THE UNIVERSITY OF ALABAMA
COLLEGE OF ENGINEERING
BUREAU OF ENGINEERING RESEARCH

1975 NASA/ASEE SUMMER FACULTY FELLOWSHIP RESEARCH PROGRAM

GEORGE C. MARSHALL SPACE FLIGHT CENTER

THE UNIVERSITY OF ALABAMA - AUBURN UNIVERSITY

FINAL ADMINISTRATIVE REPORT

submitted to
Office of University Affairs
NASA Headquarters
Washington, D.C.

Dr. B. F. Barfield, University Co-Director
Professor of Mechanical Engineering
The University of Alabama

Mr. Charles O. Jones, NASA/MSFC Co-Director
Electronics and Control Laboratory
Marshall Space Flight Center

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The University of Alabama

BER Report No. 199-94

September, 1975

UNIVERSITY, ALABAMA 35486

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HOST INSTITUTION

THE UNIVERSITY OF ALABAMA

UNIVERSITY, ALA.

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AUBURN UNIVERSITY

AUBURN, ALA.

NASA CENTER

MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALA.

AERONAUTICS AND SPACE RESEARCH 10 weeks, 2 June–8 August 1975

PROGRAM DESCRIPTION

The Marshall Space Flight Center at Huntsville, Alabama, became a part of NASA in July, 1960. It employs approximately 4200 persons. Marshall serves as one of NASA's primary Centers for the design, development and testing of space transportation systems, including large launch vehicles and engines for the Space Shuttle program. The Center also has a lead role in space flight payload planning, integration and management; and in the complete design, development and management of scientific projects such as the High Energy Astronomy Observatory and the Gravitational Redshift Space Probe.

The Center is currently involved in the direction and management of the following ongoing programs:

The Space Shuttle main engine and the Solid Rocket Boosters and External Tank, also for the Space Shuttle
The High Energy Astronomy Observatory
The Gravitational Redshift Space Probe
The Apollo/Soyuz Test Project
The Spacelab, operating with the Space Shuttle as a pressurized and habitable module
The Concept Verification Testing Program
The Laser Geodynamic Satellite

The Center has been assigned the lead role in the study and definition of several additional programs, primarily involving space payload planning, to include:

The Space Tug, a vehicle for delivery and retrieval of automated payloads. This stage will augment the Shuttle capability, particularly for high energy missions
The Large Space Telescope, on earth orbital, three meter-class optical telescope
Participation in the NASA Earth Observation Program

In addition, the Center is involved in the conceptual definition of Shuttle payloads in various disciplines such as life sciences, astronomy, solar physics, gravitational physics, zero-g cloud physics, and space processing. A solar electric propulsion vehicle stage is also being studied from a conceptual standpoint.

The laboratories of the Center have an extensive research effort underway in many disciplines of science and engineering related to the overall space exploration program.

GENERAL INFORMATION

Huntsville is also the home of the Redstone Arsenal where the Army Missile Command conducts military rocket research. One of the oldest communities in the state, Huntsville dates from 1805 and has changed from the "Watercress Capital of the World" to the "Space Capital." The population has grown from approximately 16,000 in 1550 to 130,000 in 1970.

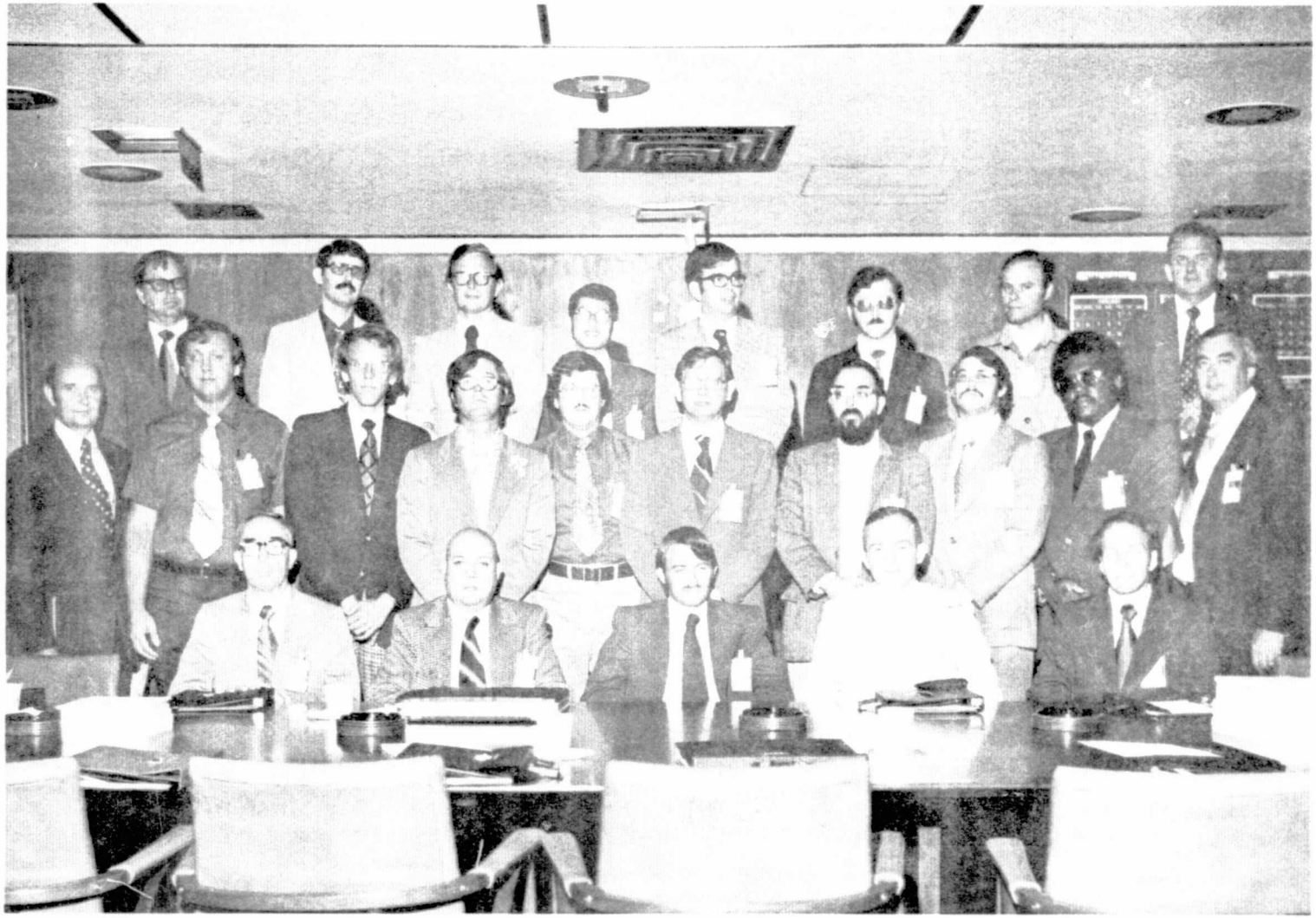
Transportation to and from Huntsville is provided by five major highways, two railways, and 35 scheduled airline flights per day. Direct flight service is available to Chicago, Washington, New York, Philadelphia, Detroit, Atlanta, Birmingham, Mobile, Nashville, Memphis, Knoxville, Chattanooga, New Orleans, and Miami.

Housing is available in the city of Huntsville. All apartments are air conditioned, have swimming pools and range from one to four bedroom garden or multiple unit buildings. Most feature wall-to-wall carpet, draperies, all electric kitchens, garbage disposals, barbecue areas, laundry facilities, and recreational rooms. Rentals range from $150 to $250.00. Thirteen major shopping centers and a central business district handle all types of goods and services.

Send request for additional information and/or completed application form to:

Dr. B. F. Barfield
Department of Aerospace Engineering,
Mechanical Engineering and
Engineering Mechanics
The University of Alabama
University, Alabama 35486
Telephone: (205) 348-6311

1975 NASA/ASEE SUMMER FACULTY FELLOWS - RESEARCH



Seated: Dr. Mott, Dr. Foreman, Dr. Martin, Dr. Oberly, Dr. Smith.
Middle Row: Dr. Bucher (NASA), Dr. Sergent, Dr. Carroll, Dr. Mitchell, Dr. Cosby, Dr. Kersten, Dr. Nunes, Dr. Douglas, Prof. Frazier, Dr. Barfield (U. of Ala.).
Top Row: Dr. Hall, Dr. Utter, Prof. Holmes, Dr. Pao, Dr. Newbolt, Dr. Hopkins, Dr. Fay, Mr. O'Brien (Auburn U.).
Not Shown: Dr. Biesbrock, Dr. Debney, Dr. Flowers, Dr. Shepard, Mr. Jones (NASA).

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LIST OF TABLES

SECTION I. INTRODUCTION

For the twelfth consecutive year a NASA-ASEE Summer Faculty Fellowship Research Program was conducted at the Marshall Space Flight Center (MSFC). The program was conducted by the University of Alabama and MSFC with assistance from Auburn University. It was operated under the auspices of the Space Engineering Committee of the American Society for Engineering Education. The Office of University Affairs, NASA Headquarters, Washington, D.C., sponsored this program as well as eight other Aeronautics and Space Research Institutes at various National Aeronautics and Space Administration centers in the United States.

The basic objectives of the program, which is in its thirteenth year of operation nationally, are:

(1) To further the professional knowledge of qualified engineering and science faculty members.

(2) To stimulate an exchange of ideas between participants and NASA engineers and scientists.

(3) To enrich and refresh the research activities of the participants' institutions.

Fellows spend 10 weeks at the Marshall Space Flight Center working on a research problem in conjunction with MSFC personnel, and attending lectures and seminars organized by the program co-directors. In addition, a tour is conducted of NASA facilities at MSFC and other technical facilities in the area. Fellows are normally invited to participate for two consecutive summers. The 1975 program began June 2, 1975 and continued through August 8, 1975.

At the completion of a Fellow's period of participation, there is no doubt that he has become familiar with the aims and objectives as well as the policies and procedures of NASA. As can be concluded from the Fellows' written comments summarized herein, the Fellows derive immeasurable benefit from participation on the program as, it is believed, does MSFC and NASA in general.

SECTION II. RECRUITING, SELECTION, AND ASSIGNMENT OF FELLOWS

Recruiting

As in past years, ASEE placed advertisements for the program in Aeronautics and Astronautics and the Journal for Engineering Education, and mailed brochures to a majority of the educators in the engineering and scientific community. In addition, the University of Alabama Co-Director mailed brochures and letters to a large number of deans, department heads, and individuals across the United States. Further, the MSFC Assistant Director for University Affairs sent letters and brochures to a large number of minority schools stressing the desire to increase the number of minority and women participants in the program. The Marshall Co-Director, through various members of the MSFC professional staff, contacted potential participants whose research interests were known to be of interest to MSFC personnel. The University of Alabama Co-Director also spent considerable time at professional meetings talking to individuals and groups of individuals in an effort to familiarize them with the NASA/ASEE Research Institute, the aims and objectives of these institutes and the potential value of the institutes to young engineering and science faculty members.

Selection

Selection of the participants was made by the following committee:

Dr. B. F. Barfield, University Co-Director, University of Alabama
Mr. Charles O. Jones, NASA Co-Director, MSFC
Mr. J. Fred O'Brien, Assoc. Director, Auburn University
Dr. George Bucher, Deputy Associate Director for Science, MSFC

Selection was made on the basis of applicant qualifications and MSFC research needs. Preference was given to minority applicants and applicants from schools with a minority student body.

Assignment of Fellows

The MSFC Co-Director solicits statements of potential research tasks from all areas of the Center. After the closing date for participant applications, the Selection Committee meets for the purpose of matching participants to the available tasks. This process results in a list of participants in order of preference. Based on the number of First-Year slots available, offers are made until all positions are filled.

After receiving an offer along with one or more potential tasks, the participant then contacts the person(s) at MSFC who generated the task statement(s). Together they select and finalize a research project for the Fellow to undertake.

This process was undertaken some years ago at MSFC and has proven highly satisfactory as evidenced by the fact that, since that time, every Fellow has had a well-defined project from the day he arrived at the Center. In most cases, the Fellows work with the same MSFC Counterpart both summers they spend at the Center.

In 1975, there were twelve positions available for First-Year Fellows. The first twelve on the priority list were contacted and all accepted. The twelve positions for Second-Year Fellows were filled by returnees from the 1974 program. Thus, a total of twenty-four Fellows participated in the research activities in 1975.

SECTION III. PROGRAM STATISTICS

The following is a summary of some of the program statistics with reference, when applicable, to the table in this report which presents the information in greater detail.

Number of Participants (Table I)

Second-year Fellows	12
First-year Fellows	12
Total	24

Distribution of Participants

GEOGRAPHICAL (TABLES II A, II B, AND III)

Number of states represented	15
Number of universities represented	21

DEGREES (TABLE IV)

Number of Fellows holding Ph.D.	22
Number of Fellows holding M.S.	2

ACADEMIC RANK (TABLE III)

Professors	4
Associate professors	9
Assistant professors	10
Instructors/Lecturers	1

DISCIPLINE

A complete breakdown by discipline is presented in Table IV.

MINORITY SCHOOLS

Minority schools represented	3

MINORITY PARTICIPANTS

Black	1
Chinese	1

TABLE I. PROGRAM APPLICANTS

First-Year Fellows	
First-Choice Applicants	34
Withdrew Before Application Deadline	0
Noncitizen Applicants	1
Number to Whom No Offer Was Made	21
Number Who Were Referred to Design Program (No Offer)	0
Number Who Declined Offer of Fellowship	0
Number Accepting Offer of Fellowship	12
Second-Year Fellows	
Number of People Contacted Who Were Eligible for a Second Year of Participation on the Program	15
Number Accepted for Second Year	12
Total Number of Second Year Participants	12
Grand Total - All Participants	24

TABLE II A. 1975 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
GEOGRAPHIC DISTRIBUTION
(FIRST-YEAR FELLOWS)

State	Number	University
1. Alabama	2	University of Alabama (1) University of Montevallo (1)
2. Arkansas	1	University of Arkansas (1)
3. Georgia	2	Atlanta University (1) Savannah State College (1)
4. Kansas	1	Wichita State University (1)
5. Mississippi	2	Mississippi State University (2)
6. Pennsylvania	1	Bucknell University (1)
7. Tennessee	1	University of Tennessee at Chattanooga (1)
8. Texas	1	University of Houston (1)
9. Virginia	1	Virginia Polytechnic Institute and State University (1)

TABLE II B. 1975 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
GEOGRAPHIC DISTRIBUTION
(SECOND-YEAR FELLOWS)

State	Number	University
1. Alabama	4	Alabama A & M University (1) Athens College (1) Auburn University (1) University of Alabama (1)
2. California	1	Modesto Junior College (1)
3. Florida	1	University of South Florida (1)
4. Georgia	1	North Georgia College (1)
5. Indiana	1	Ball State University (1)
6. Mississippi	1	Mississippi State University (1)
7. Nebraska	1	University of Nebraska - Lincoln (1)
8. Virginia	1	Washington & Lee University (1)
9. West Virginia	1	Marshall University (1)

TABLE III. DISTRIBUTION BY STATES AND INSTITUTIONS

Alabama
Alabama A & M University Dr. Walter G. Hopkins, III (Second Year) Associate Professor and Chairman; Engineering Technology Athens College Dr. Ashley M. Martin III (Second Year) Associate Professor and Chairman; Physics Auburn University Dr. B. D. Carroll (Second Year) Associate Professor; Electrical Engineering University of Alabama/Tuscaloosa Dr. Theodore D. Fay (Second Year) Assistant Professor; Physics and Astronomy Dr. Harold Mott (First Year) Professor; Electrical Engineering University of Montevallo Dr. J. William Foreman, Jr. (First Year) Professor of Physics & Chairman; Mathematics and Physics
Arkansas
University of Arkansas Dr. David E. Douglas (First Year) Associate Professor; Industrial Engineering

TABLE III. (Continued)

California
Modesto Junior College Mr. Leroy A. Holmes (Second Year) Instructor; Engineering & Physical Science
Florida
University of South Florida Dr. Jerry E. Sergent (Second Year) Assistant Professor; Electrical Engineering
Georgia
Atlanta University Prof. Donald O. Frazier (First Year) Assistant Professor; Chemistry North Georgia College Dr. Joseph A. Biesbrock (Second Year) Associate Professor; Biology Savannah State College Dr. Min-tai Pao (First Year) Assistant Professor; Engineering Technology
Indiana
Ball State University Dr. Ronald M. Cosby (Second Year) Associate Professor; Physics and Astronomy

TABLE III. (Continued)

Kansas
Wichita State University Dr. Bert L. Smith (First Year) Associate Professor; Aeronautical Engineering/Engineering Mechanics
Mississippi
Mississippi State University Dr. William B. Hall (Second Year) Associate Professor; Chemical Engineering Dr. Jerrel Reed Mitchell (First Year) Assistant Professor; Electrical Engineering Dr. W. Steve Shepard (First Year) Professor; Aerophysics and Aerospace Engineering
Nebraska
University of Nebraska/Lincoln Dr. Leendert Kersten (Second Year) Assistant Professor; Engineering Mechanics
Pennsylvania
Bucknell University Dr. Donald F. Utter, Jr. (First Year) Assistant Professor; Computer Science

TABLE III. (Continued)

Tennessee
University of Tennessee/Chattanooga Dr. David Flowers (First Year) Assistant Professor; Engineering
Texas
University of Houston Dr. Arthur C. Nunes, Jr. (First Year) Associate Professor; Mechanical Engineering
Virginia
Virginia Polytechnic Institute and State University Dr. George C. Debney, Jr. (First Year) Assistant Professor of Mathematics Washington & Lee University Dr. W. B. Newbolt (Second Year) Professor; Physics
West Virginia
Marshall University Dr. Ralph Oberly (Second Year) Assistant Professor, Chairman; Physics and Physical Science

TABLE IV. DISCIPLINE AND DEGREE DISTRIBUTION

First-Year Fellows (12)	Second-Year Fellows (12)
Ph.D., Mathematics (1)	Ph.D., Plant Pathology (1)
Ph.D., Industrial Engineering (1)	Ph.D., Electrical Engineering (3)
Ph.D., Electrical Engineering (4)	Ph.D., Physics (3)'
Ph.D., Physics (1)	Ph.D., Astrophysics (1)
Ph.D., Engineering (Materials) (1)	Ph.D., Engineering (1)
Ph.D., Mechanical Engineering (1)	Ph.D., Nuclear Physics (1)
Ph.D., Applied Mathematics (1)	Ph.D., Engineering Mechanics (Kinematics) (1)
Ph.D., Numerical Analysis (1)	M.S., Mechanical Engineering (1)
M.S., Chemistry (1)	

Combined

Mathematics	Ph.D.	1
Industrial Engineering	Ph.D.	1
Electrical Engineering	Ph.D.	7
Physics	Ph.D.	4
Mechanical Engineering	Ph.D.	1
Applied Mathematics	Ph.D.	1
Engineering (Materials)	Ph.D.	1
Numerical Analysis	Ph.D.	1
Engineering Mechanics (Kinematics)	Ph.D.	1
Plant Pathology	Ph.D.	1
Astrophysics	Ph.D.	1
Engineering	Ph.D.	1
Nuclear Physics	Ph.D.	1
Chemistry	M.S.	1
Mechanical Engineering	M.S.	1

TOTALS

Ph.D.	22
M.S.	2

AGE/SALARY SUMMARY

Second-Year Fellows

Average age	36.7 years
Average weekly salary (38 weeks)	$403.00

First-Year Fellows

Average age	37.0 years
Average weekly salary (38 weeks)	$406.00

SUMMARY OF LABORATORY ASSIGNMENTS WITHIN MARSHALL

Data Systems Laboratory	3
Electronics and Control Laboratory	4
Materials and Processes Laboratory	3
Payload Studies Office	1
Space Sciences Laboratory	5
Structures and Propulsion Laboratory	3
Systems Analysis and Integration Laboratory	2
Systems Dynamics Laboratory	3

TABLE V.

Table V presents a complete listing of the Fellows along with the name of their counterpart, their home institution, the laboratory in which they worked, and a brief statement indicating the nature of the project they undertook during the summer.

TABLE V. 1975 NASA/ASEE SUMMER FACULTY FELLOWSHIP RESEARCH PROGRAM

Second-Year Fellows		
Name - University	Counterpart - Laboratory	Research Project
Dr. Joseph A. Biesbrock North Georgia College	Mr. Sanford Downs - Data Systems Lab	Color, Color Infrared and Multispectral Imagery for Detecting Pine Beetle Infestations
Dr. B. D. Carroll Auburn University	Mr. John M. Gould - Electronics and Control Lab	Test Pattern Generation for LSI Logic Circuits
Dr. Ronald M. Cosby Ball State University	Mr. Leon Hastings - Structures and Propulsion Lab	Concentration Characteristics of the Cylindrical Fresnel Lens Solar Concentrator
Dr. Theodore D. Fay University of Alabama	Mr. Edgar R. Miller - Space Sciences Lab	Development of a Visual TV System to Observe X-Ray Stars
Dr. William B. Hall Mississippi State University	Mr. Marshall King - Materials and Processes Lab	Fracture Mechanics of Glass-Ceramics Materials
Dr. LeRoy A. Holmes Modesto Junior College	Mr. Raoul Lopez - Structures and Propulsion Lab	Heat Transfer to Large Cryogenic Propellant Tanks During Groundhold
Dr. Walter G. Hopkins III Alabama A & M University	Mr. Gerald Wittenstein - Systems Analysis and Integration Lab	Interactive Mission Planning Study
Dr. Leendert Kersten University of Nebraska	Mr. Will Thornton - Electronics and Control Lab	Teleoperator Wrist Design Concept

TABLE V. (Continued)

Second-Year Fellows		
Name - University	Counterpart - Laboratory	Research Project
Dr. Ashley M. Martin III Athens College	Dr. Robert L. Kurtz - Space Sciences Lab	Special Topics in HNDT
Dr. W. B. Newbolt Washington & Lee University	Mr. J. O. Ballance - Payload Studies Office	Interactions of a Plasma Beam in the Upper Atmosphere
Dr. Ralph Oberly Marshall University	Dr. Robert L. Kurtz - Space Sciences Lab	Holographic Studies of Microscopic Particle Fields
Dr. Jerry E. Sergent University of South Florida	Mr. S. V. Caruso - Electronics and Control Lab	Some Aspects of Adhesion in Thick Film Hybrid Microcircuits
First-Year Fellows		
Dr. George C. Debney, Jr. Virginia Polytechnic Institute and State University	Dr. R. Decher - Space Sciences Laboratory	Techniques of Global Analysis Applied to Gravitational Theories
Dr. David E. Douglas University of Arkansas	Mr. Jerry Weiler - Systems Analysis and Integration Lab	Development of an Interactive Manpower Information System
Dr. David Flowers University of Tennessee	Dr. John Glaese - Systems Dynamics Lab	Analysis of Magnetic Torquers for Backup Attitude Control of LST

TABLE V. (Continued)

First-Year Fellows		
Name - University	Counterpart - Laboratory	Research Project
Dr. J. William Foreman, Jr. University of Montevallo	Mr. Richard B. Hoover - Space Sciences Lab	Ray Trace Investigation of Several X-Ray Telescopes
Prof. Donald O. Frazier Atlanta University	Mr. Mike Clemmons - Materials and Processes Lab	Study of Some Physicochemical Properties of Chlorotriflouromethane (Freon 13)
Dr. Jerrel Reed Mitchell Mississippi State University	Mr. Barry Guynes - Systems Dynamics Lab	Modification of the CIP for Handling Systems Initially Closed-Loop Unstable
Dr. Harold Mott University of Alabama	Mr. D. O. Lowrey - Electronics and Control Lab	Surface Acoustic Wave Devices
Dr. Arthur C. Nunes, Jr. University of Houston	Mr. P. G. Parks - Materials and Processes Lab	Weld Puddle Physics
Dr. Min-tai Pao Savannah State College	Dr. R. Jayroe - Data Systems Laboratory	Study of Two-Dimensional Spatial Filtering in the Edge Enhancement of Multispectral Imagery
Dr. W. Steve Shepard Mississippi State University	Mr. T. F. Greenwood - Systems Dynamics Lab	Acoustic Simulation of SRB Heat Shield on Re-Entry
Dr. Bert L. Smith Wichita State University	Mr. John Key - Structures and Propulsion Lab	Analysis of Composite Plates

TABLE V. (Continued)

First-Year Fellows		
Name - University	Counterpart - Laboratory	Research Project
Dr. Donald F. Utter, Jr. Bucknell University	Mr. Ken Kadrmas - Data Systems Laboratory	Environmental Data Monitoring System

SECTION IV. SEMINAR PROGRAM

Wednesday
9:00 - 11:00
Room A-251
Building 4487

June 4	MSFC Tour
June 11	Self-Introduction of Fellows
June 18	Discussion of NASA-University Relations Mr. Marion Kent
June 25	ASTP, Dr. Bob Snyder & Mr. Art Boese
July 2	Laser Doppler Vortex, Milton Huffaker
July 9	Dr. Story Musgrave, NASA Scientist/Astronaut
July 16	Earth Resource Sensing Mr. Sanford Downs & Dr. Joe Biesbrock
July 23	Interactive Computer Systems Dr. John Moore
July 30	Solar Heating & Cooling Mr. Robert Middleton
August 6	NASA/ASEE Systems Design Study Presentation
August 7	Final Banquet hosted by University of Alabama, College of Engineering, Redstone Officer's Club
August 8	Final Meeting - Completion of Program Details

ACTIVITIES PROGRAM

June 4	Fellows' Tour of MSFC
June 12	Informal Supper - Shakey's Pizza
June 17	Wives' tour of MSFC Luncheon at Redstone Officer's Club
June 29	Family Tour of Alabama Space Center
July 7	Wives' Trip to "First Monday" in Scottsboro, Alabama
July 13	Annual Picnic, Point Mallard Park; Decatur
July 22	Family Film Night: Two Hours of NASA Films
July 25	Fellows' Tour of Brown's Ferry Nuclear Power Plant
August 7	Final Banquet for Fellows and their Wives - Courtesy of the University of Alabama, College of Engineering

ROLL TIDE!

SECTION V. SUMMARY OF EVALUATION QUESTIONNAIRES COMPLETED BY FELLOWS AND COUNTERPARTS

During the course of the program, the Co-Directors were in contact with the various laboratory personnel working with the Faculty Fellows and with supporting offices such as Public Affairs, Manpower Utilization, Training, etc. In conversations with these people it is apparent that this program is very well accepted. The program has received good publicity and is considered as a valuable link between NASA and the Academic Community. The many benefits to the Fellows are certainly obvious but most MSFC personnel also feel that the Fellows are making a worthwhile contribution to MSFC's assigned tasks. Total cooperation from every area within the Center was encountered by the Co-Directors. Perhaps the best testimonial to the program is the active competition among the various laboratories for assignment of Faculty Fellows to specific projects.

To document the feelings of the Faculty Fellows and their MSFC Counterparts, each Fellow and each MSFC Counterpart was asked to complete a questionnaire concerning the program. Part A of this section presents a facsimile of the questionnaire completed by the Fellows followed by a summary of the answers and comments of the Fellows. Part B presents the same information taken from the questionnaire by each Fellows' MSFC Counterpart.

PART A

FELLOWS' QUESTIONNAIRE AND SUMMARY OF COMMENTS

NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
EVALUATION QUESTIONNAIRE FOR USE BY ASEE SPACE ENGINEERING COMMITTEE

1. NAME _____
2. INSTITUTION _____
3. NAME OF NASA COUNTERPART _____
4. LABORATORY AND ADDRESS OF COUNTERPART _____
5. EVALUATION OF STIPEND (MEAGER, ADEQUATE, GENEROUS) _____
6. DID YOU HAVE DIFFICULTY IN FINDING HOUSING _____
7. WAS INFORMATION SUPPLIED PRIOR TO START OF PROGRAM SATISFACTORY? _____
8. SUGGESTIONS OF OTHER INFORMATION WHICH MIGHT HAVE BEEN HELPFUL _____
9. BRIEF DESCRIPTION OF RESEARCH TOPIC _____
10. DID YOU HAVE A REASONABLE CHOICE OF RESEARCH TOPIC AFTER ARRIVING AT MSFC?
11. WAS THE TOPIC CHALLENGING?
12. WAS THE TOPIC IN A FIELD SATISFACTORILY NEAR YOUR BASIC RESEARCH INTERESTS? ___
13. WERE YOUR RELATIONS WITH YOUR COUNTERPART SATISFACTORY FROM A TECHNICAL POINT OF VIEW?
14. SUGGESTIONS FOR IMPROVEMENT OF RELATIONSHIP _____
15. CONSIDERING THE CIRCUMSTANCES OF A SUMMER PROGRAM, WERE YOU AFFORDED ADEQUATE FACILITIES AND SUPPORT?
16. IF ANSWER TO 15 IS NO, PLEASE COMMENT _____
17. DO YOU FEEL THAT YOU HAVE BEEN STIMULATED TO CONTINUE OR EMBARK ON NEW RESEARCH AS A RESULT OF YOUR EXPERIENCE AT MSFC? _____
18. DO YOU ANTICIPATE THAT YOUR ACTIVITIES WILL RESULT IN A NASA CONTRACT WITH YOU? _____
19. DO YOU FEEL THAT THE RATIO OF TIME SPENT ON RESEARCH TO TIME SPENT ON OTHER ACTIVITIES SUCH AS SEMINARS AND TOURS WAS APPROPRIATE? _____
20. IF ANSWER TO 19 IS NO, PLEASE COMMENT _____
21. CONSIDERING THE WIDELY VARYING BACKGROUND OF THE FELLOWS, DO YOU FEEL THAT THE SEMINARS WERE REASONABLY INTERESTING AND VARIED? _____
22. COMMENT ON SEMINARS PRESENTED BY:
    A. OUTSIDE SPEAKERS _____
    B. MSFC SPEAKERS _____

23. PLEASE SUGGEST SPECIFIC INDIVIDUALS FOR FUTURE SEMINAR PROGRAMS (INCLUDE TOPIC AND ADDRESS):
A. OUTSIDE SPEAKERS _____

B. MSFC SPEAKERS _____

24. PLEASE COMMENT ON WHAT ARE, IN YOUR OPINION, THE WEAK POINTS OF THE PROGRAM _____

25. PLEASE COMMENT ON WHAT ARE, IN YOUR OPINION, THE STRONG POINTS OF THE PROGRAM _____

26. PLEASE MAKE FURTHER COMMENTS ON SUCH ITEMS AS TOURS, FACILITIES, SEMINARS, PROGRAM CONDUCT, EXPENSES, RESEARCH ASSIGNMENTS, ETC. _____

27. WERE YOU AWARE OF THE RESEARCH POTENTIAL AVAILABLE AT AND THROUGH MSFC BEFORE YOU BECAME A SUMMER FELLOW? _____

28. HOW WOULD YOU RATE MSFC AS A PLACE TO SPEND A SUMMER AS A FACULTY FELLOW? _____

29. HOW WOULD YOU RATE HUNTSVILLE AND ITS ENVIRONS AS A CITY IN WHICH TO SPEND A SUMMER? _____

30. ADDITIONAL COMMENTS:

SUMMARY OF FACULTY FELLOWS' REPLIES TO QUESTIONNAIRE

As would be expected from a program of this nature, the comments from the Faculty Fellows concerning the program were wide ranging. The comments were, however, almost unanimously positive. The following is a summary of the Fellows' replies and comments to the questionnaire; the numbers correspond to the sample questionnaire shown on the preceding pages.

5. The following replies were noted in the evaluation of the stipend:

Generous	0
Adequate	11
Meager	13

6. The following replies were noted concerning possible difficulty in finding housing:

Yes	1
No	19
Moderate	3

7. The following replies were noted as to whether or not the information supplied prior to the start of the program was satisfactory:

Yes	20
No	1
Marginal	1

8. While most of the Fellows felt the information supplied prior to the start of the program was satisfactory, there were several suggestions for improvement in the following areas:
   a. All information on the program should be mailed to the Fellows further in advance of the start of the program.
   b. Information should be sent concerning Fellows who wish to share rides and apartments.
   c. There is a need for more detailed information on travel reimbursement procedure.
   d. Information should include descriptions of camping facilities in the area.

9. See the abstracts in Section VII.

10. All the Fellows except one indicated that they had a reasonable choice of research topics after arriving at MSFC. One Fellow commented that he was assigned a topic after selecting a lab.

11. All the Fellows except one felt that their research topics were challenging. One of the Fellows said he did not have access to the proper equipment.

12. All the Fellows felt that their research topics were near their field of basic interest.

13. & 14. All the Fellows felt their technical relations with their Counterparts were satisfactory. It was suggested that first-year Fellows be put in contact with their Counterparts as soon as possible to avoid wasted time after arrival.

15. & 16. All Fellows except one felt that they were afforded adequate facilities and support. However, some indicated the need for improving the turnaround time for runs on the computers.

17. All of the Fellows indicated that they had been stimulated to continue or embark on new research as a result of their experience at MSFC.

18. The following replies are concerning anticipation of a NASA Contract this year:

Yes	13
No	3
Uncertain	8

19. & 20. Approximately 75% of the Fellows felt that the ratio of time spent on research to time spent on other activities such as seminars and tours was appropriate. Suggestions for improvement were as follows:
   a. Seminars sometimes run too long and should be limited to 1-1 1/2 hours.
   b. Seminar program is good for first-year Fellows but should be somewhat optional for second-year Fellows since some repetition is unavoidable.
   c. There should be a standardized time slot for all enrichment activities and tours to take place in.
   d. Seminars should be at 8 AM Mondays to avoid breaking up the work week.

21. & 22. All the Fellows felt that the seminars were interesting and varied. The comments indicated that each of the speakers presented an interesting view of his topic. Many Fellows indicated that more preparation was needed by some of the speakers and some felt that some of the talks could have been shortened.

23. The answers to this question are not tabulated here. Information will be used by Co-Directors to plan next year's seminar program.

24. Some of the comments on the weak points of the program were as follows:
   a. Small stipends.
   b. Program is too short; suggested extending it to 12 weeks.
   c. Should not be limited to two summers.

d. Security clearances should not be necessary for summer Fellows; or should at least be obtainable from previous clearances to cut down on the cost.
e. Travel expenses should be expanded to include more actual expenses such as furniture storage and expenses connected with finding an apartment.

25. Some of the comments on the strong points of the program were as follows:
a. Freedom to pursue research interests unhampered by usual day-to-day interruptions.
b. Opportunity to work on stimulating problems.
c. Good research facilities, excellent technical personnel.
d. Acquaints participant with research needs of NASA - and NASA with university capabilities.
e. The Fellows are able to make contacts with personnel at MSFC that might produce research support.

26. The comments under this item were extremely complimentary to the program. Some comments were:
a. The variety and quality of activities contribute greatly to the total program.
b. I am very satisfied with the program and pleased with the way it is handled administratively.

27. The following replies were noted concerning prior awareness of research potential available at MSFC:

Yes	10
No	11
Limited Extent	1

28. The following replies were made concerning MSFC as a place to spend a summer as a Faculty Fellow:

Excellent	15
Very Good	6
Good	3

29. The following replies were made concerning Huntsville and its environs as a city in which to spend a summer:

Excellent	5
Very Good	9
Good	6
Satisfactory	4

30. Some of the additional comments were as follows:
a. It was more enjoyable the second year due to the familiarity of people and mode of operation.

b. The insight one gains in the type of research NASA is interested in has to have a positive effect on some of his future research objectives.
c. The program in its entirety was very worthwhile. By experiencing the offerings and facilities of NASA, I am better able to carry out my research activities.
d. Of all the workshops, institutes, conferences, and summer programs I have participated in, I consider NASA/ASEE at MSFC to be the best and most beneficial.
e. The summer program has considerably accelerated my professional development and my research capability. I am pleased that I was chosen and would especially recommend the program to a young faculty member.

PART B

MSFC COUNTERPARTS' QUESTIONNAIRE AND SUMMARY OF COMMENTS

NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
EVALUATION QUESTIONNAIRE FOR USE BY ASEE SPACE ENGINEERING COMMITTEE

1. NAME
2. LABORATORY/DIVISION/BRANCH
3. NAME OF FACULTY FELLOW WORKING WITH YOU
4. WAS FELLOW ADEQUATELY PREPARED FOR HIS PROJECT?
5. COMMENTS ON PREPAREDNESS
6. DID FELLOW CONTRIBUTE TO RESEARCH PROGRAM?
7. COMMENTS ON CONTRIBUTIONS
8. COMMENTS ON FELLOW'S COOPERATIVENESS, DILIGENCE, INTEREST, ETC.
9. IN YOUR OPINION, HAS PARTICIPATION ON THE NASA/ASEE PROGRAM CONTRIBUTED TO AN INCREASE IN THE FELLOWS' POTENTIAL TO PERFORM RESEARCH?
10. WERE YOUR RELATIONS WITH THE FELLOW SATISFACTORY FROM A TECHNICAL POINT OF VIEW?
11. SUGGESTIONS FOR IMPROVEMENT OF RELATIONSHIP
12. CONSIDERING THE OVERALL OBJECTIVES OF THE PROGRAM, DO YOU FEEL THAT THE DIVISION OF TIME BETWEEN RESEARCH AND OTHER ACTIVITIES FOR THE FELLOW WAS PROPER?
13. COMMENTS ON DIVISION OF TIME
14. A. DO YOU FEEL THAT ASSOCIATION WITH A FACULTY FELLOW DURING THE SUMMER IS STIMULATING AND/OR BENEFICIAL TO MEMBERS OF YOUR BRANCH OR DIVISION?

    B. DO YOU FEEL THAT THE FACULTY FELLOW IS STIMULATED BY ASSOCIATION WITH MEMBERS OF YOUR BRANCH OR DIVISION?
15. PLEASE SUGGEST NAMES OF MSFC PERSONNEL (AS WELL AS TOPICS) WHICH YOU BELIEVE SHOULD PRESENT SEMINARS ON THE SUMMER PROGRAM

16. ASSUMING THAT ONE OF THE OBJECTIVES OF THE PROGRAM IS TO DISSEMINATE THE NASA "STORY" THROUGH THE FACULTY FELLOWS, DO YOU:
A. BELIEVE THE PRESENT PROGRAM IS EFFECTIVE? _____
B. HAVE SUGGESTIONS FOR IMPROVING THE DISSEMINATION THROUGH THE PRESENT PROGRAM? _____

17. WOULD YOU BE INTERESTED IN HAVING A FELLOW WORK WITH YOU IN FUTURE SUMMER PROGRAMS? _____

18. PLEASE STATE YOUR COMMENTS ON THE PROGRAM AND/OR RECOMMENDATIONS FOR IMPROVEMENT OF THE PROGRAM:

_____ _____
SIGNED DATE

FORM B (TO BE COMPLETED BY MSFC RESEARCH ADVISOR) BFB-1975

SUMMARY OF COUNTERPARTS' REPLIES TO QUESTIONNAIRE

As usual, the Counterparts' replies varied from simple "yes and no" to a detailed response to certain questions. There did, however, appear to be a consist nt feeling of enthusiam for the contributions which the Fellows had made during this summer's work. A desire to see the program continue and even be expanded or lengthened was also apparent. Pages 29 and 30 are facsimiles of the questionnaire used by the Research Advisors (Counterparts) for evaluating the program as a whole and the particular Fellow they advised. A summary of the replies follows:

5. Comments on the Fellows' preparedness were very complimentary. Some specific comments were:

   a. Fellow's academic background and his scientific curiosity resulted in a well organized approach to to our stated program objective.

   b. This is his second summer; he returned with plans for continuing the project of last summer well prepared and ready to begin the research.

   c. He has a detailed knowledge pertaining to the acoustic work relating to the Solid Rocket Booster reentry. We consider ourselves very fortunate to have an individual of his technical caliber.

   d. The Fellow's excellent credentials were not misleading.

6. All replies except one indicated that the Fellow made significant contributions to the research project. The reason given for this exception was that the research project was too novel and complex for any Fellow to make a contribution in 10 weeks.

7. Several replies made detailed comments outlining the Fellow's contribution. Some examples are:

   a. When the project is completed, it will be a contribution to the field. The work will be continued under contract.

   b. He performed optical raytracing that we could not have otherwise done.

   c. His inputs were needed and appreciated; the inputs were timely, appropriate, and technically accurate.

   d. He was able to significantly improve an image edge enhancement technique that was being used considerably.

e. He provided additional insights into the problem and developed additional simulation tools that will be useful in our future work.

f. Fellow ran the entire program this summer.

8. All Counterparts were favorably disposed toward the Fellows, their cooperation, their diligence and interest in their work. Such adjectives as "outstanding", "excellent", "cooperative", "professional" were frequently used. A few examples were:

a. Excellent in all areas; so interested in his work that he quite often worked after normal quitting time.

b. Fellow was very cooperative and fit right in with the MSFC engineers.

c. He works hard, nights included, and enjoys being helpful--I would say that he has been a "model person" for the Faculty Fellowship Program.

d. Fellow is a fine co-worker; it was enjoyable to have him here again.

9. Twenty-one replies indicated that the Fellow's research potential had been enhanced by participating in the program. The other two replies indicated the Fellow already had excellent research capability before participating in the program.

10. All Counterparts stated their relationship with the Fellow from a technical point of view was satisfactory.

11. The only suggestions for improving the technical relationships were extending the length of the program and earlier contact with the Fellow prior to the start of the program.

12.&13. All Counterparts felt the division of time between research activities and other activities was reasonable although several indicated the program should be longer than 10 weeks.

14. All but two Counterparts felt that their organization had been stimulated and/or benefitted from having associated with a Summer Faculty Fellow.

15. The answers to this question are not tabulated here, but the results will be used to plan future seminar programs.

16. All but one Counterpart believed that the "NASA Story" was effectively disseminated through the summer programs. The other simply stated he did not know.

17. All Counterparts indicated that they would like to have a Fellow work with them in future summers.

18. All replies were favorable to the program. A few of the suggestions and comments were:

    a. Prearrange for an extension of effort either in the Fellow's academic enivronment or here at MSFC.

    b. I think this program is worthwhile. It gives professors at the university level a chance to come face to face with the current problems in industry. At the same time, we in industry have a chance to discuss with the faculty their problems as well as their strengths or strong points with regard to an area of research. I'm convinced the money spent on university research gives the government the most for its dollar versus money spent in industry.

    c. I feel that the program is important in that it integrates the various advances in engineering from universities to NASA and from NASA to the universities.

    d. I feel the program is beneficial to the Fellow and to our division at NASA, and I'd like to see it continue.

    e. The program essentially worked as it should in this case. A genuine need for the Fellow's background existed. He was able to relate the "theoretical" to the "actual" and present his analytical results in a usable form.

    f. Very good program and I was impressed with the quality of the participants. Recommend 12 weeks.

    g. I personally believe that a significant percentage of Faculty Fellows should be recruited from minority institutions for the program to provide maximum all-around benefit to NASA.

SECTION VI. CONCLUSIONS AND RECOMMENDATIONS

A. The enthusiasm for the NASA/ASEE Summer Faculty Fellowship Program conducted at Marshall on the part of the Fellows, their Counterparts, and the Administration at Marshall continues to increase each year. It is therefore recommended to continue the program in the general outline as that of this year and previous years.

B. There are two areas which should be given consideration by the ASEE Space Engineering Committee and the NASA Office of University Affairs. These are:

1. Increase in Stipend. Each year there has been a widening gulf between the Fellows' average salary and the stipend. This year the weekly average salary of the First-Year Fellows exceeds the stipend by 48% and the average salary of Second-Year Fellows exceeds the stipend by 34%. It is strongly recommended that an effort be made to provide the funds necessary to narrow this difference.
2. Due to the remoteness of MSFC from housing available to Fellows as well as the absence of public transportation to the Center, an automobile is essential. While Fellows are advised to bring an auto for their summers at MSFC, no real provision is made to cover the expense of driving the vehicle to Huntsville or home. In particular those Fellows from all but the adjacent states usually do not receive proper reimbursement due to travel regulations and a lack of funds.

   At present, only direct second class air fare and, at most, two days travel is authorized as the maximum travel expenses paid. Both MSFC personnel and University personnel (Alabama and Auburn) feel that actual, reasonable, travel expenses for the Fellow (one person) should be paid; and, that one day of expenses should be allowed to locate an apartment after arrival in Huntsville.

   An alternate to actual expenses would be an allowance system based on miles from Huntsville. One formula might be:

Travel Allowance	
Less than 100 miles from Huntsville	$ 50
100 to 300 miless from Huntsville	75
300 to 500 miles from Huntsville	100
500 to 750 miles from Huntsville	140
750 to 1000 miles from Huntsville	180
Over 1000 miles from Huntsville	250

It should be noted that the brochures and flyers describing the various programs have always stated that "a travel allowance will be paid." Many of the Fellows have expected just that. If an "allowance" is not permitted in the future, it is recommended that the wording in the descriptive literature be changed.

C. Reports from the Fellows indicate that a number of low-cost, study-type contracts are being given to the Fellows to work on problems for MSFC back at their universities. While the exact reasons for this are speculative, a reasonable explanation appears to be that this is a means of obtaining high quality research during a period of reduced budgets. At any rate, it is an arrangement of considerable benefit to the Fellows and MSFC. Further, it is viewed as another proof that MSFC Counterparts find the Fellows' competence and assistance to be of real value to them. It is clearly encouraging to see that, even after twelve years, interest in and support for the program by MSFC personnel continues to grow.

SECTION VII. ABSTRACTS OF FELLOWS' FINAL REPORTS

This section presents brief abstracts of the final report prepared by each of the 1975 Faculty Fellows. A compilation of the complete report prepared by each Fellow will be published under a separate cover and copies distributed to the Fellows and program officials. Additional copies of the final reports can be obtained from either Dr. Barfield or Mr. Jones at the address shown inside the front of this report.

COLOR, COLOR INFRARED, AND MULTISPECTRAL PHOTOGRAPHIC COMPARISONS FOR DETECTING SOUTHERN PINE BARK BEETLES

BY

JOSEPH A. BIESBROCK

ABSTRACT

Color, color infrared, and multispectral photographic coverage for detecting southern pine beetle infestations have been procurred and analized. The merits of the various photographic comparisons and configurations are presented and discussed. Low altitude and high altitude aerial photographic capabilities are also discussed. Preliminary photo interpretation test items have been prepared; however, the test instrument has not been finalized. Preliminary ground survey data (i.e., silivical, biological, climatological, and geophysical factors) are presented. Arrangements for a continuing research effort are treated.

TEST PATTERN GENERATION FOR LSI LOGIC CIRCUITS

B.D. Carroll

ABSTRACT

Testing of large scale integrated (LSI) logic circuits is considered from the point of view of automatic test pattern generation. A system for automatic test pattern generation is described. A test generation algorithm is presented that can be applied to both combinational and sequential logic circuits. Also included is a programmed implementation of the algorithm and sample results from the program. Recommendations for continued study are also discussed.

CONCENTRATION CHARACTERISTICS OF THE CYLINDRICAL FRESNEL LENS SOLAR CONCENTRATOR

By
Ronald M. Cosby

ABSTRACT

Large plastic cylindrical Fresnel lenses have been proposed for use as solar concentrators in solar thermal power plants of the distributed field design. The suitability of Fresnel lenses for this application depends largely on their optical transmission and imaging properties with respect to the solar spectrum and solar source. The present study extends an earlier theoretical analysis of the concentration characteristics of a perfectly tracking, grooves down, cylindrical Fresnel lens solar concentrator. Simple ray optics and the laws of reflection and refraction are used to develop theoretical expressions for the transmission coefficient, the total lens transmittance, the geometrical behavior of sunlight refracted from individual serrations, and the distributions of concentrated sunlight beneath the concentrator. Chromatic aberration and the nature of the solar spectrum are accounted for in the theory. Numerical computer calculations for a 22 inch wide test lens with an f-number of 1.0 are presented. A defocus length parameter is included in the theory to allow future study of the sensitivity of the concentration characteristics to defocusing.

TECHNIQUES OF GLOBAL ANALYSIS APPLIED TO GRAVITATION THEORIES

By

George Debney

ABSTRACT

This study takes the non-symmetric unified field theory of Einstein, via Bonner's modifications, and interprets its geometrical and physical properties in the light of modern techniques. In this theory, there is also a symmetric part of the unified field identifiable with an ordinary torsion-free geometry for gravitation, plus the non-symmetric part taken to be an electromagnetic field. The main features of the unified field are displayed as part of a torsion-free geometry which contains another basic field (the torsion). The field equations are decomposed to exhibit similarities and differences between Einstein-Maxwell general relativity and the unified geometry. Subsequent investigations deal with the implications upon large-scale space-time structure.

DEVELOPMENT OF AN INTERACTIVE MANPOWER INFORMATION SYSTEM

by

DAVID E. DOUGLAS

ABSTRACT

The heart of any information system is its files or data base. The purpose of this project is to develop a Querry Language-Directed graphics interactive system to operate on a data base.

This Querry Language-Directed system allows the user to search, compute, update, display, and plot the data. The system is designed for the non-programming user, therefore, the Querry Language is format free. The system is used on a Graphics display terminal.

The Data Base for this system was designed for a particular application with considerations of access time, secondary storage space and update capabilities. Up to seven levels of hierarchical data can be utilized by this system. The data base will contain quarter data for four line items for FY 1976 through FY 1991.

DEVELOPMENT OF A VISUAL TV SYSTEM TO OBSERVE X-RAY STARS

by

Theodore D. Fay

ABSTRACT

A search for the visual counterparts of two unidentified cosmic X-ray sources was made with a UBVRI filter photometer. The photometric measurements reported will be used as standard fields for testing a video system to identify these X-ray sources. Twenty stars were selected whose positions were within the 0.5 degree error box at each X-ray source location. The optical flux was measured for each star using ultraviolet (U), blue (B), visual (V), red (R) and infrared (I) filters. The reported measurements were made with the UBVRI photometer on both NASA's 1.5 meter telescope and LPL's one meter telescope (LPL: Lunar and Planetary Lab, Univ. of Ariz.). These telescopes are located on Mount Lemmon near Tucson, Ariz. Measurements were made between 23-26 May, 1975. At the positions of each of the two X-ray sources (MX 1347-32 and MX 1716-31) only one star was found with U-B and B-V optical flux differences that are similar to the known X-ray source SS Cyg. The optical light of these given stars should be studied for spectral and time variations similar to SS Cyg. Finder charts for the stars are given in this report.

Known X-ray sources are reported by many observers to vary in time at both optical and X-ray wavelengths. Time scales and amplitudes of these variations can be used to establish the identification of the optical counterpart of each X-ray source. Time variations of the known X-ray sources, Cyg X-1, 3U1700-37 and SS Cyg were studied between 23-26 May, 1975 in addition to their colors. It was found to be impractical to monitor time variations of all possible optical companions of the unidentified X-ray sources during the available observing time. To overcome this problem, a visual TV system is being developed that will monitor 20-100 neighboring stars simultaneously. Stars previously measured with the UBVRI photometer can be used for TV system calibration.

A 25mm diameter SEC vidicon camera was modified during the past two summers to allow operation in an integration mode for low-light level astronomical work. The camera was mated this summer to a tilt-tunable Hα (656.3nm) and Hβ (486.1nm) filter system. We report filter transmission curves as a function of the tilt angle between the optic axes of camera and both the Hα and Hβ filters. Unfortunately, we find that the bandwidth (1.0nm) of the filter increases strongly with tilt (3nm/8 degrees). The wavelength of peak transmission decreases by 1.0nm for each 8.5 degrees of tilt. Tilting the filter is also undesirable due to a change in polarization of the transmitted light. Therefore, we are designing a filter slide system that would allow the camera to successively record Hα (656.3nm) and neighboring continuum (634.0nm) as well as Hβ and continuum.

ANALYSIS OF MAGNETIC TORQUERS FOR BACKUP ATTITUDE CONTROL OF LST

ABSTRACT

by

David C. Flowers

Two analytical methods are developed to facilitate design of magnetic torquer control algorithms. One method involves development of a maximum torque envelop which defines a three-dimensional bound on available average torque over a time interval. This method has application possibilities in preliminary/conceptual design or torquer control algorithms and equipment sizing studies. The second method involves use of a computer program for simulation of spacecraft dynamics while in earth orbit. This program is developed to give designers quick response to design questions via real time computer terminal operations. It includes effects of gravity gradient torques and magnetic torques. Both techniques have been used to analyze proposed LST magnetic torquer control algorithms. Some of these results are included.

ABSTRACT

Three separate tasks are covered in this report. First, a ray-trace analysis of the second stop design in an x-ray telescope system which is to be flown on a Skylark rocket was conducted. The second stop design was found to be satisfactory, but not optimum. Second, theoretical computation of the point-spread function for the S-056 x-ray telescope was made at several different points in its field of view for comparison with measurements made by R. B. Hoover. There was satisfactory agreement between theory and experiment. Third, the optical design of a new nested Wolter Type I x-ray telescope having a hyperbolic-aspheric channel in the inner mirror set was undertaken. The design of both sets of Wolter Type I mirrors was completed, but owing to lack of time the aspheric mirror design was not completed.

J. William Foreman, Jr.

SOME PHYSICHOCHEMICAL PROPERTIES OF CHLOROTRIFLOUROMETHANE (FREON 13)

By

Donald O. Frazier

ABSTRACT

A phenomenological study on the ease of crystal formation due to the lack of convection currents at zero-g is being pursued. Infra-red frequency shifts from vapor phase to condensed phase cannot be considered negligible, the average shift per normal mode for CF_3Cl being 6.0 cm^{-1}. Similar frequency shifts for the liquid-solid transition could prove interesting. Furthermore, in a 0-g environment, it is possible that frequency shifts may occur in the liquid as weak dipole-dipole interactions become more important due to a relatively convection free environment. Significant shifts in vibrational frequencies may effect, to some extent, thermodynamic functions at temperatures normally considered of the liquid state.

Gaseous Freon 13 force fields will be determined by the method of force constant adjustment, and fundamental frequencies compared with infra-red spectra. Condensed phase force fields near the freezing point will be similarly determined with careful attention given to the positions and intensity of the lattice modes. These modes may be most easily observed in combination bands with strong stretching vibrations in the vicinity of 1212 cm^{-1} (C-F stretch) or 780 cm^{-1} (C-Cl stretch).

Isotope effects will be theoretically calculated by use of the Begeleisen equation, assuming a reasonable condensed phase model, and compared with future distillation experiments. Zero point energy factors from energy partition function ratios can be related to the enthalpy of vaporization of CF_3Cl.

A 0-g spectrum at a temperature just above freezing will be obtained via an infra-red spectrometer, equipped with a low temperature absorption cell, and sample placed in a KC-135 flying in consecutive Keplerian ballistic arcs (chosen for relative ease of boarding).

FRACTURE MECHANICS OF A GLASS-CERAMICS MATERIAL

BY

WILLIAM B. HALL

Cer-Vit C-101 is a glass-ceramic material being considered for reflecting mirrors in space telescopes. One desired property characterization of Cer-Vit C101 is its fracture mechanics.

Fracture mechanics properties were determined by crack propagation studies made utilizing the constant load technique on double cantilever beam specimens. Data was taken in controlled temperature atmosphere of 100, 200, 300, 400, and 500 degrees fahrenheit. The crack velocity vs stress intensity factor data is presented in graphical form, and the data is consistent with the Charles-Hillig stress corrosion theory.

Recommendations for continuing the study are made.

HEAT TRANSFER TO LARGE CRYOGENIC PROPELLANT TANKS DURING GROUND HOLD

ABSTRACT

by

Leroy Holmes

The present study is a continuation of the development of an analytical capability for predicting heat transfer to large cryogenic propellant tanks during the ground hold period. Efforts were concentrated on (1) refining an existing computer model capable of predicting heat transfer to large cylindrical tanks subject to humid air crossflow and (2) on developing criteria for determining the limits of ice/frost formations on insulated tanks.

The principal improvement to the computer model consisted of the inclusion of a transient response capability. Excellent agreement of theory and experiment was obtained when the analytical results were compared to recent MSFC tests that were conducted under time varying ambient temperature, relative humidity and wind speed conditions.

Criteria were developed to show the effect of environmental conditions (including rain) on "worst case" ice/frost formations on insulated cryogenic propellant tanks. Predictions were made for limiting ice/frost formation rates on the Space Shuttle External Propellant Tank (ET). Results show that with one inch of spray-on foam insulation, the ice/frost formations on the ET will most likely be small.

INTERACTIVE MISSION PLANNING STUDY

By

Walter G. Hopkins, III

ABSTRACT

A review and analysis has been made of the present status and future potential of various technologies that are presently used or proposed as means for developing display devices. Descriptions of display parameters of interest are presented in a chart form that permits a comparison to be made among the technologies assessed. A discussion of the parameters and properties under consideration points out both merits and shortcomings of particular approaches. It is concluded that no one technology is so far superior that it will replace and supersede the others; each technology has promise and will find specific applications where it is superior.

A further survey is made of other aspects of interactive computing systems including system configuration and time-sharing capabilities. These studies are slanted towards present and future applications for interactive mission planning of such programs as the Space Shuttle. Examples of use and recommendations for the existing interactive design system now in use are made.

TELEOPERATOR WRIST DESIGN CONCEPT

by

Leendert Kersten

ABSTRACT

NASA is conducting increased research in the development of remote control technology to guide devices commonly designated as Teleoperators. These devices are considered for planetary explorations, satellite programs and space shuttle missions.

Among the technologies under advancement is the Remote Manipulator and this includes many areas such as

a. the development of structures, limbs and joints

b. the development of control systems and end-effector systems

This report deals with a development of a new wrist concept to satisfy many criteria;

1. the last three degrees of freedom of the manipultor (the wrist) shall be as close as possible to the terminus (hand) and shall have mutually perpendicular axes.
2. the joint shall be of such configuration as to provide a maximum of visibility.
3. the joint shall be capable of providing a torque of 15 ft.lb in each degree of freedom.

The concept has been properly documented and disclosed for future patent application.

HOLOGRAPHIC INTERFEROMETRY

by Ashley M. Martin, III

ABSTRACT

A system to provide pressure and thermal loading for HNDT has been designed and a prototype system has been assembled. The system provides pressure control and monitoring with an accuracy of $\pm$ .05 p.s.i. and temperature monitoring and control with an accuracy of $\pm$ .2 C^{o}.

Temperature gradients near hot and cool objects have been examined interferometrically. Included in this is an examination of the melting of ice in one "g" in order to supplement the analysis of the low "g" melting in the Skylab experiment.

MODIFICATION OF THE COMPENSATOR IMPROVEMENT PROGRAM FOR HANDLING SYSTEMS INITIALLY CLOSED-LOOP UNSTABLE

by Jerrel R. Mitchell

ABSTRACT

The Compensator Improvement Program (CIP) is a computer-aided design program that has been developed for aiding in the design of dynamic feedback compensation for flexible boosters. It is tailored for designing compensation for single input, multiple output systems. The specifications that this program attempts to achieve are frequency response in type. The CIP previously had the limitation that the initial compensation had to be sufficient for producing a closed-loop stable system; this report presents the theory and modifications to remove this limitation.

The basic theoretical approach for removing this limitation is to let CIP use frequency response data generated along a chosen contour in the s-plane that do not include right half-plane (RHP) closed-loop poles with break frequencies in the control frequency region. High frequency RHP poles are allowed inside the contour if they are to be gain stabilized. This report describes how CIP uses this information for designing compensation for stabilizing the system.

In order to apply the above mentioned theoretical approach, it is necessary to be able to generate frequency response information along chosen contours in the s-plane. A computer program, also described in this report, has been developed for accomplishing this for a specific vehicle configuration.

APPLICATION OF SURFACE ACOUSTIC WAVE TECHNOLOGY TO SPREAD-SPECTRUM COMMUNICATIONS

by

Harold Mott

ABSTRACT

Surface acoustic wave (SAW) tapped delay lines are convenient for generating coded waveforms for use in spread-spectrum communication systems. Code generation may be accomplished by using the SAW device as a delay line shift register with feedbacks from appropriate taps, or by driving the device with an electrical or acoustic impulse and summing tap outputs. Fixed biphase codes are generated most conveniently, but variable codes may be developed by switching the taps. Current technology restricts the frequency of SAW code generators to the range from a few megahertz to about 2 GHz, although X-band devices are being developed. Bit rates of 150 Mbits/s are within the realm of current fabrication ability. The most widely used substrate materials are quartz, with a small delay-time change with temperature, and lithium niobate, with a high electroacoustic coupling coefficient.

INTERACTIONS OF AN ION BEAM IN THE UPPER ATMOSPHERE

BY

W. BARLOW NEWBOLT

ABSTRACT

A simple model is proposed for the interactions of a 50 KeV, 1-amp, beam of CS ions (in the upper atmosphere). An attempt is made to include the effects of heating of ions by the ion source, the geomagnetic field, and elastic collisions between the beam and the constituents of the upper atmosphere. These considerations suggest that it is possible to deposit most of the mass and energy of the beam at an altitude of about 100 km and that the size of the beam spot at that altitude may be kept smaller than 8 km.

WELD PUDDLE PHYSICS

By

Arthur C. Nunes, Jr.

ABSTRACT

The pulsed-arc technique was applied to the gas shielded tungsten-arc welding (GTAW) process in the early 1960's for thin sheet applications with the intent of maintaining adequate penetration without excessive heating. It would appear from subsequent investigations of pulse GTAW that not only can one hope for gains in penetration but in reduction of porosity and other improvements as well. A clearer understanding of the mechanism by which pulsing affects penetration and porosity is needed in order to make most effective use of the technique.

Penetration, given a reasonably stable arc, appears to be controlled by a balance of heat flows into and out of the weld puddle. An experimental study showed current pulsing on flat position aluminum GTAW spot welds to reduce penetration at a noticeable surface wave resonance (about 8 kcps) as well as in the 1 to 10 cps frequency band. It was also found that fixtures can reduce penetration in an erratic way by as much as 16%.

Porosity formation requires nucleation and growth of bubbles in the molten puddle plus the successful operation of a bubble entrapment mechanism. An experimental study of porosity caused by grease pencil contamination inside a flat position weld seam showed no obvious pulse frequency effect.

A theory of bubble entrapment, which relates bubble size and growth rate to solidification rate in a criterion for porosity formation, can explain some features of porosity formation in welds.

HOLOGRAPHIC STUDIES OF MICROSCOPIC PARTICLE FIELDS

by

Ralph E. Oberly

ABSTRACT

An onboard holographic system has been proposed for the Space Lab/Shuttle system to study cloud formation under zero-g conditions. Various ground-based holographic geometries have been investigated in preparation for the onboard system. The feasibility of using a mode-locked, cavity-dumped ion laser as the holographic coherent light source has been studied. A laboratory based system has been assembled for viewing the cloud chamber holograms using a video display system with semi-automatic data collection and recording devices.

The Study of Two-Dimensional Filtering in the Edge Enhancement of Multispectral Imagery

By
Min-tai Pao

Abstract

In the unsupervised classification of Earth Resources Technology Satellite (ERTS) multispectral imagery, it is desirable to find edges or boundaries which completely surround all spectrally different ground features. However, this is not always possible because sometimes changes within a particular feature are as large as changes existing between different features that are geographically adjacent.

In this research, a method has been developed to improve the boundary map of multispectral imagery. The distinct feature of this method is that it first classified each data point as boundary point, or as undecided point, or as non-boundary point according to the degree of its feature change, and then employs two-dimensional logical filtering operation to convert some (or all) of the undecided points into either boundary points or non-boundary points. The procedure has been tested on real data and the results are tendered.

Also included in this research is a study of frequency composition of the raw data and the effect of data smoothing on the boundary map.

ABSTRACT

Some Aspects of Adhesion in Thick Film Hybrid Microcircuits

by

Dr. Jerry E. Sergent
University of South Florida

This paper considers two aspects of adhesion in thick film hybrid microcircuits; the degree of adhesion of a fired film to an alumina substrate and the electrical properties of silicon transistors which have been attached to thick film metallization with conductive adhesives.

The standard method of measuring the adhesion of thick films is to solder a #20 tinned copper wire to an 80 x 80 mil pad of the conductor, bend the wire 90^{o} exactly 50 mils from the pad, and pull the wire at a steady rate until the conductor pad pulls away from the substrate. The force required to accomplish this is measured and recorded as the adhesion. This paper considers the effects of processing variables, such as multiple firings, temperature storage, and temperature cycling on the adhesion of thick films.

In the second part of the paper, the effect of long term temperature storage on silicon transistors which have been attached with conductive adhesives is determined. In this study, 3 gold epoxies, 2 silver epoxies, a silver polyimide adhesive, and a silver polyamide-imide adhesive are used to bond 2N2369 transistor chips to a conductive pad.

After storage at $150^{o}C$, the V_{CE} (SAT) of these transistors is measured and compared to that of transistors which have been eutectically bonded and subjected to the same conditions.

ACOUSTIC SIMULATION OF SRB HEAT SHIELD ON REENTRY

By

W. Steve Shepard

Preliminary calculations of the acoustic environment for the SRB on reentry gave maximum sound pressure levels in the 180 db range which were conservative since peak levels around 190 db were measured on a 0.5 percent scale model. It is desired to keep the levels below 164 db to avoid damage to components located in the skirt cavity of the SRB. In this report several calculations are presented and their results compared on estimating the peak sound pressure levels for the SRB on reentry. Levels of 190 db are confirmed. Also, the effect of air dissociation and ionization, due to aerodynamic heating, on the acoustic sound field is discussed, and its effects are shown to be negligible.

All of the calculations and measurements to date have been performed on models without the flexible heat shield which is to be installed between the skirt and nozzle to protect the components located in the skirt cavity. The omission of the flexible heat shield is a result of a delay in deciding on a final heat shield design and the lack of technical capability to accurately simulate it. In this report the influence of the flexible heat shield on the acoustic field generated by the SRB on reentry is discussed. Some initial similarity parameters have been derived from the differential equations describing the phenomena and are presented herein. An investigation has been initiated on determining the sound pressure levels and the fundamental frequencies expected for the SRB on reentry with its heat shield in place, however, no significant results have been obtained at this time, thus, they will be presented in a future report.

ANALYSIS OF THIN LAMINATED COMPOSITE PLATES

by

Bert L. Smith

ABSTRACT

This paper contains two methods for analyzing thin laminated composite plates. The first method is a classical method for determining deflections and stresses from the principle of stationary work by the method of Ritz. Lagrange multipliers are used to enforce any forced boundary conditions not satisfied by the assumed deflection functions. In the second method, equations are developed for determining the properties of an orthotropic plate which is "equivalent" to the thin laminated composite plate. Once these properties are known, the composite plate can be analyzed using either classical orthotropic plate theory or any finite element program that contains an orthotropic plate element. Both methods allow for any form of external loading, and for effects from temperature change.

Environmental Data Monitoring Systems

by

Donald F. Utter, Jr.

The design of the hardware and software for an environmental data monitoring system which has low power consumption and is relatively inexpensive is presented. The design is specifically oriented to the problem of wind energy conversion sitings. Data is needed to determine if wind energy is available at a site and then the distribution of changes of wind directions at the site determine the optimal choice of parameters of a wind energy conversion unit.

The hardware consists of a sensor, interface, M6800 microprocessor and a magnetic tape recorder. The software embodies the decisions of the type of data to record and the algorithms to process the data. By including a microprocessor in the hardware, the system has "distributed intelligence" to process the data while sampling. Also, the microprocessor allows easy system modifications by simply changing the software to accommodate new applications. These applications include solar heating and cooling, water quality and air pollution.

The decision on the type of data to record and output are crucial. The volume of data is significantly reduced by recording changes in the data instead of all the data. Also, the output on magnetic tape is a complete report for most purposes and does not require further processing.