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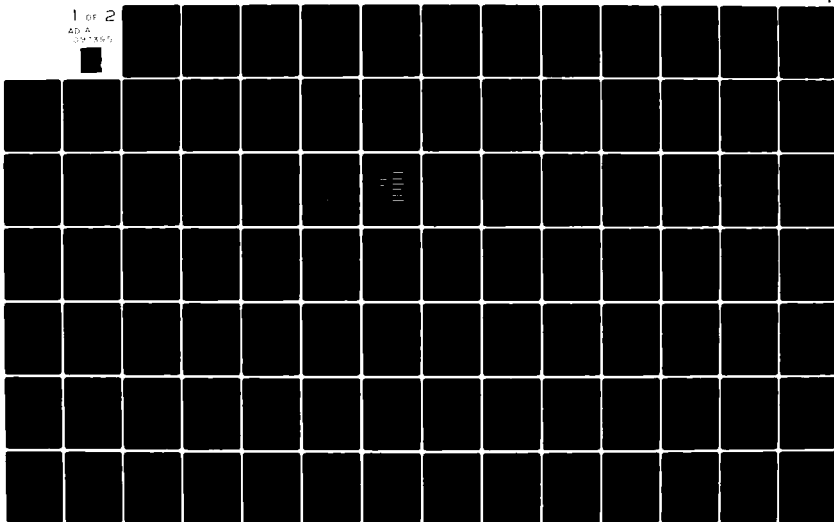
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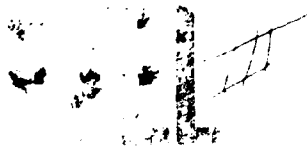
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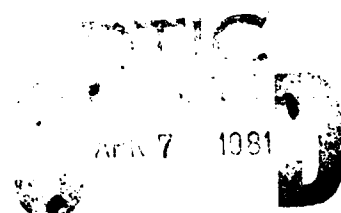
UNITED STATES AIR FORCE  
SUMMER FACULTY RESEARCH PROGRAM

1980

PROGRAM MANAGEMENT

SOUTHEASTERN CENTER FOR  
ELECTRICAL ENGINEERING EDUCATION

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <b>The United States Air Force Summer Faculty Research Program (USAF SFRP) is a program designed to introduce university, college, and technical institute faculty members to Air Force research. This is accomplished by the faculty members being selected on a nationally advertised competitive basis for a ten-week assignment during the summer intercession to perform research at Air Force Laboratories/centers. Each assignment is in a subject area and at an</b>			

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→ Air Force facility mutually agreed upon by the faculty member and the Air Force. In addition to compensation and travel expenses, a coat of living allowance is also paid. The USAF-SFRP is sponsored by the Air Force Office of Scientific Research/Air Force Systems Command, United States Air Force, and is conducted by the Southeastern Center for Electrical Engineering Education, Inc.

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1980 USAF/SCEEE SUMMER FACULTY  
RESEARCH PROGRAM

Conducted by  
Southeastern Center for  
Electrical Engineering Education  
under  
USAF Contract Number F49620-79-C-0038

MANAGEMENT REPORT

Submitted to  
Air Force Office of Scientific Research  
Bolling Air Force Base  
Washington, D.C.  
by

Southeastern Center for  
Electrical Engineering Education

October 1980

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UNITED STATES AIR FORCE  
SUMMER FACULTY RESEARCH PROGRAM

1980

PROGRAM MANAGEMENT  
SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCATION

## I. Introduction and History

The United States Air Force Summer Faculty Research Program (USAF-SFRP) Contract was awarded to the Southeastern Center for Electrical Engineering Education on December 7, 1978. The contract is sponsored by the Air Force Office of Scientific Research, Air Force Systems Command, United States Air Force and is conducted by SCEEE.

The program provides opportunities for research in the physical sciences, engineering, life sciences, business, and administrative sciences. The program has been effective in providing basic research opportunities to the faculty of universities, colleges, and technical institutions throughout the United States.

The program is available to faculty members in all academic grades: instructor, assistant professor, associate professor, professor, department chairman, and research facility directors. It has proven especially beneficial to young faculty members who are starting their academic research programs and to senior faculty members who have spent time in university administration and are desirous of returning to scholarly research programs.

Follow-on research opportunities have been developed for a large percentage of the participants in the Summer Faculty Research Program in 1979 and 1980.

## II. Recruiting and Selection

The program is conducted on a nationally advertised and competitive selection basis. Advertising was placed in Science Magazine, The American Scientist, and OR/MS Today. Information on the SFRP was mailed to over 500 department chairmen; brochures were made available to all participating USAF Laboratories/Centers; distribution was made through AFROTC units on university campuses; information was supplied to all who made requests. Overall, over 3000 brochures were distributed throughout the country.

In the 1979 program, 70 faculty members participated. In the 1980 program, 87 faculty members participated. There were approximately 5 applicants for each available position in the 1980 program.

Applications were due at SCEEE on or before February 1, 1980. The selection panel convened in February and announcements of selection were made before March 1, 1980.

### III. The Historically Black College Workshop

SCEEE and AFOSR place special emphasis on the participation of Historically Black Colleges. As a part of the USAF-SFRP, SCEEE conducted an Opportunities in Research Workshop for representatives from 77 Historically Black Colleges. To further emphasize its commitment to Historically Black Colleges, SCEEE negotiated a subcontract with the Atlanta University Center to host the workshop. The purpose of the workshop was to familiarize the attendees with the research and development requirements, facilities, and activities of the Air Force and specifically with opportunities available within the USAF R&D community. There were 127 participants at the workshop.

SCEEE has received substantial encouragement from the Historically Black Colleges since the December 1979 workshop. Ten Historically Black College faculty members were offered appointments by SCEEE in the 1980 AFOSR Summer Faculty Research Program. This indication is that initiatives such as the Opportunities in Research Workshop will provide a much needed bridge between federal laboratories and the Historically Black Colleges. SCEEE has been encouraged by the Historically Black Colleges to offer a workshop devoted to Opportunities in Research on a bi-annual basis.

### IV. 1980 Summer Faculty Research Program Management

After each Research Associate had signed and returned his Appointment Letter to the Southeastern Center, he was directed to contact the designated representative at the laboratory/center of assignment to schedule the pre-summer visit. The purpose of the pre-summer visit was basically threefold: 1) to meet laboratory personnel, especially the Effort Focal Point with which the Research Associate would be most closely working and become personally acquainted with the laboratory facilities; 2) to finalize and formalize objectives for the Research Associate's summer research period and report these to SCEEE; and 3) to make arrangements for lodging for the research period. The focus of this visit was on making sufficient preparation so that the summer research effort would be effective. Preceding the summer research period, all Research Associates were provided with detailed written instructions and procedures for obtaining payment for research efforts, travel reimbursement, and lodging cost reimbursement.

Data collected via critique is available in this report.

PARTICIPANT'S QUESTIONNAIRE & SUMMARY

USAF/SCEEE SUMMER FACULTY RESEARCH PROGRAM  
EVALUATION QUESTIONNAIRE  
(TO BE COMPLETED BY PARTICIPANT)

Name \_\_\_\_\_ Title \_\_\_\_\_  
Dept. (at home) \_\_\_\_\_ Home Institution \_\_\_\_\_  
Research Colleague(s) \_\_\_\_\_  
Laboratory Address of Colleague(s) \_\_\_\_\_  
Brief Title of Research Topic \_\_\_\_\_

A. TECHNICAL ASPECTS

1. Was the offer of research assignment within your field of competency and/or interest?  
YES \_\_\_\_\_ NO \_\_\_\_\_
2. Did you have a reasonable choice of research assignment? YES \_\_\_\_\_ NO \_\_\_\_\_ If no, why? \_\_\_\_\_
3. Was the work challenging? YES \_\_\_\_\_ NO \_\_\_\_\_ If no, what would have made it so? \_\_\_\_\_
4. Were your relations with your research colleague(s) satisfactory from a technical point of view? YES \_\_\_\_\_ NO \_\_\_\_\_ If no, why? \_\_\_\_\_
5. Suggestions for improvement of relationship(s). \_\_\_\_\_
6. Considering the circumstances of a summer program, were you afforded adequate facilities and support? YES \_\_\_\_\_ NO \_\_\_\_\_ If no, what did you need and why was it not provided? \_\_\_\_\_
7. Considering the calendar "window" of ten weeks (limited by varying college and university schedules), please comment on the program length. Did you accomplish more than \_\_\_\_\_, less than \_\_\_\_\_, about what you expected \_\_\_\_\_ in actual meaningful research? Other comments: \_\_\_\_\_
8. Do you feel that your work was an integral part of the mission and/or responsibility of the laboratory/division in which you were assigned? YES \_\_\_\_\_ NO \_\_\_\_\_ Do you feel that your work has or will contribute to this mission/responsibility? YES \_\_\_\_\_ NO \_\_\_\_\_ Comments: \_\_\_\_\_
9. Do you think that you have been stimulated to continue this or related research efforts upon returning to your home institution (i.e., application for mini-grant and/or other funding)? YES \_\_\_\_\_ NO \_\_\_\_\_ Give brief explanation of your plans. \_\_\_\_\_
10. Were you asked to present seminars on your work and/or your basic expertise? YES \_\_\_\_\_ NO \_\_\_\_\_ Please list number, dates, approximate attendance, length of seminars, title of presentations (use reverse side if necessary).

PARTICIPANT QUESTIONNAIRE

Page Two

11. Were you asked to participate as a regular attendee in routine staff/group meetings in your laboratory? YES\_\_\_ NO\_\_\_ If yes, approximately how often did these occur and what was the nature of your participation? \_\_\_\_\_

12. Did you perform travel on behalf of the laboratory? YES\_\_\_ NO\_\_\_ Where to? \_\_\_\_\_  
Purpose? \_\_\_\_\_

13. Give a list of other "special" meetings you may have attended or participated in, such as conferences, visiting lectures, etc. \_\_\_\_\_

14. Other comments concerning any "extra" activities. \_\_\_\_\_

15. On a scale of A to D, how would you rate this program? (A high, D low)

Meaningful and stimulating experience	A	B	C	D
Technically challenging	A	B	C	D
Future research opportunity	A	B	C	D
Professional association	A	B	C	D
Enhancement of my academic qualifications	A	B	C	D
Enhancement of my research qualifications	A	B	C	D

B. ADMINISTRATIVE ASPECTS

1. How did you first hear of this program? \_\_\_\_\_

2. What aspect of the program was the most decisive in causing you to apply? \_\_\_\_\_

3. Considering the time of year that you were required to accept or reject the summer fellowship offer, did this cause you any problems of commitment? YES\_\_\_ NO\_\_\_ If yes, please explain. \_\_\_\_\_

4. After your acceptance, was information (housing, location, directions, etc.) supplied to you prior to the summer period satisfactory? YES\_\_\_ NO\_\_\_ How could it be improved? \_\_\_\_\_

5. Did you have any difficulty in any domestic aspects (i.e., locating suitable housing, acceptance in community, social life, any other "off-duty" aspects)? YES\_\_\_ NO\_\_\_ If yes, please explain. \_\_\_\_\_

6. How do you evaluate the stipend level? Meager\_\_\_ Adequate\_\_\_ Generous\_\_\_

PARTICIPANT QUESTIONNAIRE  
Page Three

7. How do you rate the importance of the expense-paid pre-program visit to the work site?  
Not worth expense\_\_\_ Convenient\_\_\_ Essential\_\_\_ Please add any other comments you  
may have. \_\_\_\_\_

8. Please give information on housing: Did you reside in VOQ\_\_\_, apartment\_\_\_? Name  
and address of apartment complex and manager's name \_\_\_\_\_

9. Please suggest names (and give source) of organization, mailing lists, or other infor-  
mation you think would be helpful in advertising next year's program. \_\_\_\_\_

10. Considering the many-faceted aspects of administration of a program of this magnitude,  
how do you rate the overall conduct of this program? Poor\_\_\_ Fair\_\_\_ Excellent\_\_\_  
Please add any additional comments. \_\_\_\_\_

11. Please comment on what, in your opinion, are:

a. Strong points of the program \_\_\_\_\_

b. Weak points of the program \_\_\_\_\_

12. Other remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THANK YOU

QUESTIONNAIRE EVALUATION SUMMARY  
(86 of 87 PARTICIPANTS REPORTED)

A. TECHNICAL ASPECTS

1. Assignment in field of competency and/or interest? Yes - 85 No - 1
2. Reasonable choice of assignment? Yes - 78 No - 7 N/A - 1  
a. If no, why? Air Force personnel selected topic before arrival of Associate.
3. Work challenging? Yes - 86 No - 0
4. Relations with colleague satisfactory? Yes - 83 No - 3  
a. If no, why? Research colleague too busy; needed more technical input.
5. Suggestions for improvement? Comments were either positive or none. There were comments as follows: rights of publication should be clarified, travel funds needed during research period, regularly scheduled meetings with laboratory personnel, pay be increased, the pre-summer visit be coordinated more closely with the Research Colleague, needed more information on housing, BOQ inadequate.
6. Afforded adequate facilities? Yes - 81 No - 5
7. Accomplishment in ten weeks? More than expected - 24 Less than expected - 17 About what expected - 45  
a. Comments? Five Research Associates indicated that 10 weeks is inadequate; three indicated 10 weeks is too much and preferred 8 weeks.
8. Work integral part of lab/division mission? Yes - 83 No - 3  
Work contributed to lab/division mission? Yes - 81 No - 1 NA - 4
9. Stimulated to continue? Yes - 83 No - 3
10. Asked to present seminars? Yes - 44 No - 42
11. Participate as regular attendee in lab meetings? Yes - 43 No - 43
12. Traveled on behalf of laboratory? Yes - 12 No - 74
13. Special meetings? Twenty-nine Research Associates attended conferences, seminars, or presentations.
14. Other comments on extra activities? Comments offered were in regard to conferences, seminars, presentations, and other professional meetings.
15. Meaningful and stimulating? A - 69 B - 16 C - 0 D - 0 NA - 1  
Technically challenging? A - 58 B - 22 C - 5 D - 0 NA - 1  
Future research opportunities? A - 67 B - 15 C - 2 D - 0 NA - 2  
Professional association? A - 57 B - 23 C - 5 D - 0 NA - 1  
Enhancement of academic qualifications? A - 35 B - 38 C - 11 D - 1 NA - 1  
Enhancement of research qualifications? A - 56 B - 26 C - 2 D - 1 NA - 1

PARTICIPANTS SUMMARY  
PAGE TWO

B. ADMINISTRATIVE ASPECTS

1. First hear about program? Through brochure or flier at university - 32  
From friend or associate - 28 Through regular publication advertising - 13  
Through Opportunities in Research Workshop for Historically Black Colleges - 7  
Through ASEE - 5 Through direct mail - 5
2. Aspect most influential in causing application? Desirable opportunity for research - 37 Opportunity to participate in a particular project or with particular people - 26 Opportunities for continuing research and relationships - 21 Location - 8 Opportunity to participate in applied research - 5  
Summer employment - 4 Housing allowance - 2
3. Commitment to program a problem? Yes - 15 No - 71  
a. If yes, explain? Late appointment, other research or teaching opportunities, summer commitments.
4. Program information satisfactory? Yes - 72 No - 13 N/A - 1
5. Problems in domestic aspects? Yes - 20 No - 63 N/A - 3  
a. If yes, explain? Troubles locating short-term housing, VOQ overcrowded, high cost of rent in areas, no local information provided, trouble with family housing, not much social life.
6. Stipend level? Meager - 18 Adequate - 62 Generous - 6
7. Preprogram visit? Not worth expense - 3 Convenient - 22 Essential - 57  
N/A - 4
8. Housing information? VOQ - 35 Apartment - 31 Neither (motel, rented house, home, private home) - 17 N/A - 3
9. Mailing list suggestions? Mailing list suggestions have been tabulated for future use.
10. Program administration overall rating? Poor - 0 Fair - 33 Excellent - 52  
N/A - 1  
a. Comments? Invoice processing slow - 8 Too much paper work - 2 Ran smoothly, rapid payment, pre-summer visit not well organized at laboratory, security clearance delayed, delay in getting orders for BOQ, program handled well, quick and courteous responses to inquiries, pay check lost - slow reissue, BOQ facilities outstanding, very pleased with program administration, very orderly program. The SCEEE representative at WPAFB (Mr. Danishek) was complimented several times.
11. A. Strong points of the program? Interaction with USAF researchers and introduction of USAF activities - 34 Good research opportunities - 19  
Opportunity for development/continuation of research support - 13 Excellent facilities and conditions - 7 High calibre USAF researchers - 5 No distractions - 4 Good remuneration - 3 Chance to get away from academia - 3  
Simple invoice/paperwork - 2 Program outstanding, excellent opportunity for professional growth, great program, program flexibility, early announcement of selection, contractor administrative structure, program concept, enriching experience, living in VOQ, opportunity to work in real world.

PARTICIPANTS SUMMARY  
PAGE THREE

11. B. Weak points? Invoice processing too slow - 14 Short duration - 8  
Stipend too low - 6 Too much paper work - 4 Need money advanced - 3  
Inadequate travel allowance during pre-summer visit - 3 Housing allowance  
too low - 2 Paying via mail - 2 Housing difficulties, research period too  
long, inadequate on-site research support, inadequate time to decide, no  
responsibility on site, separation from family, lack of academic atmosphere,  
poor office space, lack of public transportation, laboratory program  
description sketchy.
12. Other comments: Elaboration on the remarks in Item 11 are pervasive. Many  
are problems which are peculiar to locations, individuals, or circumstances.

RESEARCH COLLEAGUE'S QUESTIONNAIRE & SUMMARY

USAF/SCEE SUMMER FACULTY RESEARCH PROGRAM  
EVALUATION QUESTIONNAIRE  
(TO BE COMPLETED BY PARTICIPANT'S RESEARCH COLLEAGUE)

Name \_\_\_\_\_ Title \_\_\_\_\_  
Division/Group \_\_\_\_\_ Laboratory \_\_\_\_\_  
Name of Participant \_\_\_\_\_

A. TECHNICAL ASPECTS

1. Did you have personal knowledge of the Associate's capabilities prior to arrival at work site? YES \_\_\_ NO \_\_\_ If yes, where/how/what? \_\_\_\_\_  
\_\_\_\_\_
2. Was the Faculty Associate prepared for his project? YES \_\_\_ NO \_\_\_
3. Please comment on his preparedness/competency/scope/depth of knowledge of subject area: \_\_\_\_\_  
\_\_\_\_\_
4. Please comment on the Associate's cooperativeness, diligence, interest, etc. \_\_\_\_\_  
\_\_\_\_\_
5. In your opinion, has his participation in this summer program contributed to an increase in the Associate's potential to perform research? YES \_\_\_ NO \_\_\_ Comments: \_\_\_\_\_  
\_\_\_\_\_
6. Did work performed by the Associate contribute to the overall mission/program of your laboratory? YES \_\_\_ NO \_\_\_ If yes, how? \_\_\_\_\_  
\_\_\_\_\_
7. Were your relations with the Associate satisfactory from a technical point of view? YES \_\_\_ NO \_\_\_ Suggestions as to how they might be improved: \_\_\_\_\_  
\_\_\_\_\_
8. Do you think that by having a Faculty Associate assigned to your group, others in the group benefited and/or were stimulated by his presence? YES \_\_\_ NO \_\_\_ Comments: \_\_\_\_\_  
\_\_\_\_\_
9. Do you feel that the introduction to each other, together with the summer work experience and performance could form a sound basis for continuation of effort by Associate at his home institute? YES \_\_\_ NO \_\_\_ If yes, how? \_\_\_\_\_  
If no, why not? \_\_\_\_\_  
\_\_\_\_\_
10. One of the objectives of this program is to identify sources of basic research capability and availability to the USAF. On a scale of A to D, how effective do you think this program will be in that respect? (A high)

A B C D

COLLEAGUE QUESTIONNAIRE  
Page Two

Also, please evaluate:

Opportunity to stimulate group activity	A	B	C	D
Professional association	A	B	C	D
Program administration	A	B	C	D

**B. ADMINISTRATIVE ASPECTS**

1. When did you first hear of this program? \_\_\_\_\_

2. Were you involved in the screening and prioritizing of the faculty persons' applications for your lab? YES\_\_\_ NO\_\_\_ If yes, do you have any suggestions for improvement of the procedure used? \_\_\_\_\_

3. How do you rate the importance of the expense-paid pre-program visit to the work site?  
Not worth expense\_\_\_ Convenient\_\_\_ Essential\_\_\_ Please add any comments: \_\_\_\_\_

4. Considering the calendar "window" of ten weeks (limited by varying college and university schedules), please comment on the program length. Were you as a team able to accomplish more than\_\_\_, less than\_\_\_, about what you expected\_\_\_? Comments: \_\_\_\_\_

5. Would you desire another Faculty Associate to be assigned to you and/or your group/division? YES\_\_\_ NO\_\_\_ If no, why not? \_\_\_\_\_

6. Other remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THANK YOU

QUESTIONNAIRE EVALUATION SUMMARY  
(77 of 87 RESEARCH COLLEAGUES REPORTED)

A. TECHNICAL ASPECTS

1. Personal knowledge of Associate's capabilities? Yes - 39 No - 38  
a. If yes, where/who/what? Through telephone conversations, prior visit, application and resume, Associate colleagues, Associate technical publications, knew Associate prior to program, pre-summer visit, through references of past Associates.
2. Was Associate prepared? Yes - 74 No - 2 NA - 1
3. Comments on preparedness, etc? Comments were generally complimentary; e.g.: Surprisingly good, slow start up but developed considerable depth, very well prepared, excellent, had done a great deal of background research after pre-summer visit and prior to arrival (these were numerous), outstanding, an expert, fully prepared, he did his homework, superior competence, exactly suited, had extensive experience, recognized authority, outstanding knowledge, very solid, instant start.
4. Comments on cooperativeness, etc? All comments were positive with most being highly complimentary.
5. Increase in Associate's research potential? Yes - 70 No - 6 NA - 1
6. Work performed contribute to overall lab mission? Yes - 75 No - 0 NA - 2
7. Were technical relations with Associate satisfactory? Yes - 76 No - 1
8. Did Associate stimulate others? Yes - 77 No - 0
9. Will summer experience and performance form basis for continuation?  
Yes - 70 No - 4 NA - 3
10. Basic research resource identified? A - 56 B - 19 C - 2 D - 0 NA - 0  
Opportunity to stimulate group activity? A - 53 B - 20 C - 2 D - 0 NA - 2  
Professional association? A - 57 B - 17 C - 1 D - 0 NA - 2  
Program administration? A - 40 B - 24 C - 10 D - 1 NA - 2

B. ADMINISTRATIVE ASPECTS

1. When first heard of program? Most answered that they had known about it for several years due to past SFRP participants while others stated that they just learned of the program this year. The answers ranged from 1960 to 1980.
2. Involved in screening and prioritizing? Yes - 54 No - 23
3. Expense-paid pre-program visit? Not worth expense - 3 Convenient - 9  
Essential - 63 N/A - 2
4. Calendar "window" of ten weeks to accomplish research? More than expected - 14  
Less than expected - 9 About what expected - 54
5. Want another participant? Yes - 76 No - 1  
a. If no, why? Lack of adequate facilities to accommodate serious researchers.

COLLEAGUES SUMMARY  
PAGE TWO

6. Other comments?

I wish I had a few more like him. If I could figure a way to entice him to join us on a full time basis, I would.

Candidates should have the requirement to identify in some detail (few pages) planned research program in advance.

Excellent program--expands research base for USAF and benefits USAF mission accomplishment.

I hope there will be opportunities in the future to continue the association and pursue the common interest jointly.

These questions do not seem appropriate at this time.

Lack of "A" rating on Research Associate does not reflect upon him, but rather upon the limited support for research at his university. If it is the purpose of the AF grants to support research at smaller academic institutions, then a future grant to the Research Associate would be an excellent investment. Better written coordination should be developed between SCEEE and the Research Colleague, particularly duties and responsibilities of the Research Colleague, and points of contact at SCEEE.

Very intellectually stimulating--send more of the same!

Overall the program provides a good basis for symbiotic exchanges between the civilian academic community and the USAF scientist.

This program needs two-way cooperation in order to succeed. That implies that the host laboratory, as well as the participant, be prepared for and committed to the support of the research activity sought. Unfortunately, administrative and budgetary duties often unexpectedly leave the AF Associate little time for productive interaction during the fellowship's tenure. I would recommend a stronger statement of the responsibilities and the host laboratory in this regard so that upper management will realize and more fully understand the nature of the commitment.

Excellent program.

Very beneficial program to the Air Force laboratories doing research work.

This is the most valuable program to accomplish research that exists.

The Research Associate was superior in every respect evaluated against the results I have observed in the past. However, the administration of this this effort would receive poor marks.

The program will retain its viability only if the caliber of the participants remains high. To get the good people in the program, advertising must be early and extensive. Other federal programs compete and make it hard to get those researchers who can do the AF the most good.

I need to participate more in the selection process throughout the year.

The Research Associate is extremely competent, energetic, and productive.

Our laboratory was very fortunate to have him here. He typifies the best one would hope to obtain under such a program and provides the justification for the program to continue.

I was very pleased with the Research Associate. It is a valuable program if the laboratory is ready for the project when the person arrives.

Excellent applicant--please find more of them.

The pre-program visits allowed us to agree on scope and objective of the project. Thus our lab could insure any materials or supplies were available when the faculty member arrived.

I feel that it is a very worthwhile program, since it helps develop potential sources of research, and is a stimulating and educational opportunity for our staff.

COLLEAGUES SUMMARY  
PAGE THREE

6. Other comments?(cont.)

A great program. We love it!

The Research Associate is an exceptional individual and we were indeed fortunate to have him. The program is a very sound program and should be continued.

It is quite proper not to limit the program to the "summer" only.

A very valuable program. While we have been able to attract scientists to our program, the Research Associate is the first engineer. His expertise complimented our program and identified some important gaps. I thoroughly support this type of cross-fertilization. This program is ideal for allowing researchers to expand their interests without an unacceptable time commitment. It also gives us a chance to interest people in other disciplines in our research.

I expect that a business management topic would be a little easier to handle in a short period of time than a hard science topic. This is not the case and is probably more difficult to handle because of the complexity, in general, of learning the business environment within which the research work will be done.

This is an excellent program for cross-fertilization in government laboratories.

This program has yielded for our group a very useful product.

Supervisors and all others in my group had a very cordial working relationship with the Research Associate. He gained upmost respect for his technical knowledge and his personality was such that everyone enjoyed conversations with him. Everyone considers the Summer Faculty Research Program to be very productive for the Air Force.

Prompt payments due to the SFRP participant would help to relieve the financial burden incurred by the participation.

I have been a believer in the program since 1976. Our experience has always been excellent.

This is an excellent way of finding new talent.

There has been very little information on how we can continue having an individual on contract research for us. It would be a natural follow on for one who is accomplishing research during the summer to continue this effort during the fall, etc. However, with the termination of the summer program and a lapse until any contract can be established, we lose any continuity that would be desired in a research program. Please help!

My greatest frustrations as supervisor of a large number (28) of scientists, engineers, technicians, etc. is the constant added administrative duties that are imposed, especially when taking on individuals on a part-time basis. The time needed in filling this out is a case in point. I hurried through it; I hope it's coherent and legible. Can the administrative burden be entirely placed on the participant?!

Associates must be paid promptly on receipt of completed vouchers. I was irritated by constant complaints about delays in invoice processing.

I have been very pleased with the Research Associate's contributions to our laboratory efforts. His overall personality makes him a pleasure to be associated with. His dedication to his work is very impressive.

The information that is circulated to the faculty members apparently does not relate some of the projects and work that is going on in the digital technology area. We noticed that the Research Associate's resume and interests were in this area and we found out that he was going to another laboratory because of their digital work. We informed him of what we were doing and he changed his plans and came to our laboratory.

COLLEAGUES SUMMARY  
PAGE FOUR

6. Other comments?(cont.)

We have had two productive summers with two different investigators. Both efforts have been very productive.

Provide Air Force colleagues with some information on Mini Grants.  
Excellent program.

The Research Associate is a delightful, conscientious individual. He has tried very hard to come to grips with the maintenance aspects of this project. His participation in my section has been very valuable to us. I regret that the press of duties prevented me from spending more time with him.

Excellent program. Would like to have an increase of at least two additional positions next summer.

Our group has enjoyed many technical and professional benefits throughout the Summer Faculty Research Program.

Program benefits the laboratory by providing new perspectives to Air Force problems from experienced professionals. It assists the laboratories in supporting and performing their in-house programs. Would like to see more minority schools and professionals participate. Suggest one enhancement to the program, it would be useful if the Associate could obtain a security clearance prior to arrival at work site.

Excellent program--expands research base for USAF and benefits USAF mission accomplishment.

I have found this to be a most beneficial program which has yielded significant long-term benefits.

This program is extremely worthwhile in enhancing the professional relationship between government laboratories and those in the academic community.

LABORATORY REPRESENTATIVE'S QUESTIONNAIRE & SUMMARY

USAF/SCREE SUMMER FACULTY RESEARCH PROGRAM  
EVALUATION QUESTIONNAIRE  
(TO BE COMPLETED BY LABORATORY REPRESENTATIVE)

Laboratory/Center \_\_\_\_\_

Name \_\_\_\_\_

1. How do you rate the correspondence, verbal and telephone communications, and other aspects concerning program administration? Poor\_\_\_ Average\_\_\_ Excellent\_\_\_ How could it be improved? \_\_\_\_\_

2. The participant selection process is two-fold: academic and technical. Did you have sufficient time to conduct the technical selection processing of applications? YES\_\_\_ NO\_\_\_ If no, how much time do you suggest? \_\_\_\_\_  
Was the method used satisfactory? YES\_\_\_ NO\_\_\_

3. Was the number of faculty associates assigned to your organization satisfactory? YES\_\_\_ NO\_\_\_ If not, how many would be desired? \_\_\_\_\_  
How did you determine this number? \_\_\_\_\_

4. Please rate the expense-paid pre-program visit: Not worth expense\_\_\_ Convenient\_\_\_ Essential\_\_\_

5. In your opinion is the ten-week time period an optimum length of time to obtain the objective of providing the introduction to each other (associates and laboratory/center personnel and programs)? YES\_\_\_ NO\_\_\_ If no, what length would be? \_\_\_\_\_  
Other comments: \_\_\_\_\_

6. Did your laboratory/center establish a seminar program (or other means) to "tap" the faculty associates' academic knowledge (other than his research assignment)? YES\_\_\_ NO\_\_\_ If yes, give description and evaluation. \_\_\_\_\_

7. Did the laboratory/center conduct a general (or Commander's) briefing, tour, and/or other formal means of welcome and introduction for the associate(s) assigned to your organization? YES\_\_\_ NO\_\_\_ If yes, please give description. \_\_\_\_\_

8. Did you have a formal exit exercise for each associate (such as doing his final technical briefing to the organization management, or in private interview, or other)? YES\_\_\_ NO\_\_\_ Please give description. \_\_\_\_\_

9. In your opinion, what was the overall quality of this year's participants as measured by attitude, technical competence, work habits and production, and meaningful research accomplishment? (NOTE: These answers will be held confidential.) QUESTION CONTINUED ON NEXT PAGE.

LABORATORY REPRESENTATIVE QUESTIONNAIRE  
Page Two

9. (CONTINUED)

<u>List Name(s)</u>	<u>Poor</u>	<u>Average</u>	<u>Excellent</u>	<u>Superior</u>
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10. Please furnish any other comments or suggestions to improve the program in future years.

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THANK YOU

QUESTIONNAIRE EVALUATION SUMMARY  
(21 of 25 LABORATORY REPRESENTATIVES REPORTED)

1. Rate correspondence? Poor - 1 Average - 3 Excellent - 17
2. Sufficient time for selection? Yes - 18 No - 3  
Was method satisfactory? Yes - 17 No - 2 NA - 2
3. Number of Associates satisfactory? Yes - 13 No - 8
  - a. How many desired? Answers ranged from 3 to 5 Associates.
  - b. How determined? Extent of research, one for each technical area, one for each division.
4. Rate pre-program visit? Not worth expense - 0 Convenient - 3  
Excellent - 17 NA - 1
5. Ten-week period an optimum amount of time? Yes - 15 No - 3 NA - 3
  - a. What length? 12-14 weeks.
6. Establish seminar program? Yes - 9 No - 10 NA - 2
7. Conduct briefing? Yes - 12 No - 8 NA - 1
8. Exit exercise? Yes - 16 No - 5
9. Quality of participants? Poor - 0 Average - 7 Excellent - 38  
Superior - 29
10. Comments?

I believe AEDC has a unique problem: We are remote, unknown, and have trouble getting interest from the people with qualifications in math, physics, and engineering. I don't have any good ideas to solve this problem, but I'm "thinking."

More lead time in the selection phase and between selection and start work would improve quality of selection process and allow more interaction between the sponsor and Associate to develop the research project. This would permit the researcher to start work immediately when reporting. In the future, I would like to see a longer program.

Time period could be more flexible, perhaps other than the summer. This way we could recruit and use more Research Associates. Payment of individuals should be more responsive. Delayed first payments cause financial hardship on participants, especially when coupled with moving and relocation. Perhaps an advance is warranted.

It became apparent to APL that two of the participants (after selection) were not planning to return to the university research area after completion of the SFRP, thus nullifying the program objective for follow-on research. It is suggested that applicants be asked their future plans prior to final selection.

We would like very much to receive two additional slots for next summer. This is an excellent program.

Please continue the program as is. How can we be assured of a minority participant again next year?

SCIENTISTS SUMMARY  
PAGE TWO

Advertising in management science area for the 1980 program did not appear in professional journals until closing date for applications. Would suggest earlier time (Oct.-Nov. 1980 issues) for the 1981 program. Need to analyze the method of payment to consider the following alternatives: Certified mail, registered mail, fund cites to local Accounting & Finance Office.

Overall, program is useful. It provides a medium for professors from smaller colleges and universities for follow-on research with AF in their areas of expertise. One suggestion might be to assure that program assignments are not too complex and therefore unmanageable in a 10-week period.

The candidates at Hanscom for the summer of 1980 were super. I don't see any way of improving the system if it continues to provide candidates of the 1980 caliber.

It seems silly to restrict a program such as this for some contractual limitation (\$2,000,000 limit). The best thing to do is get this arbitrary ceiling raised so the program can be used to its full potential.

#### APPENDIX I

1. Program Statistics
2. List of 1980 Participants
3. Participant Laboratory Assignments

1980 USAF/SCEEE SUMMER FACULTY RESEARCH PROGRAM

Conducted by  
SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCATION, INC.

PROGRAM STATISTICS

1. Number of Air Force Installations (Laboratories/Centers) - 25

2. Applications Received (First Choice as Follows) - 311

APL	(W-PAFB)	- 9	HRL/FTD	(Williams)	- 8
AMRL	(W-PAFB)	- 22	HRL/PRD	(Brooks)	- 10
AD	(Eglin)	- 26	HRL/TTD	(Lowry)	- 12
AEDC	(Arnold)	- 4	LMDC	(Maxwell)	- 2
AL	(W-PAFB)	- 13	LC	(W-PAFB)	- 1
BRMC	(W-PAFB)	- 6	LMC	(Gunter)	- 4
ESMC	(Patrick)	- 3	ML	(W-PAFB)	- 19
ESD	(Hanscom)	- 12	RPL	(Edwards)	- 6
ESC	(Tyndall)	- 30	RADC	(Griffiss)	- 23
FDL	(W-PAFB)	- 14	RADC/ET	(Hanscom)	- 4
FJSRL	(USAFAC)	- 22	SAM	(Brooks)	- 30
GL	(Hanscom)	- 10	WL	(Kirtland)	- 13
HRL/ASD	(W-PAFB)	- 6	General Preference		- 2

3. Number of Participants - 87

Number holding Doctorate Degree	- 85
Number holding Masters Degree	- 2
Number holding Professor Rank	- 13
Number holding Associate Professor Rank	- 36
Number holding Assistant Professor Rank	- 34
Number holding Instructor Rank	- 2
Number holding Chairman Rank	- 2

4. Average Age of Participants - 39.7 years

5. Distribution of Participants Location

APL	(W-PAFB)	- 4	HRL/FTD	(Williams)	- 2
AMRL	(W-PAFB)	- 5	HRL/PRD	(Brooks)	- 3
AD	(Eglin)	- 5	HRL/TTD	(Lowry)	- 1
AEDC	(Arnold)	- 2	LMDC	(Maxwell)	- 2
AL	(W-PAFB)	- 5	LC	(W-PAFB)	- 1
BRMC	(W-PAFB)	- 4	LMC	(Gunter)	- 2
ESMC	(Patrick)	- 1	ML	(W-PAFB)	- 5
ESD	(Hanscom)	- 1	RPL	(Edwards)	- 3
EDC	(Tyndall)	- 5	RADC	(Griffiss)	- 5
FDL	(W-PAFB)	- 7	RADC/ET	(Hanscom)	- 2
FJSRL	(USAFAC)	- 3	SAM	(Brooks)	- 5
GL	(Hanscom)	- 6	WL	(Kirtland)	- 6
HRL/ASD	(W-PAFB)	- 2			

PROGRAM STATISTICS - PAGE TWO

6. Disciplines Represented - 27

Administration	1	Engineering	3
Aeronautics & Astronautics	1	Environmental Engineering	1
Bioengineering	1	Industrial Engineering	3
Biology	5	Industrial Management	3
Business Administration	3	Management	3
Chemical Engineering	4	Mathematics	8
Chemistry	5	Mechanical Engineering	7
Civil Engineering	6	Mechanical & Industrial	
Computer Science	1	Engineering	1
Data Processing	1	Meteorology	1
Economics & Finance	1	Physics	6
Educational Administration	2	Psychology	5
Electrical & Computer		Systems Engineering	1
Engineering	2	Systems Science	1
Electrical Engineering	9		

7. Number of Colleges/Universities Represented - 68

Arizona State University	New York/Buffalo, State University of
Arkansas/Little Rock, University of	New York College/Bufalo, State
Atlanta University	University of
Case Western Reserve University	New York College/Oneonta, State
Central Florida, University of (2)	University of
Central Washington University	Nicholls State University
Cincinnati, University of	North Carolina Central University
Clark College	North Carolina State University
Clarkson College of Technology (2)	Oklahoma State University
Clemson University (2)	Pennsylvania, University of
College of the Holy Cross	Puerto Rico, University of
Cornell University	Purdue University/Indianapolis
David Lipscomb College	Purdue University/West Lafayette
Dayton, University of	Rice University
Detroit, University of	Sam Houston State University
District of Columbia, University of	San Diego State University (2)
Duke University (2)	San Jose State University
Florida A&M University (2)	Southeast Missouri State University
Florida State University	South Florida, University of
Florida, University of	Texas A&M University (2)
George Washington University	Texas/Arlington, University of
Georgia Institute of Technology	Texas/El Paso, University of
Grambling State University	Tulane University
Hartford, University of	Tuskegee Institute
Illinois Institute of Technology	US Naval Academy
Kansas University	Utah, University of
Kentucky, University of (2)	Virginia Polytechnic Institute &
Louisiana State University	State University (6)
Massachusetts/Boston, University of	Washington & Jefferson College
Massachusetts Institute of Technology	Wayne State University
Memphis State University	Western Carolina University
Miami University	West Florida, University of
Morgan State University	Wisconsin/Madison, University of
Nebraska/Omaha, University of	Wisconsin/Superior, University of
New Mexico State University (6)	Wright State University
New York/Binghamton, State University	

PROGRAM STATISTICS - PAGE THREE

8. Number of States/US Territories Represented - 31

Alabama	Nebraska
Arizona	New Mexico
California	New York
Connecticut	North Carolina
District of Columbia	Ohio
Florida	Oklahoma
Georgia	Pennsylvania
Illinois	Puerto Rico
Indiana	South Carolina
Kansas	Tennessee
Kentucky	Texas
Louisiana	Utah
Maryland	Virginia
Massachusetts	Washington
Michigan	Wisconsin
Mississippi	

1980 USAF/SCEEE SUMMER FACULTY RESEARCH PROGRAM

LIST OF PARTICIPANTS

NAME/ADDRESS	DEGREE, SPECIALTY, & LABORATORY ASSIGNMENT
Dr. Howard L. Alford Professor Dept. of Business Management & Education Administration Morgan State University Cold Springs & Hillen Road Baltimore, MD 21239 (301) 444-3160	Degree: PhD, 1972 Specialty: Management, Organizations, Behavior Assigned: AFHRL (Brooks)
Dr. Timothy J. Anderson Assistant Professor University of Florida Dept. of Chemical Engineering Gainesville, FL 32611 (904) 392-0856	Degree: PhD, Chemical Engineering, 1979 Specialty: Semiconductor material pro- cessing, Thermodynamics Assigned: AFRADC (Hanscom)
Dr. Robert L. Armstrong Associate Professor New Mexico State University Dept. of Physics Box 3D Las Cruces, NM 88003 (505) 646-4308	Degree: PhD, Physics, 1970 Specialty: Lasers, Optics, & Spectroscopy Assigned: AFGL (Hanscom)
Dr. Inez R. Bacon Professor University of District of Columbia Dept. of Biology 1331 B Street, N.W. Washington, DC 20005 (202) 727-2743	Degree: PhD, Zoology, 1972 Specialty: Protozoology & Parasitology Assigned: AFAMRL (Wright-Patterson)
Dr. Thomas M. Baseheart Assistant Professor University of Cincinnati Dept. of Civil Engineering Mail Location #71 Cincinnati, OH 45221 (513) 475-4939	Degree: PhD, Civil Engineering, 1973 Specialty: Structural Dynamics, Computer Application, Concrete & Masonry Design Assigned: AFESC (Tyndall)
Dr. Frederick T. Bear Associate Professor Western Carolina University Dept. of Economics & Finance Cullowhee, NC 28723 (704) 227-7401	Degree: PhD, Finance, 1973 Specialty: Financial Management, Investment Assigned: AFBRMC (Wright-Patterson)

Pages 28 thru 39 deleted  
per AFOSR.

11 May 81

PARTICIPANT LABORATORY ASSIGNMENT

1980 USAF/SCREE SUMMER FACULTY RESEARCH PROGRAM

APL AERO PROPULSION LABORATORY  
(Wright-Patterson Air Force Base)  
1. Dr. Leslie Fishler - Oklahoma State University  
2. Dr. James Lawler - University of Dayton  
3. Dr. Albert Menard - Washington & Jefferson College  
4. Dr. Dasara Rathnamma - US Naval Academy

AMRL AEROSPACE MEDICAL RESEARCH LABORATORY  
(Wright-Patterson Air Force Base)  
1. Dr. Inez Bacon - University of the District of Columbia  
2. Dr. Thiruvankatasamy Govindaraj - Purdue University  
3. Dr. Vernon Henderson - Grambling State University  
4. Dr. Timothy Hight - Duke University  
5. Dr. John Petersik - Southeast Missouri State University

AO ARMAMENT DIVISION  
(Eglin Air Force Base)  
1. Dr. Stanley Benton - Tulane University  
2. Dr. Karen Frair - Virginia Polytechnic Institute/State University  
3. Dr. Lester Frair - Virginia Polytechnic Institute/State University  
4. Dr. Royce Harbor - University of West Florida  
5. Dr. James Sinclair - Rice University

AEDC ARNOLD ENGINEERING DEVELOPMENT CENTER  
(Arnold Air Force Station)  
1. Dr. Arend Hagedoorn - University of Central Florida  
2. Dr. Robert Kerce - David Lipscomb College

AL AVIONICS LABORATORY  
(Wright-Patterson Air Force Base)  
1. Dr. Frank Brown - University of Kentucky  
2. Dr. Samuel Ling - Wright State University  
3. Dr. Max Mintz - University of Pennsylvania  
4. Prof. Harry Nienhaus - University of South Florida  
5. Dr. Edward Winkofsky - Virginia Polytechnic Institute/State University

BRMC BUSINESS RESEARCH MANAGEMENT CENTER  
(Wright-Patterson Air Force Base)  
1. Dr. Frederick Bear - Western Carolina University  
2. Dr. Sallye Benoit - Nicholls State University  
3. Dr. Richard Burton - Duke University  
4. Dr. George Worm - Clemson University

ESMC EASTERN SPACE & MISSILE CENTER  
(Patrick Air Force Base)  
1. Dr. Venkateswararao Vemuri - State University of New York,  
Binghamton

PARTICIPANT LABORATORY ASSIGNMENT (Continued)

ESD ELECTRONIC SYSTEMS DIVISION  
(Hanscom Air Force Base)

1. Dr. John Papageorgiou - University of Massachusetts, Boston

ESC ENGINEERING & SERVICES CENTER  
(Randall Air Force Base)

1. Dr. Thomas Bascheart - University of Cincinnati
2. Dr. James Gossett - Cornell University
3. Dr. Thomas Higgins - Arizona State University
4. Dr. Thomas Mason - Florida A&M University
5. Dr. Lawrence Rude - Virginia Polytechnic Institute/State University

FPL FLIGHT DYNAMICS LABORATORY  
(Wright-Patterson Air Force Base)

1. Dr. Franklin Eastep - North Carolina State University
2. Dr. Arthur Grainger - Atlanta University
3. Dr. Sherif Noah - Texas A&M University
4. Dr. Louise Raphael - Clark College
5. Dr. Kuldip Rattan - Wright State University
6. Dr. Shiva Singh - University of Kentucky
7. Dr. Akhourl Sinha - Purdue University

FJSRL FRANK J. SELLER RESEARCH LABORATORY  
(USAF Academy)

1. Dr. Richard Deckro - Virginia Polytechnic Institute/State University
2. Dr. Howard Sherwood - University of Central Florida
3. Dr. Almon Turner - University of Detroit

GL GEOPHYSICS LABORATORY  
(Hanscom Air Force Base)

1. Dr. Robert Armstrong - New Mexico State University
2. Dr. Stephen Berman - University of Oklahoma
3. Dr. David Cooke - University of Utah
4. Dr. Peter Hierl - Kansas University
5. Dr. George Peace - College of the Holy Cross
6. Dr. William Tucker - Florida A&M University

HRL/ASD HUMAN RESOURCES LABORATORY/ADVANCED SYSTEMS DIVISION  
(Wright-Patterson Air Force Base)

1. Dr. Larry Wall - New Mexico State University
2. Dr. Richard Warren - State University College/Buttalo

HRL/FTD HUMAN RESOURCES LABORATORY/FLYING TRAINING DIVISION  
(Williams Air Force Base)

1. Prof. Marshall Waller - George Washington University
2. Dr. Yehoshua Zeevi - Massachusetts Institute of Technology

HRL/PRD HUMAN RESOURCES LABORATORY/PERSONNEL RESEARCH DIVISION  
(Brooks Air Force Base)

1. Dr. Howard Allford - Morgan State University
2. Dr. Richard Christ - New Mexico State University
3. Dr. Philip Iolin - Central Washington University

PARTICIPANT LABORATORY ASSIGNMENT (Continued)

HRL/TTD	<p>HUMAN RESOURCES LABORATORY/TECHNICAL TRAINING DIVISION (Lowry Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Barbara Lindauer - Miami University</li> </ol>
LMDC	<p>LEADERSHIP &amp; MANAGEMENT DEVELOPMENT CENTER (Maxwell Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Edward Conlon - Georgia Institute of Technology</li> <li>2. Dr. Thomas Petrie - University of Nebraska/Omaha</li> </ol>
LC	<p>LOGISTICS COMMAND (Wright-Patterson Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Paul Williams - University of Wisconsin/Superior</li> </ol>
LMC	<p>LOGISTICS MANAGEMENT CENTER (Gunter Air Force Station)</p> <ol style="list-style-type: none"> <li>1. Dr. Andrew Hargrove - Tuskegee Institute</li> <li>2. Dr. James Patterson - Clemson University</li> </ol>
ML	<p>MATERIALS LABORATORY (Wright-Patterson Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Billy Covington - Sam Houston State University</li> <li>2. Dr. Charles Falkner - University of Wisconsin</li> <li>3. Dr. Michael Hyer - Virginia Polytechnic Institute/State University</li> <li>4. Dr. Francis Loo - Clarkson College of Technology</li> <li>5. Dr. Joseph Schmidt - Memphis State University</li> </ol>
RPL	<p>ROCKET PROPULSION LABORATORY (Edwards Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Joseph Chiang - State University of New York College/Oneonta</li> <li>2. Dr. Chong Jin Park - San Diego State University</li> <li>3. Dr. Daniel Yannitell - Louisiana State University</li> </ol>
RADC	<p>ROME AIR DEVELOPMENT CENTER (Griffiss Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Caroline Eastman - Florida State University</li> <li>2. Dr. Edward Lee - Wayne State University</li> <li>3. Dr. Lonnie Ludeman - New Mexico State University</li> <li>4. Dr. Francis Merat - Case Western Reserve University</li> <li>5. Dr. Eugene Moriarty - San Jose State University</li> </ol>
RADC/ET	<p>ROME AIR DEVELOPMENT CENTER (Hanscom Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Timothy Anderson - University of Florida</li> <li>2. Dr. Charles Smith - University of Texas/Arlington</li> </ol>
SAM	<p>SCHOOL OF AEROSPACE MEDICINE (Brooks Air Force Base)</p> <ol style="list-style-type: none"> <li>1. Dr. Craig Daniels - University of Hartford</li> <li>2. Dr. Howard Duncan - North Carolina Central University</li> <li>3. Dr. Walter Kuklinski - Texas A&amp;M University</li> <li>4. Dr. Leland Morgans - University of Arkansas/Little Rock</li> <li>5. Dr. Marvin Riedesel - University of New Mexico</li> </ol>

PARTICIPANT LABORATORY ASSIGNMENT (Continued)

WL

WEAPONS LABORATORY

(Kirtland Air Force Base)

1. Dr. Richard Fragaszy - San Diego State University
2. Dr. Rafael Jimenez-Perez - University of Puerto Rico
3. Dr. Richard McCluskey - Clarkson College
4. Dr. Gerald Melvor - Illinois Institute of Technology
5. Dr. James Steelman - New Mexico State University
6. Dr. David Williams - University of Texas/El Paso

## APPENDIX II

1. Listing of Research Reports Submitted in the  
1980 Summer Faculty Research Program
2. Abstracts of 1980 Associates' Research Reports

# RESEARCH REPORTS

## 1980 USAF-SCEEE SUMMER FACULTY RESEARCH PROGRAM

<u>Volume I</u> <u>Report No.</u>	<u>Title</u>	<u>Research Associate</u>
1	The Human Resources Laboratory Management Model for Increasing R&D Productivity	Dr. Howard L. Alford
2	Influence of Reaction Variables on the Electrical Properties of Homoepitaxial InP in the Hydride System	Dr. Timothy J. Anderson
3	Molecular Absorption in the Far Wings	Dr. Robert L. Armstrong
4	Teratologic Evaluation of a Model Perfluorinated Acid, NDFDA	Dr. Inez R. Bacon
5	The Response of Reinforced Concrete Structures to Near Field Explosions	Dr. Thomas M. Baseheart
6	Incentives for Defense Industry Investment	Dr. Frederick T. Bear
7	Improving Information Management Skills of the Air Force Business Research Management Center Personnel to Achieve Optimum Extension and Productivity of Research Services	Dr. Sallie S. Benoit
8	Response Surface Fitting for Missile Endgame Models	Dr. Stanley H. Benton
9	Parameterizing Boundary-Layer Processes for General Circulation Models	Dr. Stephen Berman
10	Inferential Processor	Dr. Frank M. Brown
11	Manpower Allocation in ASD's Matrix Organization	Dr. Richard M. Burton
12	Fourier Transform Infrared Spectroscopy Analysis of MNA	Dr. Joseph F. Chiang
13	An Alternative to Existing Strategies for Personnel Selection and Classification	Dr. Richard E. Christ
14	Investigations of Behavioral Consultation in the Air Force	Dr. Edward J. Conlon
15	Investigation of Aspects of the Cosmic Ray Penumbra	Dr. David J. Cooke
16	Infrared Study of Silicon: Indium, NTD Silicon, and Silicon-Germanium Alloys	Dr. Billy C. Covington

RESEARCH REPORTS (Continued)

<u>Report No.</u>	<u>Title</u>	<u>Research Associate</u>
17	Measurement of Coronary-Prone Behavior and Autonomic Reactivity	Dr. Craig E. Daniels
18	Modeling Network Disruption	Dr. Richard F. Deckro
19	Serologic Evaluation of Chagas' Disease in Nonhuman Primates	Dr. Howard B. Duncan
20	Nonlinear Oscillations of a Fluttering Panel in a Transonic Airstream	Dr. Franklin E. Eastep
21	Search Problems in Logic-Based Systems	Dr. Caroline M. Eastman
22	Operations Research Strategies for Manufacturing Control	Dr. Charles H. Falkner
23	Modeling Turbulence with a Five-Equation Reynolds Stress Closure	Dr. Leslie S. Fishler
24	A Research Program for Blast-Induced Liquefaction	Dr. Richard J. Fragaszy
25	A Theoretical Review of Detonation Waves with Possible Applications to Dispersed High Explosives	Dr. Karen L. Frair
26	Air Base Survivability--An Initial Investigation	Dr. Lester C. Frair
27	Packed Tower Air Stripping of Trichloroethylene From Dilute Aqueous Solution	Dr. James M. Gossett
28	Modeling Human Attention Allocation Strategies in Situations with Competing Criteria	Dr. Thiruvengatasamy Govindaraj
29	Multi Dimensional Linear Interpolation	Dr. Arthur D. Grainger
30	An Interactive Command System for Building Finite Element Models	Dr. A. Henry Hagedoorn
31	An Investigation of Selected Observations Noted in Implementing Optimal Guidance in Air-to-Air Ballistic Missiles	Dr. Royce D. Harbor
32	An Assessment of Air Force Maintenance Scheduling Procedures	Dr. Andrew Hargrove
33	Effects of Hydrazine on the Morphology and Physical Development in Rainbow Trout ( <i>Salmo Gairdneri</i> ) Eggs	Dr. Vernon Henderson

# RESEARCH REPORTS (Continued)

<u>Report No.</u>	<u>Title</u>	<u>Research Associate</u>
34	Translational Energy Dependence of Selected Ion-Molecule Reaction Cross Sections	Dr. Peter M. Hierl
35	Treatment of Plating Wastewater by Sulfide Precipitation, Coagulation and Upflow Filtration	Dr. Thomas E. Higgins
36	Long-Bone Injury Criteria for Use with the ATB Model	Dr. Timothy K. Hight
37	Unsymmetric Laminates	Dr. Michael W. Hyer
38	Postcracking Model for Finite Element Analysis of Reinforced Concrete	Dr. Rafael Jimenez-Perez
39	Laser Velocimeter Signal Processing	Dr. Robert H. Kerce
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THE US AIR FORCE HUMAN RESOURCES LABORATORY  
MANAGEMENT MODEL FOR INCREASING R&D PRODUCTIVITY

by

Howard L. Alford

ABSTRACT

The question of the uniqueness of the AFHRL Laboratory Operations Center (MIS) was investigated. A model flow chart of the word processing component and data entry/data flow was developed and discussed. Results show that management is committed to advancing an effective, quality Management Information System which includes the recommendations of a cross section of task scientists, administrators and technicians. Some manual tasks and office procedures are being updated and automated. Opinions of a diversified group of employees regarding the LOC were discussed. Tendered were suggestions and implications for further research.

INFLUENCE OF REACTION VARIABLES ON THE ELECTRICAL PROPERTIES OF  
HOMOEPITAXIAL InP IN THE HYDRIDE SYSTEM

by

Tim Anderson

ABSTRACT

The effect of various reaction variables on the unintentional doping levels in homoepitaxial InP were investigated in the hydride system. The predominant impurity was believed to be Si produced through interaction of HCl with the quartz reaction tube and reaction parameters reported important in GaAs deposition and the chloride process were examined. The  $H_2$  flow rate in the  $PH_3$  inlet tube and both the  $PH_3$  and HCl inlets was varied and produced no sizeable effect on the 77°K free carrier concentration and mobility as measured with the Van der Pauw technique. An independent HCl sidestream was introduced to the process and resulted in minor changes in the electrical properties and yielded a decrease in growth rate with increasing HCl flow. The temperature in the mixing zone was varied thus changing the  $PH_3$  decomposition extent and again produced a negligible change in the measured electrical properties. Procedures were established for InP substrate preparation and reaction conditions were found that reproducibly yielded device quality InP films with free carrier concentrations near  $10^{15} \text{ cm}^{-3}$ .

# MOLECULAR ABSORPTION IN THE FAR WINGS

by

Robert L. Armstrong

## ABSTRACT

The results of a theoretical investigation of molecular absorption in the far wings of spectral lines is reported. General properties of the spectrum and the related Fourier transform dipole auto-correlation function are examined as providing a guide to the selection of a model spectral profile. A model spectrum for line wing absorption is considered in detail. Model parameters are related to kinematical and dynamical properties of the absorbing molecules using the known spectral moments. The model spectral profile is applied to the analysis of the spectrum of the high-frequency wing of the  $\nu_3$  band of  $\text{CO}_2$ . Agreement between theory and available experimental data is qualitatively good but quantitative discrepancies exist. A number of extensions to the research reported here are suggested to improve the fit between theory and experiment, and to investigate other spectral regions of interest.

TERATOLOGIC EVALUATION OF A MODEL PERFLUORINATED ACID, NDFDA

by

Inez R. Bacon

ABSTRACT

The teratogenic effect of a perfluorinated acid, nonadecafluorodecanoic acid(NDFDA), was evaluated in Fisher 344 rats. Rats were given 0, 5, 10, or 15 mg/kg NDFDA by gavage on Day 9 of gestation. Rats were also treated with 0, 10, 20, or 30 mg/kg NDFDA by gavage on Day 12 of gestation. There were no significant differences between treatments and controls at 5, 10, or 15 mg/kg/Day 9 of gestation and 10 or 20 mg/kg/Day 12 of gestation. There was a statistically significant decrease in maternal body weight gain, corpora lutea, resorptions, and mean fetal body weight at 30 mg/kg/Day 12 of gestation. There were no significant differences between experimentals and controls of soft tissue or skeletal abnormalities at any dosage level.

THE RESPONSE OF REINFORCED CONCRETE STRUCTURES  
TO NEAR FIELD EXPLOSIONS

by

T. Michael Baseheart

ABSTRACT

This investigation is a study of the response of buried reinforced concrete slabs that are subjected to high intensity, near field conventional explosions. A review of numerous experimental test reports revealed significant differences among test specimens, their restraint and loading conditions, and the interpretation of breach conditions. From these reports, the various failure mechanisms and their relationship to scaled breach distances are documented. This information is then used to evaluate an existing empirical design procedure. The extent to which existing analytical techniques are available to investigate this problem is also discussed. Recommendations for further experimental and analytical research on this subject are presented.

Incentives for Defense Industry Investment

by

F. Thomas Lear, Ph.D.

ABSTRACT

A rapid escalation in the cost of weapons systems and related materiel has been of increasing concern to the Department of Defense for several years. Higher prices have led to a reduction in the quantity of weapons and materiel that can be purchased. Several studies, including the Air Force Systems Command effort entitled *Manufacturing Technology Investment Strategy* (Payoff '80) have looked at these problems. Suggestions have been made that greater investment in modern manufacturing equipment by defense contractors could result in lower costs and higher productivity for weapons and materiel. Recent studies of defense industry investment and profits are reviewed. Numerous possible incentives for defense industry investment are identified. A questionnaire is developed to obtain input from defense contractors as to the value of suggested incentives and to elicit their ideas for other incentives that have the potential to generate significant investment in the defense industry.

IMPROVING INFORMATION MANAGEMENT SKILLS OF AIR FORCE BUSINESS  
RESEARCH MANAGEMENT (AFBRMC) PERSONNEL  
TO ACHIEVE OPTIMUM EXTENSION AND PRODUCTIVITY OF RESEARCH SERVICES

by

Sallye S. Benoit

ABSTRACT

An overview of management's problems with white-collar productivity is given. Improved communication (internal and external) and information management are suggested as two paths which can lead to extended services and increased productivity in an office environment. A sample study of the communication and the information management operations in the Air Force Business Research Management Center is described. The literature is reviewed, and the technique of observation and personal interview, to analyze and evaluate office problems, is detailed. Recommendations for optimum use of personnel and equipment are given, and suggestions are made for further studies to be conducted.

RESPONSE SURFACE FITTING FOR  
MISSILE ENDGAME MODELS

by

Stanley H. Benton, Jr.

ABSTRACT

To eliminate some of the high cost of running typical air-to-air missile endgame programs, some sort of surface fitting is desirable. In theory, this is simply a problem of fitting a real function of several real variables to a collection of data points. However, the data leads to functions with steep rises and large flat areas, suggesting exponential functions with their corresponding numerical difficulties in fitting. It was determined that such a fitting process is feasible, but that further work is needed in the areas of design of the experiment and optimization methods.

PARAMETERIZING BOUNDARY-LAYER PROCESSES

FOR GENERAL CIRCULATION MODELS

by

Dr. Stephen Berman

ABSTRACT

The principal ways of parameterizing boundary-layer momentum, heat, and moisture fluxes for inclusion in general circulation models (GCM's) are presented. Those for the surface layer include the Bulk-Transfer, Monin-Obukhov Similarity, and PBL-Matching techniques. Those for the Ekman layer include K-Theory and Surface-Layer Extrapolation techniques. A comparison of boundary-layer parameterization used in six different operational GCM's is provided in table form, followed by preliminary evaluations of the schemes taken from published reports. It is recommended that the methods be tested in systematic fashion by incorporating them into a specific GCM, one at a time, with verification made with observed data.

## INFERENTIAL PROCESSOR

by

Frank Markham Brown

### Abstract

A new type of computer, called an inferential processor, is proposed and some of its potential applications are discussed. This machine is special-purpose in the ordinary sense; it is general-purpose, however, within the domain of propositional logic and Boolean algebra. The inferential processor is designed to function as an adjunct to a general-purpose (host) computer, performing a variety of deductive operations on logical data supplied by the host. The time required to perform tasks requiring extensive logical deduction (such as the diagnosis, on-line, of faults in complex systems) can be drastically reduced by the introduction of such a processor. The design of the processor is detailed at the register-transfer level, and a command-set is specified. Suggestions are offered for the transformation of this concept into working hardware.

## MANPOWER ALLOCATION IN ASD'S MATRIX ORGANIZATION

by

Richard M. Burton

### ABSTRACT

Manpower is the critical scarce resource at ASD. Matrix organization has been increasingly used to obtain a better allocation of manpower and to enhance the manpower mobility in response to changing demands. A more efficient utilization of manpower has been realized.

There are several unique aspects of ASD's matrix. Military and civilians have similar tasks throughout the organization. The ASD matrix is a two level organization: a matrix between functional home office and the SPO, and a second matrix within some SPO's. The first matrix has a major responsibility in planning and allocating manpower. The second is an operating matrix involving coordination problems at the work level. Finally, the matrix growth experience began from a program organization and then created matrix functional home offices.

In this study, manpower planning is described and analyzed for ASD's matrix organization. An organizational enhancement is proposed to obtain information which reveals relative SPO manpower surpluses as well as deficiencies. This information could be used to increase the short term mobility for manpower, and further, the information could be used to help establish organizational priorities in hiring.

FOURIER TRANSFORM INFRARED SPECTROSCOPY ANALYSIS OF MNA

by

Joseph Chiang

ABSTRACT

A method was devised based on Fourier Transform Infrared (FTIR) spectroscopic technique to analyze the low concentration, carcinogenic, anti-oxidant, N-methyl-p-nitroaniline (MNA) in solid rocket propellant. The sliced propellant was extracted by chloroform in a Soxhlet extract tube at 60°C for 24 hours. The extracted MNA was purged with dry nitrogen to remove the solvent. Then 6.0 ml chloroform was added and the absorbents of this solution were measured using two minutes of FTIR scanning time in a 0.143 mm KBr cell. 65% of MNA was recovered based on a 0.2% MNA in the original propellant. Detailed procedure for this extraction was prepared for future analysis of MNA in solid propellant.

ALTERNATIVES TO EXISTING STRATEGIES  
FOR PERSONNEL SELECTION AND CLASSIFICATION

by

Richard E. Christ

ABSTRACT

It has been suggested that computer-assisted testing of perceptual and psychomotor abilities will provide data which will lead to an improvement of prediction of learning and performance criteria. A review of relevant literature supports that suggestion. Furthermore, the literature review suggests that selected measures of performance from relatively complex tasks will yield information concerning different components of performance when they operate in combination and concurrently. Two experiments were designed to examine a domain of multiple component behavior which is central to the efficient operation of complex man-machine systems. Suggestions for further research in this area are offered.

INVESTIGATIONS OF BEHAVIORAL CONSULTATION  
IN THE AIR FORCE

by  
Edward J. Conlon Ph.D.

ABSTRACT

This report summarizes an attempt to evaluate and augment the various methodologies used for management consultation in the Air Force. The evaluation utilized an existing data base to estimate the degree to which consultation affected key outcome variables in Air Force work groups. In addition, factors were identified that facilitate or inhibit the survey feedback consulting method frequently used.

The existing data base presented a variety of methodological problems that prevented an unequivocal analysis of consultation effectiveness. These problems were discussed in detail and a survey methodology was proposed for overcoming them.

Finally, cluster analysis was used in an attempt to provide a classification scheme by which consultants could identify problems and prescribe solutions. A solution was obtained involving 27 clusters in a four dimensional space. The clusters were found to be related to different job types and warrant further study.

INVESTIGATION OF ASPECTS OF THE

COSMIC RAY PENUMBRA

by

David J. Cooke

ABSTRACT

Techniques have been developed for use in investigating cosmic ray penumbral structure. In particular it has been found that charged particle trajectories (as traced by computer) approaching any given point in the geomagnetic field may be summarized effectively in terms of precisely located trajectory cardinal points (loops, low points, equatorial crossings). When the positions of these points are plotted as a function of trajectory path length (as measured in the "negative" time direction) over ranges of one or more of the calculation parameters-rigidity, for example--the complex penumbral patterns are displayed with dramatic clarity. Highly ordered and beautiful structures whose phenomenology is as yet completely unexplored, are revealed in a manner which makes them accessible to understanding and interpretation. Understanding of this phenomenology will open the way to efficient mapping of the penumbral structures, and will potentially allow their utilization in the experimental investigation of aspects of both the geomagnetic field and cosmic ray spectrum.

INFRARED STUDY OF SILICON:INDIUM, NTD SILICON,  
AND SILICON-GERMANIUM ALLOYS

by

B. C. Covington

ABSTRACT

We present the results of an infrared absorption study of silicon conventionally doped with indium, pure silicon doped by neutron transmutation, and silicon-germanium alloys.

We attempt to observe the previously reported 4.1 mev excitation level of indium in silicon. The failure to observe excited levels associated with the 4.1 mev level suggests that the transitions are selection rule forbidden or that the proximity of the levels to the normal excited levels of indium prevented easy observation.

A detailed study as a function of annealing temperature is made of neutron transmutation-doped pure silicon. Results from preliminary analyses are given and several spectra are shown.

Several silicon-germanium alloys are investigated before and after a 650°C anneal. Unknown lines are reported at 880, 480, and 400  $\text{cm}^{-1}$ .

Suggestions for further research are made.

MEASUREMENT OF CORONARY-PRONE BEHAVIOR  
AND AUTONOMIC REACTIVITY

by  
Craig E. Daniels

ABSTRACT

In spite of a slight decrease in the number of fatal myocardial infarctions over the last few years, coronary disease remains the country's number one killer. A recent Air Force report estimated the cost to the Air Force of cardiovascular incidents involving active duty personnel at \$64 million per year.

In addition to traditional risk factors (e.g., age, smoking, cholesterol level) the concepts of coronary-prone behavior and stress responses as major factors in the development of coronary disease have, within the last decade, received wide support. Research on the Type A Coronary-Prone Behavior Pattern has shown Type A's to be higher than Type B's on a number of biochemical and psychophysiological variables associated with accelerated development of atherosclerosis.

Current methods of assessing coronary-prone behavior using either the Structure Interview of the Jenkin's self-report questionnaire have inherent methodological limitations or assumptions which substantially reduce their utility, especially when they are used to help detect sub-clinical heart disease in an educated population, such as Air Force pilots, which is highly motivated not to display cardiovascular disease symptomatology.

Since hyper-reactivity or hyper-lability of the sympathetic nervous system is thought to be the major physiological mechanism underlying coronary-prone behavior, an extensive review of the literature was undertaken to determine whether it would be feasible to measure coronary-prone behavior more directly by means of autonomic response profiles. On the basis of this review, such a project is considered feasible and a multi-stage project for the development and testing of a protocol to measure autonomic reactivity under stressful conditions is recommended.

## MODELING NETWORK DISRUPTION

by

Richard F. Deckro

### ABSTRACT

The network disruption problem concerns forcing a network operation below minimum performance standards. These standards may vary dependent upon the intended function of the network. Closely associated with the disruption problem is the synthesis problem; the construction of defensible networks.

This paper reviews a number of associated graph theoretic techniques. An anotated bibliography is provided. The bibliography, together with the body of the paper provides a strong base for future research in the area. *Suggestions for futher research are offered.*

SEROLOGIC EVALUATION OF CHAGAS' DISEASE  
IN NONHUMAN PRIMATES

by  
Howard B. Duncan

ABSTRACT

The direct agglutination (DA) test and the fluorescent antibody (FA) test were compared to the complement fixation (CF) test as tools for diagnosing T. cruzi infection in nonhuman primates. Although a greater percentage of rhesus monkey sera was positive by CF and DA than by CF and FA, it appeared that the combination of CF and FA tests is the best diagnostic combination based upon specificity. Preliminary data and organisms were also obtained for the future study of pathological differences between the Corpus Christi strain of Trypanosoma cruzi and the wild strain of T. cruzi infecting the Brooks Air Force Base, Texas rhesus monkey colony.

NONLINEAR OSCILLATIONS OF A FLUTTERING  
PANEL IN A TRANSONIC AIRSTREAM

by

Franklin E. Eastep

ABSTRACT

The large deflection response of an elastic panel situated in a transonic airstream is considered. The large deflection equations are represented by Von-Karman's plate equations. The solution to the small disturbance transonic potential equation which allows for the existence of weak shocks is obtained from a finite difference alternative direction implicit code called NLR-LTRAN2. A method for integrating the nonlinear plate equations and the nonlinear transonic aerodynamic equation simultaneously is described. Recommendations for further study of the large response of a panel in a transonic airstream are given.

# SEARCH PROBLEMS IN LOGIC-BASED SYSTEMS

by

Caroline M. Eastman

## ABSTRACT

The efficiency of searching algorithms in intelligent systems based on resolution logic is examined: emphasis is on the Loglisp programming language. Alternatives for constraining and improving search are discussed within the context of the two relevant search paradigms. The importance of application area characteristics to search problems is emphasized, and intelligent data bases are presented as an example. Suggestions for further research in this area are offered.

OPERATIONS RESEARCH STRATEGIES FOR MANUFACTURING CONTROL

by

Charles H. Falkner

ABSTRACT

The use of operations research theory and techniques in the design of manufacturing control systems is explored. First, manufacturing control is defined and related to what is to be controlled. The planning environment is presented. Several topics which dictate requirements for or constraints on the design of manufacturing control systems are explored. Dispatching, simulation, and optimization are suggested as strategies for design. Dispatch-based and simulation-based manufacturing control are discussed. Hierarchical systems in manufacturing are briefly discussed.

MODELING TURBULENCE WITH A FIVE-EQUATION

REYNOLDS STRESS CLOSURE

by

Leslie S. Fishler

ABSTRACT

A five-equation Reynolds stress turbulence model is incorporated into the TEACH-T computer code in order to predict the flowfield in the dump combustor geometry. Upon programming the Reynolds stress equations into the computer code, problems are encountered with the convergence of the solution. Suggestions are made to overcome this problem.

A RESEARCH PROGRAM FOR BLAST-INDUCED LIQUEFACTION

by

Richard J. Fragaszy

ABSTRACT

A research program to investigate blast-induced liquefaction is presented. It is suggested that the program include laboratory triaxial testing, centrifuge testing, numerical modeling and field testing. A laboratory testing program to verify the proposed liquefaction mechanism is described. This work will provide important information on material behavior necessary for successful centrifuge testing and numerical modeling. Potential problems with centrifuge testing and their possible solutions are described. It is anticipated that these problems can be summounted and centrifuge modeling can add significantly to our knowledge of blast-induced liquefaction.

A THEORETICAL REVIEW OF DETONATION WAVES WITH POSSIBLE  
APPLICATIONS TO DISPERSED HIGH EXPLOSIVES

by

Dr. Karen L. Frair

ABSTRACT

The problem of a detonation wave propagating into a cloud of dispersed powdered high explosive is to be investigated. The objectives of this study are to

1. provide a simple review of the presently accepted theoretical models of a detonation wave
2. compare the results of two experimental/theoretical studies of a detonation in a dispersed explosive powder
3. make recommendations concerning future studies that should be made.

AIR BASE SURVIVABILITY---AN INITIAL INVESTIGATION

by

Les Frair

ABSTRACT

The problem of air base survivability after a large-scale attack by Soviet forces is investigated. The potential threat of such an attack is discussed in terms of weapon systems employed against air bases. Allied response from point defense through recovery is considered. A preliminary planning document for air base survivability is produced. This document provides a preliminary plan on how to obtain more detailed information concerning defense and recovery measures. Several operations research techniques were discussed as to their application and usefulness of air base survivability planning. Recommendations and suggestions for further research on this problem are offered.

PACKED TOWER AIR STRIPPING OF TRICHLOROETHYLENE  
FROM DILUTE AQUEOUS SOLUTION

by

James M. Gossett

ABSTRACT

Air stripping is among the technologies being considered by the Air Force for TCE removal from contaminated groundwaters. The most promising stripper configuration is that of the countercurrent flow, packed column. This study was undertaken to model the performance of such a stripping reactor applied to TCE removal. Equations are presented which relate efficiency to packed volume, air and liquid flows, gas/liquid partition coefficient (Henry's constant,  $H$ ) and overall mass transfer coefficient ( $K_{La}$ ). A major objective of this study was to quantify the effect of temperature and ionic strength on  $H$ ; and of temperature, air flow and liquid flow on  $K_{La}$ .

Henry's constant was measured by an equilibrium, mixed batch reactor technique, over a temperature range from 10° - 30°C, and a range of ionic strengths from 0 - 1 M (KCl). The effect of temperature was practically significant; the effect of ionic strength was not.

$K_{La}$  was determined for 5/8 - inch (1.59 cm) plastic Pall rings over a range of temperature from 10° - 30°C. The effect was significant, and equations are presented for calculating the dependency. Air and liquid flow velocity did not affect  $K_{La}$  over the range examined.

MODELING HUMAN ATTENTION ALLOCATION STRATEGIES

IN SITUATIONS WITH COMPETING CRITERIA

by

Thiruvengkatasamy Govindaraj

ABSTRACT

In supervisory control situations involving multiple human operators, successful operation of a system depends on proper cooperation and coordination among the various operators. Normally, the individual operators have certain responsibilities assigned to them. They are also jointly responsible for the operation of certain aspects of the system. From time to time, the individual whose workload permits him to engage in other activities takes charge of the tasks associated with the common tasks. In such situations involving multiple operators it is usually not clear when and who should take responsibility for the joint tasks. When a number of tasks demand attention, it becomes necessary to schedule the tasks to result in optimal performance. Understanding how a single operator performs in an environment with possibly conflicting criteria and when the available time is limited will help in understanding multiple operator systems. A model for the human based on Pareto optimality and Fuzzy Set theory has been proposed. An experimental paradigm has been developed based on a threat assessment situation typical in an air defense system. Features of the experimental paradigm are explained. A detailed outline for the model structure is given, and some possible heuristics that might be used by the human are identified. Recommendations are given for further research in modeling multi-operator systems.

## MULTI DIMENSIONAL LINEAR INTERPOLATION

by

Arthur D. Grainger

### ABSTRACT

The question of determining a mathematical method for multi dimensional linear interpolation that can be transformed into an efficient high speed computer algorithm which meets the requirements of real time aeronautical simulation is investigated. In particular, the method is designed to use the parallel processing capabilities of an array processor. We first define a logical algorithm for approximating the value of a function  $F$  at a unit argument vector  $\vec{t}$  from an  $n$ -dimensional ( $n$  is any positive integer) function table, of  $2^n$  entries, over the  $n$ -dimensional unit cube. Next, we show that the general case is transformed into linear interpolation over the  $n$ -dimensional unit cube by an elementary scaling technique applied to the argument vector. The algorithms use the technique of storing the functional values, at the corners of the  $n$ -dimensional parallelepiped that contains the argument vector, in a single column array. This maneuver has the following effect: (1) in the course of the calculations, the function table is searched only once, at the start of the algorithm and (2) all intermediate linear points are calculated simultaneously as indicated by the vector formulation of the algorithm. Both effects can be implemented by using parallel processing concepts.

AN INTERACTIVE COMMAND SYSTEM FOR  
BUILDING FINITE ELEMENT MODELS

by

A. Henry Hagedoorn

ABSTRACT

An interactive computer graphics program FEGRPH designed to help the user of finite element models to generate, display and analyze his models, is described. The structured design and modularity of the program allow for its easy understanding, verification, modification and augmentation, and maximum flexibility in emphasizing user orientation. The program is meant to integrate with the software packages presently in use.

AN INVESTIGATION OF SELECTED OBSERVATIONS NOTED  
IN IMPLEMENTING OPTIMAL GUIDANCE IN AIR-TO-AIR BALLISTIC MISSILES

by

Royce D. Harbor

ABSTRACT

Various problems have been observed in applying optimal control methods to air-to-air missile guidance systems. Several of these stem from the state estimation methods needed in order to implement a control law. In this work an investigation was made of a system in which the estimates of certain states generated by an extended Kalman filter differed significantly from the same quantities generated by a truth model. Results indicate that differences are explained on the basis of the need for agreement between the state equations which actually describe system behavior (or truth model) and those used as a model for the filter. Also considered was the effect upon miss distance of varying the time constants in the acceleration equations of the filter model. It was found that local minima exist in miss distance as a function of the time constants. Areas for additional work are suggested.

AN ASSESSMENT OF AIR FORCE MAINTENANCE SCHEDULING PROCEDURES

by

Andrew Hargrove

ABSTRACT

The complexity of the scheduling problem is examined including the large numbers of aircraft, the recurring changes of maintenance rules, and the conflict between a desired smooth flow of aircraft into maintenance and the desired flight procedures. Survey of typical schedulers reveals a need to allow a simple operation of a very complex system. Survey of available models reveals Decision Oriented Scheduling System (DOSS) as the most appropriate computer aid. Analysis of DOSS verifies its versatility but reveals the need to simplify it to the level of the average Air Force scheduler's expertise.

EFFECTS OF HYDRAZINE ON THE MORPHOLOGY AND PHYSICAL DEVELOPMENT  
IN RAINBOW TROUT (SALMO GAIKDNERI) EGGS

by

Dr. Vernon Henderson

ABSTRACT

This study was designed to duplicate conditions of an accidental spill of hydrazine. Twelve-day old rainbow trout (*Salmo gairdneri*) embryos were exposed to nominal concentrations of .01, 0.1, 1.0, and 5.0 ppm of hydrazine in a recirculating flow system. The exposure period for 48 hours did not result in significant mortality rates; therefore, hatching was not affected by the treatment. Physical development was affected, resulting in a lack of muscular control, lack of sensitivity to touch and reduced growth rate. Gross anatomical deformities including gaped mouth, scoliosis and bubble tail were observed at high frequencies.

SEM analysis revealed: (1) alteration in the chorion of all embryos exposed to hydrazine and (2) disturbance of the surface of the yolk sac epithelium and malformed hyoid bones and associated musculature. SEM confirmed our expectation that embryos experienced severe conditions which affect them but were not manifested in high mortalities. Embryos treated with the highest concentrations (1.0 and 5.0 ppm) of hydrazine were more affected than those at lower concentrations (.01 and 0.1).

TRANSLATIONAL ENERGY DEPENDENCE  
OF SELECTED ION-MOLECULE REACTION CROSS SECTIONS

by

Peter M. Hierl

ABSTRACT

A tandem mass spectrometer has been used to measure cross sections for reactions of the solvated negative ions  $\text{OH}^-(\text{H}_2\text{O})_n$  ( $0 \leq n \leq 3$ ) with the neutral molecules  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{CH}_3\text{Cl}$ , and  $\text{CH}_3\text{Br}$  over the range of reactant translational energy 0.15 - 25.0 eV (LAB). These reactions, which include solvent switching, charge transfer, collisional dissociation, nucleophilic substitution, and proton transfer, are important in predicting atmospheric composition subsequent to natural and artificial perturbations, such as aurora, nuclear detonations, and missile reentry. Of greatest aeronomic interest are the exoergic solvent switching reactions of  $\text{OH}^-(\text{H}_2\text{O})_n$  with  $\text{CO}_2$  and  $\text{SO}_2$ ; many of these reactions have large cross sections (e.g., up to  $400 \times 10^{-16} \text{ cm}^2$ ) at low energies, decreasing as  $(\text{energy})^{-1/2}$  up to 1 eV, and then decreasing more rapidly at higher collision energies. Estimates of bond dissociation energies for the cluster ions were derived from measured translational energy thresholds for the collisional dissociation reactions. Suggestions for further research on reactions of these types are offered.

TREATMENT OF PLATING WASTEWATER BY SULFIDE PRECIPITATION,  
COAGULATION AND UPFLOW FILTRATION

by

Thomas E. Higgins

&

Stephen G. TerMaath

ABSTRACT

Recent pre-treatment standards promulgated by the Environmental Protection Agency are aimed at the reduction of significant discharges of heavy metals into domestic sewage systems. Current Air Force practice in small electroplating shops is to discharge rinsewaters containing chromium, nickel and cadmium into sewers without pre-treatment. Small installations have limited facilities for adding treatment. A treatment system is needed that is compact for application at small installations and yet consistently meets these new pre-treatment standards.

Conventional treatment consists of chromium reduction at low pH followed by metal hydroxide precipitation at alkaline pH. Recently, interest has developed in metal sulfide precipitation, due to the lower solubility of sulfides as compared with hydroxides.

Results of this research indicate that reduction of chromium (VI) and precipitation of this and other metals can be accomplished in a single reactor at an alkaline pH by the addition of ferrous sulfate and sodium sulfide. Ferrous sulfate by itself effectively reduced and precipitated chromium (VI) at pH's 7 to 10. Sodium sulfide by itself was ineffective at these pH's. In combination they behaved synergistically. Sulfide precipitates tend to be colloidal. The iron salts acted as a coagulant. Iron sulfide precipitation and alkaline pH limited sulfide odors and sulfide discharge in the effluent. Clarification by upflow filtration produced an effluent with consistently low concentrations of metals in a compact treatment package.

LONG-BONE INJURY CRITERIA FOR USE

WITH THE ATB MODEL

by

Tim Hight

ABSTRACT

An existing computer program, the Articulated Total Body (ATB) model, calculates joint loadings, contact forces and segment positions for a 15-segment model of a human body subjected to high accelerations and wind loads. This project has attempted to augment this model by providing a means of predicting fracture in the long bones. Failure criteria which have been suggested in the literature are discussed, and a new set of criteria is developed. These new fracture criteria are based on reported stress vs. strain and strain rate properties for human bone in compression, and have been extended to also provide tension and shear loading criteria. Two forms of the criteria for ultimate stress are developed, one in terms of stress rate and the other in terms of pulse length. Demonstration results are presented for an aircraft ejection simulation which shows the maximum stresses and allowable stresses (both for stress rate and pulse length) as functions of time for the left lower arm.

Unsymmetric Laminates

by

Michael W. Hyer

Abstract

The report discusses the results of a study aimed at determining the room-temperature shape of unsymmetric laminates fabricated from advanced composite materials. Several families of laminates were used and the experimentally measured shapes were compared with the predictions of classical lamination theory. The correlation between theory and experiment is shown to be poor for thinner laminates. It is illustrated that the actual shapes of thin laminates are closer to right circular cylinders rather than the saddle shapes predicted by theory. This phenomena is repeatable within a batch of prepreg material and from batch to batch. Thicker laminates tend to conform to the predictions of classical lamination theory. A direction for theoretical work aimed at predicting the observed anomalies is discussed. As a method for discussing the shapes of unsymmetric laminates, Mohr's circle of curvature is introduced.

POSTCRACKING MODEL FOR FINITE ELEMENT ANALYSIS OF REINFORCED CONCRETE

by

Rafael Jiménez-Pérez

ABSTRACT

An incremental constitutive relation for the shear transfer mechanisms activated in cracked reinforced concrete elements is suggested in this paper for application to nonlinear finite element analysis. The relation derived considers the effect of the interface shear transfer stiffness and the dowel and axial stiffness provided by the reinforcement crossing the crack. A general load displacement curve for the dowel stiffness of the reinforcement that represents dowel failure by either concrete splitting or yielding of the reinforcement is included in the proposed relations. The displacements predicted by the stiffness coefficients derived are in very good agreement with experimental results.

A procedure is suggested by which the incremental constitutive relation for the postcracking mechanisms can be combined with the constitutive relations for the concrete and the reinforcement in a nonlinear finite element code based on the continuous or smeared approach. Several recommendations are also made for further research in this area.

Laser Velocimeter Signal Processing

by

R. H. Kerce, Ph.D.

ABSTRACT

The problem of processing the signals produced by a laser velocimeter for measuring velocity and turbulence in wind tunnels at Arnold Engineering Development Center (AEDC) is studied. Both simulated signals and real signals are analyzed by various techniques to discover methods of processing that would yield optional accuracies with minimal processing time. For photon-resolved (simulated) signals, it is found that a pre-whitening method called the "10-point polygonal curve fit" applied to the autocorrelation function (obtained from two or more signals) followed by the Fourier transform yields acceptable accuracies and can be implemented within allowable time frames. For classical signals, it is shown that acceptable accuracies can be obtained by directly windowing the raw signal with the "cosine bell" window followed by the Fourier transform.

A FAST WALSH TRANSFORM ELECTROCARDIOGRAM DATA COMPRESSION

ALGORITHM SUITABLE FOR MICROPROCESSOR IMPLEMENTATION

by

Walter S. Kuklinski

ABSTRACT

The feasibility of using a sequency ordered Fast Walsh Transform algorithm in a transformation - type ECG data compression scheme was demonstrated. The relationship of the mean square error between the original and reconstructed ECG signals as a function of the number of Walsh coefficients retained and the number of bits used to represent each coefficient was determined. A FIR (finite impulse response) digital lowpass filter was tested as a means of improving the diagnostic characteristics of the reconstructed ECG waveforms. Suggestions for further work in this area are included.

THE UNIQUENESS OF PHASE RETRIEVAL

FROM INTENSITY MEASUREMENTS

by

Dr. James H. L. Lawler

ABSTRACT

A four dimensional map of (1) gas temperature at depth versus (2) depth from the hot surface downward versus (3) hot surface temperature versus (4) time, has been prepared for a horizontal downward facing hot surface using natural convection and conduction from the surface, using a finite difference computer program. Use of dimensional terms rather than nondimensional terms reduced computer time over 100 fold from the more usual nondimensional techniques.

Ignition from heated surfaces was found to be a function of conditions in the gas film and not of bulk conditions.

TESTABILITY CONSIDERATIONS FOR DISTRIBUTED  
FAULT-TOLERANT COMPUTER SYSTEMS

by

Edward T. Lee

ABSTRACT

In this report, various testing methods and fault models are studied. Microprocessor test methods and four basic architectures for microprocessors are presented. According to uses, distributed fault-tolerant computer systems are classified into computation-critical applications, long life applications, high availability applications, signal processing applications, and maintenance postponement applications. Current distributed fault-tolerant computer systems including Micronet by Westinghouse for signal processing; Fault Tolerant Microprocessor (FTMP) by C. S. Draper Laboratory, and Software Implemented Fault Tolerance System (SIFT) by SRI International for critical applications; Cm\* developed at Carnegie-Mellon University, and Pluribus developed at Bolt Beranek and Newman, Inc. for general applications; and a Fault-Tolerant Building Block Computer (FTBCC) developed at the Jet Propulsion Laboratory for multiple applications are investigated. Future trends and suggestions for further research are offered.

A paper entitled "Software Fault Detection - A Case Study" has been submitted to the 5th International Conference on Software Engineering, March 8-12, 1981, San Diego, California. The abstract of this paper is in Appendix A. A second paper entitled "Diagnosable Test Approaches for Microprocessor Systems" has been submitted to the Johns Hopkins Conference on Information Sciences and Systems, March 25-27, 1981. The abstract of the second paper is in Appendix B. Based on this final report, I intend to submit a third paper to the Second International Conference on Distributed Computing Systems, April 8-10, 1981, Paris, France.

ON TRAINING MNEMONICS:  
THE ROLE OF METACOGNITION

by

BARBARA K. LINDAUER

ABSTRACT

The value of training mnemonic strategies in the assisting of instruction of technical materials has been recognized in both traditional classroom situations and computer managed instruction in the Armed Forces. However, the current training programs now in use do not include any information about cognitive awareness or metacognitive knowledge that students have in regard to the memory strategies they have available in their repertoire of study skills, the assessment of difficulty of the task or how memory performance will be evaluated. The role of metacognition, particularly awareness of one's own cognitive functioning and regulation of learning skills (the prediction, planning and monitoring of cognitive strategy execution) is examined. The current psychological literature on metamemory is reviewed and suggestions for implementation of new training strategies are made.

RADIATION DAMAGE PROFILES AND ANNEALING EFFECTS

OF 120 keV SULFUR IMPLANTS IN GaAs

by

Samuel C. Ling

ABSTRACT

The lattice damage in GaAs due to ion implantation of 120 keV sulfur ions is analyzed by Rutherford back-scattering-channeling method using a 350 keV proton beam. Damage profiles are studied in terms of the implantation fluence, the annealing temperature, ion species, and  $\text{Si}_3\text{N}_4$  encapsulation process. Results can be used to determine parameters for damage removal and to correlate with implant profiles from electrical measurements.

FINITE ELEMENT MODELING OF ELASTIC-PLASTIC CRACK GROWTH

by

Dr. Francis T. C. Loo

ABSTRACT

The results of the modeling of elasto-plastic fracture problem by using the initial stress finite element method are discussed. Eight-noded quadrilateral isoparametric elements were used in this analysis.

After brief discussions of the formulation of the stiffness matrix and the initial stress method, the procedure of the computation is extended in the analysis by using an incremental load process. Results of the sizes of plastic zones are presented in graphical form. Recommendations for future research are also included.

OPTIMUM SAMPLING TIMES FOR SPECTRAL ESTIMATION

by

Lonnie C. Ludeman

ABSTRACT

The problem of optimum sampling strategies for spectral estimation of Fourier-type signals in the case of finite discrete-time observation was investigated. It was shown that for finding minimum variance unbiased estimates of amplitudes of sine and cosine terms of a single frequency embedded in additive zero mean noise that equally spaced sampling is among the set of optimum solutions. It was also shown that for the white noise case samples taken at a non-uniform rate could be used to estimate the values of the signal at the uniform sample times, thus reducing the variances of the spectral estimates. This reduction in variance was directly proportional to the reciprocal of the ratio of sample rate to Nyquist rate. The estimates of the samples at the uniform rate could then be used as an input to any number of common spectral estimation procedures to determine the spectral content.

# GENERATION OF SINGLET DELTA OXYGEN

by

Richard J. McCluskey

## ABSTRACT

A liquid jet reactor for studying the chlorine-basic peroxide reaction is described. Procedures are given for determining chloride ion concentration in basic peroxide solutions. An extreme variation in measured reaction rate is discussed in detail. Possible modifications to the reactor for alleviating this problem are suggested. Changes in reaction rate with different base concentration are shown to be statistically significant. A subset of the experimental data gives a value for the overall transfer coefficient for absorption that compares well with published data on chlorine absorption by sodium hydroxide solutions.

AN INVESTIGATION OF THE INFORMATIONAL NEEDS  
OF THE ENGINEERING AND SERVICES LABORATORY

by

Thomas W. Mason

ABSTRACT

The general task of management is to know: "WHAT is done by WHOM, HOW and WHEN." A description is given of the current management reporting systems that are used at the Engineering and Services Laboratory -- MASIS, Manhour accounting, Status of Resources and CMIS-LS. These systems furnish the basic reports for the Technical Management Review (TMR).

The TMR can be significantly improved by having local access to locally produced data. Since the current database is about 3 megabytes in size, a variety of computing alternatives are available and are discussed. It is recommended that a computer be acquired with a suitable complement of terminals and be geared for the use of Project Officers.

TRANSIENT HEAT TRANSFER IN COATED SUPERCONDUCTORS

by

Albert Menard

ABSTRACT

The effect of coatings on the transient (of the order of one millisecond) heat transfer from superconductors to the surrounding helium bath is investigated. A computer model for calculating the response of a superconductor to pulses of heating is developed. This model permits the evaluation of the effectiveness of coatings in promoting heat transfer as a function of the properties of the coatings, particularly the specific heat and thermal conductivity of the coatings, the thickness of the coating, and the properties of the superconductor. A comparison of the predictions of this model with existing experimental data is given. The experimental test apparatus, built to verify the predictions of the model is described. Suggestions for future research in this area is offered.

FAST ALGORITHMS FOR TARGET LOCATION AND IDENTIFICATION

by

Dr. Francis L. Merat

ABSTRACT

Methods for target location and identification in digitized aerial imagery are investigated. Template matching is shown to be suitable for implementation under the RADC Automatic Feature Extraction System. Template image similarity and algorithms are examined which can recognize image similarity in fewer calculations than correlation. These sequential similarity detection algorithms have been implemented on the RADC PDP-11/70 and partial results are reported. A fast correlation algorithm has been developed but not tested. Suggestions for further research in fast similarity detection algorithms are offered.

SEVERAL APPLICATIONS OF GAME THEORY,  
MARKOV CHAINS, AND TIME SERIES MODELS  
TO TACTICAL AND STRATEGIC  
FIRE CONTROL SYSTEMS

by

Dr. Max Mintz

ABSTRACT

In this report we have briefly delineated a range of practical applications of three distinct classes of mathematical models to tactical and strategic fire control problems. The focus of the research effort reported here is the application of game theory, markov chains, and time series models in an integrated study for determining techniques to generate and/or evaluate evasive maneuvers for defensive fire control scenarios.

The applications paradigms include: Evasive Maneuvering Against GCI and Airborne EW Radar Systems; Evasive Maneuvering Against Enhanced AAA Fire Control; Evasive Maneuvering Against a Multiple Missile Threat.

A portion of this report summarizes research results obtained todate; the remainder of the report suggests avenues for further research effort.

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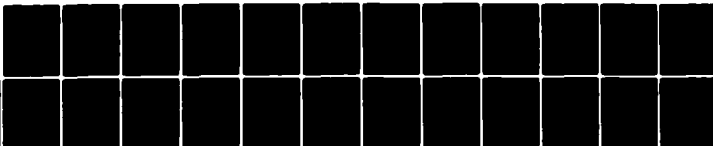
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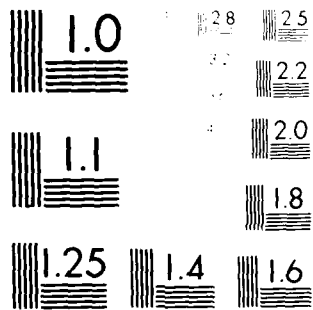
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THE EFFECTS OF DIFFERENT ENVIRONMENTS ON AUDITORY CANAL AND RECTAL TEMPERATURES

by

Leland F. Morgans

ABSTRACT

The effects that different inflight and preflight environments have on auditory canal and rectal temperatures were investigated. The various types of environments included the donning and removal of a flight helmet, different ambient temperatures, the type of material that was used to pack and cover the auditory canal, and whether or not a breeze was blowing past the subjects. Results obtained from these experiments have shown that: (1) the ambient temperatures had a significant effect upon both auditory canal and rectal temperatures; (2) the donning and removal of a flight helmet and whether or not a breeze was blowing past the subject had a significant effect on auditory canal but not rectal temperatures; (3) and the type of material used to pack and cover the auditory canal did not significantly affect either auditory canal or rectal temperatures.

# SIDE-LOBE MODULATION

by

Gene Moriarty

## ABSTRACT

This research effort considers the possibility of time-modulating an antenna's aperture such that, in the far-field pattern, the sidelobes are severely modulated while the main beam remains unmodulated. A number of different approaches are investigated. A method of time averaging of sub-arrays is found to produce the most significant results. The theoretical details as well as examples to illustrate this method are presented. Directions for further research in this area are suggested.

AUTOMATIC FAULT DIAGNOSIS  
OF A SWITCHING REGULATOR

by

Harry A. Nienhaus

ABSTRACT

This report describes a microprocessor-based system for the automatic fault diagnosis of a switching regulator. It covers the system development from a test philosophy to a working breadboard that correctly identifies single simulated faults in the switching regulator. In addition to open circuit, short circuit, and stuck at faults, the system is capable of diagnosing faults due to excessive leakage, drift in critical components, and system instability. The basic approach taken was to program the microprocessor to make the same logical decisions to isolate faults that the writer would make in troubleshooting a circuit. Self checking procedures for the automatic test equipment are also proposed. Suggestions for further research in this area are offered.

DYNAMIC ANALYSIS OF COUPLED STRUCTURES  
AND RELATIONSHIP TO TEST PROCEDURES

by

Sherif T. Noah

ABSTRACT

The problems arising in modal synthesis based on experimentally derived dynamic characteristics of separated structural components are investigated. A comprehensive review of existing synthesis techniques is presented and the relationship to test procedures is examined. It is concluded that the synthesis methods with the best potential for achieving experimental compatibility are those employing truncated sets of free-interface modes of the components plus an appropriate account for the effects of deleted modes. Feasibility of extending the free-interface component mode synthesis methods to enable utilization of complex modes is demonstrated. Recommendations for further research efforts are made.

AN APPLICATION OF GERT (GRAPHICAL EVALUATION AND REVIEW TECHNIQUE) TO AIR FORCE  
SYSTEMS DEVELOPMENT PLANNING

by

Dr. John C. Papageorgiou

ABSTRACT

Gantt charting is currently being used for planning the development of the different Air Force systems in association with established deadlines for reaching certain milestones. Given the complexity of the projects and the inherent uncertainty regarding their outcome, the GERT network modeling technique was tried as an alternative for their systematic planning and control. GERT is an improvement over PERT in allowing looping and probabilistic branching among its other features.

The Assault Breaker program was chosen as a case study and it was broken down into approximately five hundred activities. Taking into account the precedence relationship of the activities, the GERT network was constructed. Then, the parameters of the activity time distributions were estimated together with the activity realization probabilities and the network was simulated using a prewritten simulation software package.

The results of the simulation such as probabilities and time probability distributions for the realization of different events in the network or different paths of it and other kinds of statistics are considered valuable for planning and control. The benefits also derived from drawing the network were significant as people had to think and agree on a particular structure of the project and the interfacing of its component parts. Similar cost information could also be derived but it was not considered important for this case study.

THE ESTIMATION OF DECAY COEFFICIENT

IN PULSED TRANSIENT SIGNAL

by

C. J. Park

ABSTRACT

The estimation and interpretation of decay coefficient in pulsed transient signal are considered. Two methods are proposed in estimating the decay coefficient of pulse decay transient data. The methods are derived through a spectral analysis for a parametric model of impulse response function with a single frequency. Suggestions for further research in this area are offered. The estimation procedures proposed in this project can be extended to the case of multiple frequencies in an impulse response function and time dependent decay or growth coefficient.

A PRELIMINARY ANALYSIS OF ALTERNATIVE FORECASTING TECHNIQUES  
FOR THE STANDARD BASE SUPPLY SYSTEM (SBSS)

by

J. Wayne Patterson

ABSTRACT

The purpose of this research is to investigate alternative approaches to forecasting demand for expendable items in the Standard Base Supply System (SBSS). The forecasting models studied include single, double and adaptive exponential smoothing. Samples were selected from Dover AFB, Delaware and analysis of the various smoothing models was performed by a FORTRAN program written for each model. Comparison of the forecasting models was made on the basis of forecast error as measured by mean absolute deviation (MAD). The forecast error was also measured for the current forecasting model used by the SBSS. Single exponential smoothing, with small smoothing constants, proved to be the model with the lowest forecast error rate. Program activity was also studied as a possible tool to be used in demand prediction. Flying hours correlated with demand levels for some federal stock classes. Suggestions for further study are included.

QUANTITATIVE DETERMINATION OF

ODD-CHLORINE SPECIES

by

G. Earl Peace, Jr.

ABSTRACT

The feasibility of an analytical method yielding the sum of the concentrations of odd-chlorine species is investigated. The procedure would involve first reacting these odd-chlorine species with a strong, organic Lewis acid, which would be adsorbed onto the filter medium, to form HCl. The HCl would then be determined in aqueous solution using an ion-selective electrode. A quantitative, reproducible aqueous extraction procedure by which the HCl may be removed from the filter medium is described. The use of an integrating digital voltmeter and a programmable calculator to eliminate short-term noise fluctuations through a signal averaging technique allowed the ion-selective electrode to be used with good precision and reasonable accuracy well below its suggested lower limit. The Lewis acids could not be tested directly due to a lack of suitable filter media.

THE EFFECTS OF IMAGE MOTION AND ROTATION ON CONTRAST SENSITIVITY  
IN A LETTER DETECTION AND IDENTIFICATION TASK

by

J. Timothy Petersik

ABSTRACT

The effects of image motion and rotation are examined in a task in which subjects adjusted the contrast required to just detect and just recognize various stimuli consisting of (1) sine-wave gratings of various spatial frequencies and (2) Snellen letters of various sizes and rotations relative to the frontoparallel plane. Results show that motion enhances sensitivity in both tasks, but generally only with (1) low-frequency gratings and, paradoxically, with (2) small Snellen-letter targets. The advantage produced by motion generally depended upon velocity, target size, and target rotation. Other findings include the fact that sensitivity in the detection task always exceeded that in the identification task, the slope of the line relating sensitivity to target size increased with rotation, and sensitivity to small, moving targets increased with the energy of the targets. Suggestions for extending the results of this research are offered.

The Relationship of the Three Component Model of  
Leadership to the Development of Action  
Plans and Levels of Leadership

by

Dr. Thomas A. Petrie

This study analyzes the three component leadership model and its relationship to a hierarchical model of leadership. First, the Organizational Assessment Package designed to measure the three components of leaderships, situations and outcomes was analyzed to determine the congruence with the levels of leadership and potential contribution to order the data and direct the development of action plans. The face validity of this effort was confirmed by the consultants. Second, a factor analysis of the data revealed a congruence between the theoretical structure of leadership and the factor structure of leadership. Subsequent recommendations to study the longitudinal development of leaders would provide insights for the training of leaders.

REPORT 1  
FITTING NACA CAMBERED  
AIRFOIL DATA BY SPLINES

By

Louise A. Raphael

"... the experience should stiffen your backbone - you might  
call it splining your spine."

Anon

ABSTRACT

The question of finding the approximating function which best fits NACA cambered airfoil data and gives accurate information about the first and second derivatives is investigated. It was found that if the data is noisy, the best algorithm is the IMSL least squares approximation by cubic splines for variable knots. Cubic splines and derivatives have been calculated for the NACA data. To insure that users of the IMSL or Hewlett-Packard codes understand the basics of spline theory, an expository report on splines has been included. Finally, suggestions for further research is offered.

EVALUATION OF METHOD AND TECHNIQUE FOR FAST  
ESTIMATION OF ANTIOXIDANTS IN TURBINE ENGINE LUBRICANTS

by

DASARA V. RATHNAMMA

ABSTRACT

The present work describes setting up of an equipment and evaluation of the technique and method. Apparatus for determining the total effective concentration of chain stopping antioxidant species present in lubricants, described by Mahoney<sup>1</sup>, et al, was set up, made leakproof, and calibrated. Using this equipment, the method of estimating the antioxidant by titration with peroxy radicals released at a constant rate by the thermal decomposition of a free radical initiator was standardized. It was confirmed that the time required for the start of the rapid oxidation of the hydrocarbon substrate of the lubricant is proportional to the concentration of the antioxidant additive in the lubricant. The method can be applied to the study of new and used lubricants and predict possibly a chemical model for the useful lifetimes of aircraft lubricants.

DIGITALIZATION OF EXISTING CONTINUOUS-DATA CONTROL SYSTEMS

by

Kuldip S. Rattan

ABSTRACT

A computer-aided method for converting existing multiloop continuous-data control systems into digital control systems is presented. Digital controllers are synthesized by matching the frequency responses of the digital control system to that of the continuous control system with a minimum weighted mean square error. Formulas for computing the parameters of the digital controllers are obtained as a result. An example of digitalizing existing continuous flight controller for the longitudinal YF-16 aircraft is considered and the results obtained are compared with those obtained by the Tustin transform.

PHYSIOLOGICAL RESPONSES TO WEARING FIRE FIGHTER'S

ENSEMBLE ON THE TREADMILL

by

Marvin L. Riedesel

ABSTRACT

Twenty-three experiments conducted on three subjects describe considerable physiological cost to wearing the fire fighter's ensemble. The experiments involved variation in the work load, ambient temperature and clothing. Additional data are needed on two or three more subjects before the study can be published in the scientific literature. The data presented describe the wearing of the ensemble results in restricted evaporation of sweat, elevated body temperature, increased oxygen consumption and increased cardiovascular work.

EVALUATION OF THE BOMB DAMAGE REPAIR COMPUTER CODE

by

Lawrence C. Rude

ABSTRACT

An evaluation of the Bomb Damage Repair (BDR) Computer Code was completed. The evaluation consisted of outlining the structure and function of each subroutine and making a subjective appraisal. Comparisons between elastic solution of Boussinesq's equation for stresses and Steinbrenner's method of computing settlements were made. A section describing the use of the program is presented. A parameter study showing variations in crater repair is also presented.

In general the BDR computer code is a good finite element computer code. It has the capability of analyzing crater repairs, pavement structures and alternate launch and recovery surfaces. It has the capability for some non-linear material behavior as represented by Hardin's material laws, otherwise the program is a linear finite element program. The program contains axisymmetric and prismatic elements. The prismatic elements were considered to fall into a semi-analytic category and due care should be used regarding their use.

CRACK TIP VELOCITY MEASUREMENTS

DURING BRITTLE FRACTURE

by

Joseph H. Schmidt

ABSTRACT

A comprehensive review of the literature concerning elastodynamic stress fields in the crack tip neighborhood of a running crack and methods of measuring crack tip velocities has been conducted. Experiments have been suggested that should answer questions of fundamental importance and give insight to the running crack and its arrest.

# PRODUCTS OF FUZZY SUBGROUPS

by

H. Sherwood

## ABSTRACT

Products of fuzzy subgroups are defined and investigated. Some expected results are proved: the product of fuzzy subgroups is a fuzzy subgroup; products with the same, but permuted, factors are isomorphic; there is a natural isomorphism from any factor into the product. Functions called t-norms, are used to construct products of fuzzy subgroups--different t-norms giving rise to different products. A fuzzy subgroup must satisfy, among other things, a certain inequality; the strength of that inequality is important. Results are given relating the t-norm used in forming the product to the strength of the ensuing inequality. Some results indicate when a fuzzy subgroup can be expressed as a product of simpler ones. Suggestions are made for further research and a possible area of application to an important aspect of pattern recognition.

Characterization of Quasi-Correlated  
Mux Bus Traffic in a Guided Weapon

by

J.B. Sinclair

ABSTRACT

The characteristics of message traffic in a guided weapon featuring several federated processors communicating over a single time-multiplexed serial bus are analyzed. Data latency is of major concern, especially for weapon systems in which control loop information is transmitted on the bus. Message traffic is periodic in nature, and there is significant correlation between the transmissions of various messages. Three different line protocols are considered. Difficulties in achieving interprocessor synchronization may limit the effectiveness of a pure command-response protocol. Preliminary results from simulations of MIL-STD-1765 (proposed) and MIL-STD-1553B utilized in a dynamic bus allocation mode are presented, using an air-to-surface missile as a model of a typical application.

## VORTEX BREAKDOWN AND INSTABILITY

by

Shiva N. Singh

### ABSTRACT

A literature survey on the vortex breakdown phenomenon is presented. Several theoretical and numerical models which have been proposed and applied to explain the experimental observations concerning vortex bursting are reviewed. Required parameters to perform the related stability analysis have been identified. Appropriate criterion where possible are cited to assist engineers in estimating occurrence of vortex bursting. A numerical scheme to compute and verify some of the results for incompressible inviscid unstable modes is programmed on the computer at WPAFB. It is suggested that the influence of adverse pressure gradient on the vortex breakdown be investigated in detail and results thus obtained be compared with experiments under appropriate conditions.

AN APPLICATION OF INVARIANCE PRINCIPLE TO  
PILOT MODEL FOR NT-33 AIRCRAFT WITH VARIABLE  
COEFFICIENTS AND DELAYS

by

Akhourl S. C. Sinha

ABSTRACT

A method for analysing Pilot-induced oscillations (PIO) for NT-33 closed-loop pilot model when the retardations and coefficients are not constant is proposed. The fact that the retardations and the coefficients are not constant is justified due to the effect of wind shear and the neuromuscular dynamics of the pilot reflected in the available data. The nonlinearities in the model are also considered. The method is based on the use of a new description of such systems in terms of convolution equations. The spectral factorization of the entire functions of the exponential order is used to derive a criterion for the PIO-system with variable coefficients and variable delays under the assumptions of continuity and boundedness of these coefficients and delays. A Lyapunov functional is constructed which gives a criterion on the roots of a certain "quasi-polynomial", i.e., a polynomial in a variable and the exponential of that variable. The largest domain of attraction is obtained from the Invariance Principle. Recommendations for follow-on research in this area are suggested.

A MODEL AND POLDER TENSOR FOR MAGNETOSTATIC  
WAVE INTERACTIONS WITH METAL STRIPS

by

Charles V. Smith, Jr.

ABSTRACT

A novel technology for microwave (1-20 GHz) signal processing based on magnetostatic wave propagation in epitaxial Yttrium Iron Garnet films and utilizing the concept of transversal filtering has been developing during the past four years. The continued development of this technology is strongly dependent on the generation of more sophisticated models for prediction of the interaction of magnetostatic waves with various individual elements of a transducer or reflecting array which forms the transversal filter. This work presents a proposed method for the formulation of a boundary value problem for metal strips which may be utilized in the calculation of reflection and transmission factor of various elements in a given device model and a derivation of a generalized Polder tensor for application in such calculations. Recommendations are made for the further continuation of this work.

OPTIMAL CONTROL OF THE HEL BEAM

by

J. Eldon Steelman

ABSTRACT

The optimal control of the deformable mirror in a High Energy Laser is required to offset the turbulence in the atmosphere. Computer models suitable for finding the optimal control of each of the first five optical modes treated separately were developed. A detailed study of the tilt and control system model indicates that a Kalman estimator and an optimal control can provide satisfactory system response. Further research in this area is suggested.

A STUDY OF SELECTED FACTORS RELATING TO HUMAN  
RESOURCE MANAGEMENT IN THE AIR FORCE

by  
Philip Tolin

ABSTRACT

This report describes several activities performed in conjunction with the USAF - SCEE Summer Faculty Research Program. The major effort involved preparation of a USAF Human Resources Laboratory Technical Report describing the characteristics of accessions of CYs 1977 - 1979. Other projects involved work preparatory to the development of an exit interview survey instrument, assessment of the predictive efficiencies of alternative subscales of the History Opinion Inventory, a content analysis of comments related to pilot stress, and a preliminary literature review dealing with fighter pilot selection.

PROTON INDUCED NUCLEAR EVENTS IN SILICON

by

William P. Tucker

ABSTRACT

A direct result of the rapid advancements in the miniturization of electronic circuitry (in particular computer memory devices) is a marked increase in the susceptibility of these devices to the deleterious effects of high and low energy charged particles.

In various types of Random Access Memory (RAM) devices the high and low Z particles cause soft errors (zeroes converted into ones and vice-versa) or logic upsets. In this work one of the mechanisms, nuclear recoil, principally responsible for soft errors is investigated by irradiating various thicknesses of silicon with protons whose energies range from 51 to 158 MeV. The spectra of the energy deposited within the silicon slab is thus revealed.

A MODEL FOR THE THERMAL  
DECOMPOSITION OF TNT; THEORETICAL

REACTION PROFILES

by

Almon G. Turner

ABSTRACT

The molecule 1-nitropropylene has been investigated as a model system for the simulation of the thermal decomposition of TNT. Two distinct types of reaction mechanisms were considered: Intramolecular Mechanisms and Bimolecular Mechanisms. Intramolecular mechanisms investigated include an oxidative hydrogen atom transfer to form the diradical aci nitropropylene and an oxidative oxygen atom insertion reaction to form 1-nitro-3-hydroxy propylene. Semi empirical molecular orbital calculations (MNDO and MINDO/3) were carried out to obtain a reaction profile for these mechanisms, and indicated that the oxygen atom insertion reaction should lead to the reaction products, methyl nitrite and acetylene. This is not in accord with experiment. The profile for the oxidative hydrogen atom transfer was found to reproduce many of the features known for the thermal decomposition of TNT.

Bimolecular mechanisms considered included an oxidative hydrogen atom transfer from one nitropropylene molecule to another to form the 1-nitro-propylene radical and the aci form of nitropropylene and an intermolecular oxidative insertion reaction to form 1-nitro-3-hydroxy propylene and 1-nitroso propylene. Preliminary reports are given for these bimolecular mechanisms.

IMPROVEMENT OF TRAJECTORY TRACKING ACCURACY OF INSTRUMENTATION SHIPS:

A FEASIBILITY STUDY

by

V. Vemuri

ABSTRACT

The question of the feasibility of improving metric accuracy of radar data obtained from instrumentation ships is investigated. It is argued that major sources of error are tracking, navigation and stabilization. Using available data as a guide, it is argued that substantial improvements in metric accuracy are attainable if the present auto-tracking is upgraded to on-axis tracking with a Kalman-type filter in the tracking loop. It is also recommended that a simulation study be conducted to gain better insight into the nature of navigational and stabilization errors. These two recommendations are considered to be most cost-effective within the constraints of the mission under study.

A COMPARATIVE STUDY OF ORGANIZATIONAL STRUCTURES  
IN AIR FORCE MAINTENANCE ORGANIZATIONS USING A  
MACRO MODEL: POMO VRS 66-1

by  
Larry C. Wall

ABSTRACT

A historical analysis of the evolution of maintenance organization structures provides clues for understanding the two different organizational structures which are currently used by Air Force Maintenance organizations. Relying on the literature in the area of organizational theory, a macro model of performance in maintenance organizations was developed. The model was then utilized to compare and contract maintenance performance under the two different structural arrangements. After organizational behavior had been described, twenty one hypotheses were derived in order to compare performance. Several potential data collection instruments were discussed as to their feasibility for collecting data. No actual data was gathered; however, each hypothesis was discussed and a prediction as to its likely acceptance or rejection was made. Several recommendations for further research were proposed.

EVALUATION OF R&D PROGRAM ON COMPUTATION FOR SIMULATION

By

Professor Marshall Waller

ABSTRACT

An evaluation of the AFHRL R&D Program on Computation for Simulation was performed by examining the design and performance characteristics of the Advanced Simulator for Pilot Training, by reviewing the Air Force Systems Command current research objectives in science and technology, and by coordinating, formatting and analyzing project research data.

THE ASSESSMENT OF HUMAN FACTORS IN COMMAND CONTROL AND COMMUNICATION  
SYSTEMS: APPLICATION OF NON-PARAMETRIC RELATIVE  
OPERATING CHARACTERISTICS

by

Rik Warren

ABSTRACT

The problem of the assessment of human factors in command, control and communication systems is considered. Previous attempts at producing a practical quantitative method have failed and the reasons are discussed. The key to assessment is to conceive of a commander as a decision maker. The worth of a system is determined by its impact on a commander's decisions. Command decisions may be evaluated by signal detection theory. This theory provides two classes of performance indices: one of decision making quality irrespective of bias effects and one of inherent bias. Practical problems in applying classical methods are discussed and new methods and non-parametric indices are shown to be of operational value. The importance of assessing bias effects in  $C^3$  decision making is stressed.

THE EFFECT OF ROTATION, NOISE AND SIMILITUDE ON IMAGE  
MOMENTS AND MOMENT INVARIANTS

by

David H. Williams

ABSTRACT

Previous investigations have described two-dimensional moment invariant functions that are theoretically invariant to object orientation, and therefore useful for computer location and recognition of objects in digital images. In a real system, however, anomalies such as noise, computation errors, and less than perfect resolution of the object are present that would cause these functions not to be totally invariant. The objective of this study was to determine how these functions behave when faced with a limited number of such anomalies. The results indicate that moment invariants are very sensitive to the number and configuration of the object pixels, and to computation error introduced by discrete integration.

EVALUATION OF DEPOT MAINTENANCE COST  
ALLOCATION IN VAMOSC II

by

Paul L. Williams, Jr

ABSTRACT

As the operating and support costs become a larger part of the life cycle costs for a weapon system it becomes more important for those costs to be visible for management use. The Air Force Visibility and Management of Operating and Support Cost II system is a project to satisfy that need. This report is an evaluation of the depot maintenance portion of that system. All costs are not recorded by weapon system so an allocation procedure must be used. The model, data base, computer implementation and output product were evaluated. Ninety-five to ninety-eight percent of the depot costs are available for allocation; eighty percent are actually distributed. Discrepancies in the allocation ratios were found and one computer program produced erroneous output for FY79. There is a need for improved documentation. Suggestions for allocating more of the costs are made.

AN ANALYSIS OF THE PLANNED MULTIFUNCTION-MULTIBAND  
AIRBORNE RADIO SYSTEM (MFBARS) OPERATIONAL IMPACT STUDY: A MARKETING PERSPECTIVE

by

E.P. WINKOFSKY

ABSTRACT

In order to transition technological advancements, research laboratories must have the support of an appropriate operating command. The generation of such support requires the development of a suitable marketing strategy. This report develops such a strategy for MFBARS. It identifies the benefits of the MFBARS concept and the data necessary to support these benefits. In addition, future efforts inside and outside the lab needed to generate this data are detailed, and appropriate base-line documents are delineated. These efforts are then analyzed in terms of their responsiveness to the questions of the MFBARS Operational Impact Study.

APPLICATION OF RISK ANALYSIS IN THE  
ACQUISITION OF MAJOR WEAPON SYSTEMS

by

Dr. George H. Worm

ABSTRACT

An implementation of a statistical approach to cost risk analysis is developed in this paper. A general discussion of risk analysis is presented to familiarize the price analysis with the concepts involved and then forms are presented which allow for the implementation of a risk analysis. Appropriate definitions are given along with a step-by-step procedure. The results of the risk analysis are related to the effect of incentive contracts and several examples are presented.

PULSED PLASMA PLUME MODELING STUDY

by

Daniel W. Yannitell

ABSTRACT

The present state of knowledge relevant to the theoretical modeling of the exhaust plume of a solid teflon pulsed plasma thruster is examined. A phenomenological description of the sequence of events which occur during a single pulse of the thruster is given, followed by a discussion of existing analytical models and experimental investigation of the complex processes involved. Emphasis is placed on the uncertainties in the modeling and the difficulties involved in interpretation of experimental test-chamber data. Areas in which current information is inadequate are discussed, and suggestions are offered regarding further research deemed necessary to improve current understanding of the plume and its possible effects on spacecraft.

ANALYSIS OF EYE MOVEMENTS  
IN TARGET TRACKING AND DETECTION TASKS

by

Yehoshua Y. Zeevi

ABSTRACT

Preliminary experiments were conducted to determine and compare the effects of static and dynamic noise on target tracking and detection performance. It was found that saccadic latency increases as static masking noise is introduced. It was also shown that dynamic noise of the same spatial frequency content has a significantly more detrimental effect than static noise on subjects' target detection performance as manifested by longer saccadic reaction time and higher misses and false alarm rate. These results are discussed as they relate to hypotheses concerning the dynamic characteristics of channels involved in the early stages of visual information processing. The data were also consistent with previous findings in demonstrating that target luminance has a substantial effect on saccadic latency. This effect becomes even more pronounced in the presence of noise.

These results, corroborated by other studies concerning critical band masking and target detection, have important implications concerning design and specifications of ASPT in simulation of air-to-air and air-to-ground combat and evasion tasks.

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