Abstract

Crew escape engineers use the data they receive from sled test summaries to determine whether the ejection system for a particular aircraft is safe. To be considered safe, a person should be able to eject from an aircraft without cause or harm due to possible deficiencies in the design of the system. Sled track testing is conducted at speeds which are representative of the aircrafts flight envelope. During the test, the acceleration, velocity, and position of the escape system is recorded. Costs and injuries are kept at a minimum by using dummies and models for the test. These facts prove that sled track tests are very important in determining the safety of an escape system.

A SECOND YEAR STUDY ON THE IMPLEMENTATION OF THE RECIRCULATING OPTIC DELAY LINE CONCEPT IN A COHERENT RADAR SYSTEM

Dennis W. Scott, Jr.
High School Apprentice
Seeker Technology Branch

Abstract

The concept of the recirculating optic delay line (RODL) used in a coherent radar assembly as a frequency reference unit was the focus of this study. To implement the recirculating optic delay line, a simple coherent radar array was designed and assembled. The entire assembly and its subassemblies were then calibrated in order to define its variables and establish an understanding of the new radar's capabilities before any real world experimentation was conducted. The coherent radar assembly was then tested with real targets so that an idea of the recirculating optic delay line's potential use as a frequency reference unit could be evaluated. The radar performed exceptionally well when not overburdened by clutter, and images could be clearly distinguished in the return. The radar system was linked to both a digitizing oscilloscope and a personal computer so that the images could be seen in real time and stored for further analysis. The results of this study demonstrate that the recirculating optic delay line concept may be feasibly used as frequency memory unit in a coherent radar.

DISCOVERING AND EXPLORING SUPERCRITICAL FLUID CHROMATOGRAPHY

Tiffany M. Selmon
Nonmetallic Materials Division
Wright Patterson Air Force Base
Patterson Career Center

Abstract

Discovering what supercritical fluid chromatography is and how it works was part of the studies. Supercritical fluid chromatography (SFC) may be defined as a form of chromatography (i.e., a physical separation method based on the interaction of an analyte in a mobile phase with a stationary phase) in which the mobile phase is subjected to pressures and temperatures near or above the critical point for the purpose of enhancing the mobile phase solvating power. In general, three conditions must be met to truly define SFC: (a) the mobile phase must always be at temperatures and pressures near or above their critical point, (b) the mobile phase must possess solvating power and, thus, be able to contribute to selectivity in the chromatographic process, and (c) the mobile phase must be subject to these conditions throughout the full length of the analytical column.

FROM THERMOCOUPLES TO MULTI-MILLION DOLLAR CHUNKS OF TITANIUM MATRIX COMPOSITE

Jonathan D. Servaites
High School Apprentice
Centerville High School

Abstract

During the time I spent at the Flight Dynamics Directorate/ Structures Test Branch (WL\FIBT) at Wright Patterson Air Force Base, I interacted with various engineers and technicians on several projects. The military fighters and cargo aircraft go through combined environments during their flight mission such as high heat (especially along the leading edges of the craft, ie. wings, nose, etc.), induced static loads, and induced fatigue loads. The Structures Test Branch provides support for static, fatigue, and elevated temperature testing of military aircraft. Throughout my eight week tour, I participated in various tests including: the "Lightly Loaded Splice Structure," "The Elevated Temperature Aluminum Program," heat tests on composites, and F-15 and fuel tank fatigue testing. A large portion of my time at Wright-Pat was spent on the preparation for the test on the "Lightly Loaded Splice Structure," which is a part of the NASP (National Aero Space Plane) program. The structure is composed of one of technology's newest materials, titanium matrix composite or TMC. Furthermore, my involvement in this program allowed me to realize the countless procedures involved in carrying out such a test.

USING COMPUTERS FOR IP-3 INTERMODULATION ANALYSIS

Michael A. Shaffer

Abstract

A Hewlett-Packard 300 series computer was used to automate testing of microwave devices (DUT) for third order intercept point intermodulation products. A test box using two programmable attenuators , a sweep oscillator , a power meter , and a spectrum analyzer were all controlled by the computer during testing. Using a HP-IB interface bus that uses IEEE-488-1978 standard language , the computer was able to do everything from capturing and reproducing the image on the spectrum analyzer to setting the power level on the sweep oscillator. An Avantek 4 to 8 gigahertz amplifier was used as a control test. The computer was able to power in , power out , IP-3 measurement , and gain. It was also possible to import data from the Hewlett-Packard to Microsoft Cricket Graph for easier analysis using ASCII format.

A MASS SPECTROSCOPIC STUDY OF DIAMOND GROWTH FOR LOW-PRESURE CHEMICAL VAPOR DEPOSITION

David J. Spry
Summer Apprentice
Department of the Air Force
Wright Patterson Air Force Base

Abstract

This report discusses the occurrences in a series of diamond chemical vapor deposition(CVD) experiments including some experiments with CD_4 or D_2 in replacement of CH_4 or H_2. The data collected for this report was made by a quadrupole mass spectrometer. In order to try to keep methane from reacting with hydrogen or deuterium, a quartz tube was used for direct flow to the substrate. The results of these experiments show that the large the proportion of hydrogen to methane, the less breaking up of methane by the plasma.

SENSOR COMPUTATION ANALYSIS

Christina M. Trossbach
High School Apprentice
Guided Interceptor Technology Branch
WL/MNSI

Abstract

The project studied was to determine the computation capability needed to process sensor data at various frame rates. A set of specified algorithms were used to determine the number of operations in each function. A spreadsheet was created to find the operations per second, or computation capability. The experiment consisted of charts comparing millions of operations per second at different frame sizes with the frame rate being the experimental variable.

GaAs OHMIC CONTACTS AT HIGH CURRENTS

Darcie Tutin
High School Apprentice
Fuzes Branch
Wright Laboratory Armament Directorate

ABSTRACT

There is a need for ohmic contacts in GaAs photoconductive switches for detonators. These switches employ semi-insulating bulk GaAs in order to hold off high voltage until breakdown is desired. This type of device can be designed to require only small amounts of light triggering energy, thus resulting in a very efficient switch. Ohmic contact data was gathered for the conventional Au:Ge/Ni alloyed contact and a relatively new type of Pd/Ge diffused contact, both pertaining to Si doped GaAs. Unreliability associated with use of Au:Ge/Ni contacts at high currents was found which may limit their application in photoconductive switches. It was determined that Pd/Ge contacts were much more predictable and worthy of operation at high current density (approximately 1 MA/cm^2).

EVALUATION OF ENGINEERING AND SCIENTIFIC SOFTWARE TOOLS FOR USE IN ELECTRONIC WARFARE AND DIGITAL SIGNAL PROCESSING APPLICATIONS

David L. Watson

Senior

Kettering Fairmont High School

Abstract

Engineering and Scientific software tools were evaluated for their ease of use and utility in electronic warfare and digital signal processing applications. Mathcad, Mathematica, DADiSP, Harvard Graphics and HP Basic were reviewed. Short reviews of Excel and Word Perfect are also presented. Two side projects are discussed: the first involves configuring computers to print to a common printer and the second involves installing a Sun Sparc IPX for use in communication simulations.

THE TEMPERATURE DEPENDENCE OF INTRINSIC DEFECT LEVELS IN GaAs SEMICONDUCTORS

Jeffrey A. Yerian
West Carrollton Senior High School

ABSTRACT

The temperature dependence of intrinsic defect levels in GaAs semiconductors was studied. In order to investigate the temperature dependence, spectral photoconductivity data of various GaAs semiconductors was taken. Experimental data indicates that the spectral photoresponses of many GaAs semiconductors behave differently and independently of one another. However, two distinct defect levels exist in a majority of the samples. These defect levels occur at 6800 (E_i=0.80 eV) and 3680 (E_i=0.43 eV) wavenumbers, respectively. These two defect levels have been studied in the past, and much research has been documented. Our focus was on the temperature dependence of these defect levels from 9 K to 300 K. The temperature dependence data shows a noticeable decline of peak amplitudes occurring between the temperature range of 130 K to 170 K. From our research, we conclude that at these temperatures another defect level within the structure of the semiconductor is activated which traps free electrons and thus decreases the photoresponse of the entire spectrum. The activation energy of this trap was then calculated from this data.

SOFTWARE DEVELOPMENT FOR THE AEROSOL TEST CHAMBER

James E. Youngblood
High School Apprentice
Fuzes Branch
Wright Laboratory Armament Directorate

Abstract

My summer project was to help in the creation of an aerosol chamber that would be used to test optical fuze sensors. I was involved in some of the hardware construction as well as writing the software that will control all of the components. This software was developed using C along with a PC I/O board and LabWindows. The program implements a graphical user interface and, therefore, should be easy to operate. The chamber is still having the final wiring done (at the time of the writing of this paper), but the software controller is finished (although probably not bug free).

ARNOLD ENGINEERING DEVELOPMENT CENTER

GRAPHICS LIBRARY ROUTINES FOR ETF ANALYSIS SOFTWARE

Ryan Bond

Abstract

Graphics software was tested to determine the feasibility of composing a library of graphics subroutines able to interpret calls for the PLOT-10 graphics library and to make the PHIGS calls necessary to perform the same functions. The routines were written and debugged to run in PHIGS on a PHIGS workstation window similar to the way the original calls ran in PLOT-10 on a Tektronix terminal emulator. Using the routines, the test program created a plot in PHIGS almost identical to the PLOT-10 plot, and all features of the test program worked properly.

SET-UP CRITERIA FOR BLACKBODY CALIBRATION
BY ECPR DETECTOR

Steven Cortner
Shelbyville Central High School
Shelbyville, Tennessee

Abstract

In preparing for a blackbody calibration, the electrically calibrated pyroelectric radiometer (ECPR) detector must be set up so that it will detect radiation directly from the blackbody and not from the walls of the blackbody throat. This is a time-consuming task when done by hand due to many tedious calculations. With this in mind, a computer program was written to reduce the workload and the time it consumed. The program uses geometry - specifically similar triangles - to determine a minimum distance the ECPR detector should be from the aperture so that it can detect the radiation from the blackbody. It also uses the Stefan-Boltzmann law to compute the maximum and minimum distances of the power operating range.

VISUALIZATION OF QUANTUM CHEMICAL CALCULATIONS FOR MOLECULES

Genetta Gibson
Graduate of Tullahoma High School
Tennessee Technological University

Abstract

Much of the chemistry that occurs in rocket plumes is a mystery to scientists. Therefore, quantum chemistry, a relatively new field of research, is being used to analyze this chemistry. One of the first steps is visually analyzing single molecules and determining their behavior from the visualization. The behavior of the molecules depends greatly on the electrons that travel around the atomic nuclei in paths called orbitals. Since the paths of these orbitals are not definite, it is difficult to predict the behavior and location of these electrons and, therefore, the structure of the molecule. Since water and diatomic hydrogen are two significant products that are commonly found in rocket exhausts, a computer program was created to visually analyze the electron distribution of these two molecules. The source code to calculate the probability density of the electrons was written in the FORTRAN 77 programming language. Another code which was written in IDL (Interactive Data Language) transfers the probability data into the IDL graphics program. IDL graphics routines are then used to draw a 3D transformation of the electron probability density cloud. Both the FORTRAN and IDL codes are portable to workstations across the network and may be easily modified for the analysis of different molecules.

DEVELOPMENT OF A VERSATILE SPREADSHEET FOR ESTIMATING ELECTRICAL POWER AND OPERATING HOURS FOR AEDC'S TUNNEL 16T

Laura Lynn Hill
Summer Research Apprentice
Propulsion Effects Section
University of Tennessee

Abstract

The cost of the electrical power required to operate the 16-foot Propulsion Wind Tunnel at the Arnold Engineering Development Center (AEDC) is usually a major portion of the resource estimate provided by the project engineer for a particular test. The standard AEDC computer program used to calculate the power estimate does not allow for easy recalculations based on test matrix changes which often occur. To provide more flexibility for the users, the algorithm of the standard program, written in Basic (computer language), was duplicated in a spreadsheet format. The Excel spreadsheet version allows the user to make changes quickly and easily because of the many features available in this format. Formulas written into the spreadsheet cells can be easily modified as required by the user - a feature not available in the Basic program. Transposing different functions from Basic to Excel was the most difficult task of developing the new power estimate program. Because of the many features of the Excel spreadsheet, the power estimate program is now more user-friendly, easily modified to the needs of the user, and can quickly recalculate the power estimate based on last minute changes to the test schedule.

THE POWER COORDINATION STUDY

Heather Hopwood
SSI Electrical Engineering
Arnold Air Force Base

Abstract

The Power Coordination Study updates information on the protective function that a relay performs. Specifically the study provides information concerning the effectiveness of the protective devices. If a fault is found in the protection, modifications are recommended. Electrical Distribution System Analysis program (EDSA) will display any problems with the relays through time curves.

A STUDY OF dBASE III+ COMPUTER LANGUAGE AND THE DEVELOPMENT OF AN INVENTORY CONTROL PROGRAM

Richard Ian Lee
Freshman
Tennessee Technological University

Abstract

The dBASE III+ computer language was studied and an inventory control program was developed using dBASE III+. In order to learn dBASE III+, the manuals were studied and a practice program was developed. The practice program, an address and telephone management program was successfully written and is being used by Sverdrup personnel. Upon the completion of the address management program, a generic inventory control program was successfully completed and is being used by personnel involved in the CADDMAS program at Arnold Engineering Development Center (AEDC). Compilation of the final inventory program to provide a stand-alone capability was attempted, but a good compilation was not achieved. Due to lack of time, no further attempts to compile the program were made.

INSTRUMENTATION AND CONTROLS INVENTORY PROGRAM

David Lineberry
Freshman
University of Notre Dame

Abstract

A PC based inventory program for the Instrumentation and Controls Department (I&C) at Arnold Engineering Development Center (AEDC) was written. This program improved the current system of inventory control. The program was written in FOXBASE, a database programing language. The program was designed to manipulate three related database. The program also was designed to keep track of removal dates and keep track of both used and unused storage space. The final program consisted of about seventy total files.

SGAP MODEL BUILDING

CHRIS MARLOW
FRANKLIN COUNTY HIGH SCHOOL
AEDC

ABSTRACT

Wire-frame or panel computer models were built for the F-14 aircraft. SGAP model building involves many steps. Locating dimensions for the part is the first necessary step to build a SGAP geometry model. Critical points must be located and then the coordinates for the points must be assigned. When the information is placed in a data file, an executable program is run to convert the coordinates into facets. With the facets a picture can be drawn and then a verification of the dimensions and the model accuracy can be made. Once SGAP models have been made for all the individual pieces, they can be put together in the correct configuration in accordance to the wind tunnel tests. The SGAP model can finally be used to show trajectories of missiles to provide the user with visual aid of the performance of the missile.

CALIBRATION AND APPLICATION OF A SPECTRAPRO™-275 SPECTROMETER

Ryan M. Mason
Summer Student
Department of Physics
The University of the South

Abstract

A SpectraPro™ -275 spectrometer was calibrated and then used to gather data from the flowfield of the H2 test cell. The SpectraPro™ -275 was calibrated by using a mercury lamp and three Pfleuger tubes filled with argon, neon, and helium. Twenty three spectra were taken at the H2 test cell. The radiating atoms and molecules were identified by analyzing the wavelengths of their radiation. In an ideal test situation, no spectral lines at all would occur. The copper and copper oxide lines which were identified were most likely caused by copper atoms and oxidized copper atoms which came from the facility's arc heating system. Because the background light represented by these spectra was low, future non-intrusive flow diagnostic techniques appear feasible to apply in H2.

A STUDY OF THE CONTINUOUS MONITORING STATION AT ARNOLD ENGINEERING DEVELOPMENT CENTER

Sara Kathryn Waterman

United States Air Force Apprentice

Arnold Engineering Development Center

Arnold Air Force Base, Tennessee

ABSTRACT

The extensive testing which is performed at Arnold Engineering Development Center {AEDC}, Arnold Air Force Base, Tennessee, requires careful monitoring of environmental conditions. The newest piece of equipment the chemistry lab and AEDC has acquired is an automated water monitoring system. The system, known as the continuous monitoring station, examines the water flowing through Rowland Ditch, one of the outlets for the cooling water used for testing purposes, for organic pollutants at the part per billion {ppb} level. The SiCHROMAT 1-4 is a new instrument at AEDC. Thus, a complete standardization of the instrument must be performed in order to accurately record and analyze the data received. There are also many questions concerning its sensitivity, consistency, required maintenance, and needs in calibration. For approximately one month, constant time has been assigned to a complete calibration and experimentation process for the monitoring station. During this time, much data had been acquired; however, there are still many more questions to be answered.

CIVIL ENGINEERING LABORATORY

A STUDY OF LITTORINA IRRORATA AND ITS ENVIRONMENT

Philip C. Dorsch
Student Lab Assistant
Bay High School

Abstract

Research was done on Littorina irrorata to see how they would react to a change in their enviroment. Sites were selected in the upper intertidal zone of Crooked Island Sound, Tyndall AFB and certain areas were marked off as control or test areas. First, the snails were observed in thier natural surroundings and observations were made. Then the grass in the test areas was replaced with wooden dowels and the results recorded. The final results from both the natural and artificial environments were compared and little change was found.

Comparison of the HNU 311 portable and Hewlett Packard 5890 Series II Gas Chromatagraphs

by Corey D. Fogleman

Abstract

Working at the Air Force Civil Engineering and Services Agency laboratories, I gained valuable experience in a number of fields. I learned about plate counting while working with a biologist, about oxygen demand while working with some of the chemists in my laboratory, and about solar detoxification as a means of breaking down BTEX compounds. Besides this work, I vigorously pursued a full time summer research project. The purpose of my project was to compare the accuracy of the relatively new HNU 311 portable gas chromatagraph to that of the EPA approved Hewlett Packard 5890 Series II GC. I did this by first calibrating the portable and then running approximately 50 samples per week in simultaneous succession through both machines. I concluded that although some continuous research may yeild a proper method which would bring the HNU up to standards set by the HP, currently the HNU is not a comparible gas chromatagraph.

MICROBIOLOGY STUDIES
and
CUP BURNER EXPERIMENT

Angela D. Foth
High School Apprenticeship Program
A. Crawford Mosley High School

Abstract

Microbiology studies and the cup burner experiment were performed in the Air Force Civil Engineering Support Agency (AFCESA) Fire Research Lab. The purpose of the microbiology studies was to determine if the holding pond from which the samples were taken was biologically active. The purpose of the cup burner experiment was to determine percent concentration of agent and air it takes to extinguish a flame.

To grow micro-organisms, this procedure was followed: a sample from the fire training facility holding pond was obtained then diluted through serial dilution which is the method of repeatedly diluting a sample through a series of dilution blanks. After diluting the sample, 0.1mL was put on three seperate petri dishes for each dilution then the dishes were incubated for 48-hours. Results were then counted. The cup burner experiment involved burning JP-4, measuring the flow rate of air and agent, and calculating the percent concentration that extinguished the flame.

AN OBSERVATION OF PLUVIATION IN PREPARATION FOR DYNAMIC EXPERIMENTATION

[illegible] J. Giles

ABSTRACT

The altering of falling sand columns into a uniform [illegible] mist was observed. To pluviate, particles of sand were released in a controlled fall or "raining" through the air into a sample bucket. The desired outcome of pluviation was the preparation of dense samples such that they were sufficiently level and there was no need to rearrange the surface soil particles. The individual sand particles were spread out by a [illegible] screen system that transformed the falling sand jets into a homogeneous [illegible] of sand.

Pluviation prepared the soil samples for experimentation. The observed research involved the effect of soil moisture on stress wave transmission and soil structure interaction.

PHOTO DISSOCIATION OF NO_2 IN VARIOUS MEDIA AT PPM LEVELS

RICHARD C. HARTZER

ABSTRACT

The dissociation rate constants and the ultraviolet radiation intensities in a small simulation chamber were determined for nitrogen dioxide (NO_2) dissociation in synthetic air, nitrogen, helium, and argon air media. The ultraviolet radiation intensities in the simulation chamber were determined by using the decay data for NO_2. The dissociation rate constant, K_1, for NO_2 was $4.86 \pm x\ 10^{-3}$ sec. in nitrogen. The calculated ultraviolet intensities were: $6.39 \pm .027 \times 10^{6}$ quanta $cm^{-2}\ sec^{-1}$ in synthetic air, $5.73 \pm 1.9 \times 10^{15}$ quanta $cm^{-2}\ sec^{-1}$ in nitrogen, $2.62 \pm .581 \times 2.62 \pm .581 \times 10^{15}$ quanta $cm^{-2}\ sec^{-1}$ for helium, and $3.513 \pm .764 \times 10^{15}$ quanta $cm^{-2}\ sec^{-1}$ in argon. It was observed that the decay of NO_2 in synthetic air was non-linear, while the decay of NO_2 in argon, helium and nitrogen were fairly linear at NO_2 concentrations lower than one ppm. At higher concentrations of NO_2 the decay was observed to be non-linear. At lower concentrations of NO_2 in synthetic air, the concentration of NO_2 was observed to increase with each increase in irradiation time; this behavior was attributed to the rapid combination of NO with excess oxygen to form NO_2 as below.

$$NO_2 \underset{K_{-1}}{\overset{K_1}{\rightleftharpoons}} NO + O\,(^3p)$$

SOLAR DETOXIFICATION OF CONTAMINATED GROUNDWATER

Eric W. Haseltine

Abstract

The one sun method of solar detoxification uses a photocatalytic process to destroy organic compounds in water. The catalyst used is Titanium Dioxide (TiO_2). It is an extremely fine, white powder. The TiO_2 is suspended in contaminated water in a colloidal suspension. Hydrogen Peroxide is added and the pH is adjusted to slightly acidic (4-6). This mixture is pumped through transparent tubes at a rate of 0.5 L/min. The ultraviolet radiation in sunlight provokes the catalyst into destroying the organics.

DESCRIPTION OF WEATHER STATION AND ITS DATALOGGING PROGRAM

Robert L. Kuhn
Student
Rutherford High School

Abstract

The laboratory at which I was working needed a weather station to monitor not only the weather in the immediate area, but temperature inside several bins of sand. A weather station was ordered, and it contained the following items: a tripod, a wind direction and speed indicator, a barometric pressure sensor, a rain gauge, a temperature and relative humidity sensor, a battery, a solar panel, a datataker and its datalogging program, and a weather proof cabinet. The weather station was assembled on and around a shelter in which the bins were stored. The wind speed, and direction sensors did not work properly, but we assembled them for future use. The datalogging program was used once a link with the datataker had been established. The program was used to convert and store the data from the datataker.

COMPUTER PROGRAMS AND PROJECT OPERATIONS

Jefferey R. Strickland
Summer Student
Mosley High School

Abstract

In a research environment the need for an efficient office computer and machine operator is unprecedented. During the course of the eight week summer program a variety of graphics programs and a program written in basic for the Long Range Agent Delivery System (LRADS)--a system specializing in the fire extinguishment for potential explosive fires at a safe long range distance--were covered. This LRADS computer basic was analyzed preparing it for any possible improvements.

Project operations was learned through the establishment of project files, background research, and producing slides for briefings.

ROBOTIC EXCAVATION:
LUNAR AND EARTH BASED

Michael S. Strickland
A. Crawford Mosley High School

Abstract

The use of automated construction equipment in hazardous environments, such as, the repair of bombed runway, and working in the harsh lunar environments has been the focus of this study. The equipment used has been a John Deere 690c Excavator, which was modified for remote and automated use. In this time, the vehicle has gone from tethered and remotely controlled, to radio linked and partially automated. The research done on this vehicle is to be applied to Rapid Runway Repair (RRR) excavator which is soon to be delivered. In the long run, the research will also be applied to the making of lunar construction equipment to be used in the construction of a lunar base.

HSAP SUMMER APPRENTICESHIP PROGRAM

Chip Summey
High School Student

HSAP Summary

Tyndall Air Force Base in Panama City, Florida served as the location for this year's summer program. Mr. Ed Alexander served as mentor for the eight week period and proved to be an excellent supervisor and teacher. Mr. Alexander went out of his way more than a few times to make sure that the student could take advantage of all the opportunities offered as possible. The very first day of the apprenticeship program, Mr. Alexander did not assign the student to an area to work, but rather looked into several different work sites and environments and allowed the student to decide not where he would like to work but rather where he thought he would learn the most. Mr. Alexander is a shining example of what this program could be at its highest potential if the mentor is concerned for his summer help.