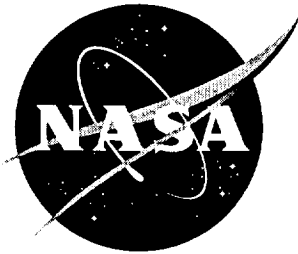


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1997 NASA-ODU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program

Compiled By

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SECTION 1

ORGANIZATION AND MANAGEMENT

The 1997 Old Dominion University (ODU)-NASA Langley Research Center (LaRC) Summer Faculty Fellowship Research Program, the thirty-third such institute to be held at LaRC, was planned by a committee consisting of the University Co-Director, LaRC Staff Assistants (SAs) from the research Groups, and the Office of Education.

An initial assessment of each applicant's credentials was made by the University Co-Director and the NASA LaRC University Affairs Officer. The purpose of this assessment was to ascertain to which Division the applicant's credentials should be circulated for review. Once this determination was made, an application distribution meeting was scheduled with the SAs where applications were distributed and instructions concerning the selection process were discussed. At a later date, the SAs notified the ASEE office of the selections made within their Group.

The University Co-Director then contacted each selected Fellow by phone extending the individual a verbal appointment, which was followed up with a formal letter of confirmation. Individuals were given ten days to respond in writing to the appointment. Once the letters of acceptance were received, a roster was sent to each SA advising them of their Fellows for the summer program.

Fellows accepting the appointment were provided with material relevant to housing, travel, payroll distribution, and the orientation. Each Fellow, in advance of commencing the program, was contacted by his or her Research Associate or representative of the branch.

Each Fellow and Research Associate received a 1997 ASEE Policies, Practices, and Procedures Manual that clarified many commonly asked questions up front regarding the roles, responsibilities, policies, and procedures of both parties. This manual was very beneficial and will be updated annually to be used in the years to come (Appendix XII).

At the Orientation meeting, Dr. Samuel E. Massenberg, Director, Langley Office of Education, officially started the first day of the summer program by welcoming everyone to LaRC. He was followed by Mr. Edwin J. Prior, Deputy Director, Langley Office of Education, who introduced the Administrative Staff and presented an overview of Langley Research Center. The program overview was presented by Mr. Roger A. Hathaway, University Affairs Officer. Ms. JoAnn Rocker provided a technical library briefing. A program breakout session was next on the agenda, enabling the ASEE administrative staff (Dr. Surendra N. Tiwari-ASEE Co-Director, and Ms. Debbie Young-ASEE Administrative

Assistant) to meet with the 1997 Fellows to discuss administrative procedures and answer questions. Following the breakout session, the Fellows were greeted by their LaRC Associates who then escorted them to their respective work sites. An evaluation of the orientation meeting was completed; refer to Section VI for results.

On the evening of the program's first day, the orientation continued with a networking reception at the local Omni Hotel. The Fellows had the opportunity to meet and interact with their colleagues. They were also requested to sign up for small Research Interest Groups within their discipline and project areas. Throughout the summer, these groups met for lunch following the weekly lectures to discuss their areas of interest.

Throughout the program, the University Co-Director served as the principal liaison person and had frequent contacts with the Fellows. The University Co-Director also served as the principal administrative officer. At the conclusion of the program, each Fellow submitted an abstract describing his/her accomplishments (Appendix IX). Each Fellow gave a talk on his/her research within the Division. The Group SAs then forwarded to the Co-Director the names of the Fellows recommended within their Group for the Final Presentations. Six excellent papers were presented to the Fellows, Research Associates, and invited guests. For the third year, the presentations were judged by a panel of LaRC researchers for "The Best Research Presentation" competition (Appendix II). The Final Presentations were concluded with a luncheon at the Langley Air Force Base Officer's Club.

Each Fellow and Research Associate was asked to complete a questionnaire provided for the purpose of evaluating the summer program.

SECTION II

RECRUITMENT AND SELECTION OF FELLOWS

Returning Fellows

An invitation to apply and possibly participate in the Old Dominion University (ODU)-NASA Langley Research Center (LaRC) Program was extended to the individuals who held 1996 fellowship appointments and were eligible to participate for a second year. Seventeen individuals responded to the invitation and eight accepted offers of appointment (Table 1). Thirteen applications were received from Fellows from previous years. Seven were selected.

First Year Fellows

Although ASEE distributed a combined brochure of the summer programs, many personal letters were mailed to deans and department heads of various engineering schools in the East, South, and Midwest, by Dr. Surendra N. Tiwari of Old Dominion University (ODU) and Prof. John H. Spencer of Hampton University (HU) requesting their assistance in bringing to the attention of their faculties the ODU-HU-NASA LaRC program. In addition to the above, a number of departments of chemistry, physics, computer science, and mathematics at colleges (including community colleges) and universities in the state of Virginia, as well as, neighboring states were contacted regarding this program. Although minority schools in Virginia and neighboring states were included in the mailing, the Co-Director from HU sent over three hundred letters to deans and department heads, and to all of the minority institutions across the United States soliciting participants (Table 2). Additional recruiting efforts included either attendance at or providing information for several of the minority conferences. These efforts resulted in a total of ninety-four formal applications indicating the ODU-HU-NASA LaRC program as their first choice, and a total of thirty applications indicating the aforementioned as their second choice. The total number of applications received came to one-hundred twenty-four (Table 3).

Forty-six applicants formally accepted the invitation to participate in the program. Four applicants declined the invitation. A few Fellows delayed their response while waiting for other possible offers from other programs. The top researchers tend to apply to more than one program, and will make their selection based on research interest and stipend. Twenty-three positions were initially budgeted by NASA Headquarters. Twenty-three positions were funded by the LaRC Divisions (Table 4).

The average age of the participants was 41.5.

Table 1 - Distribution of 1997 ASEE Fellows by Year in Program

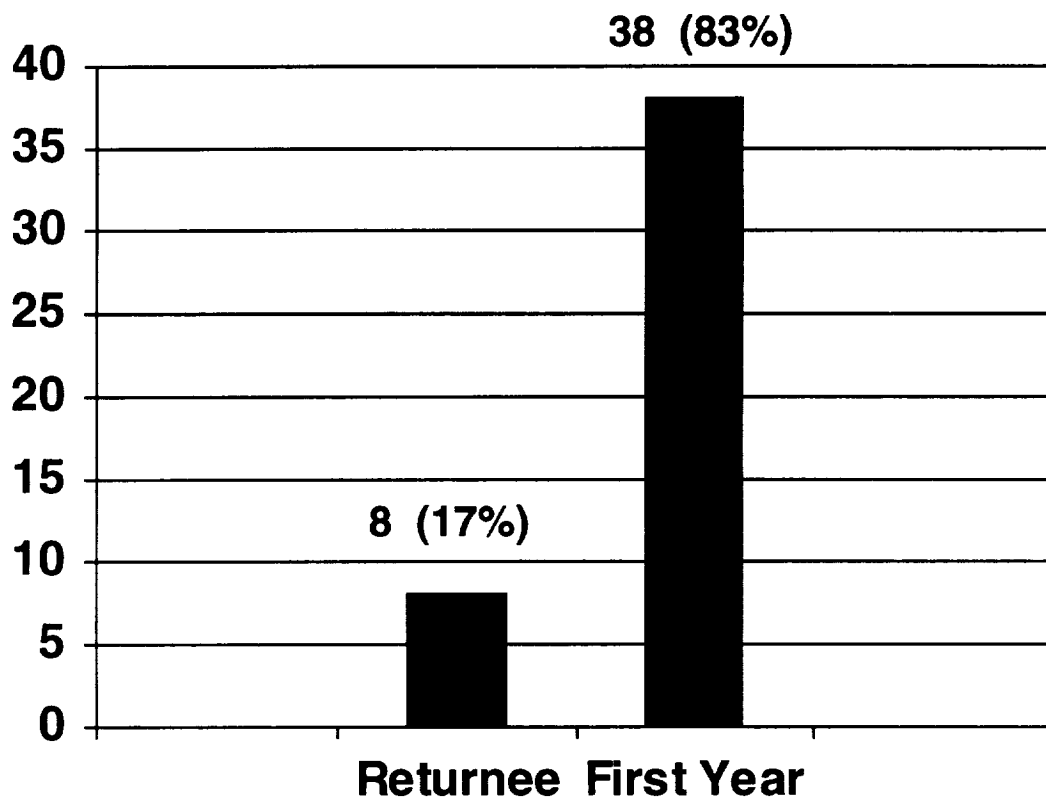


Table 2 - Distribution of 1997 ASEE Fellows by University

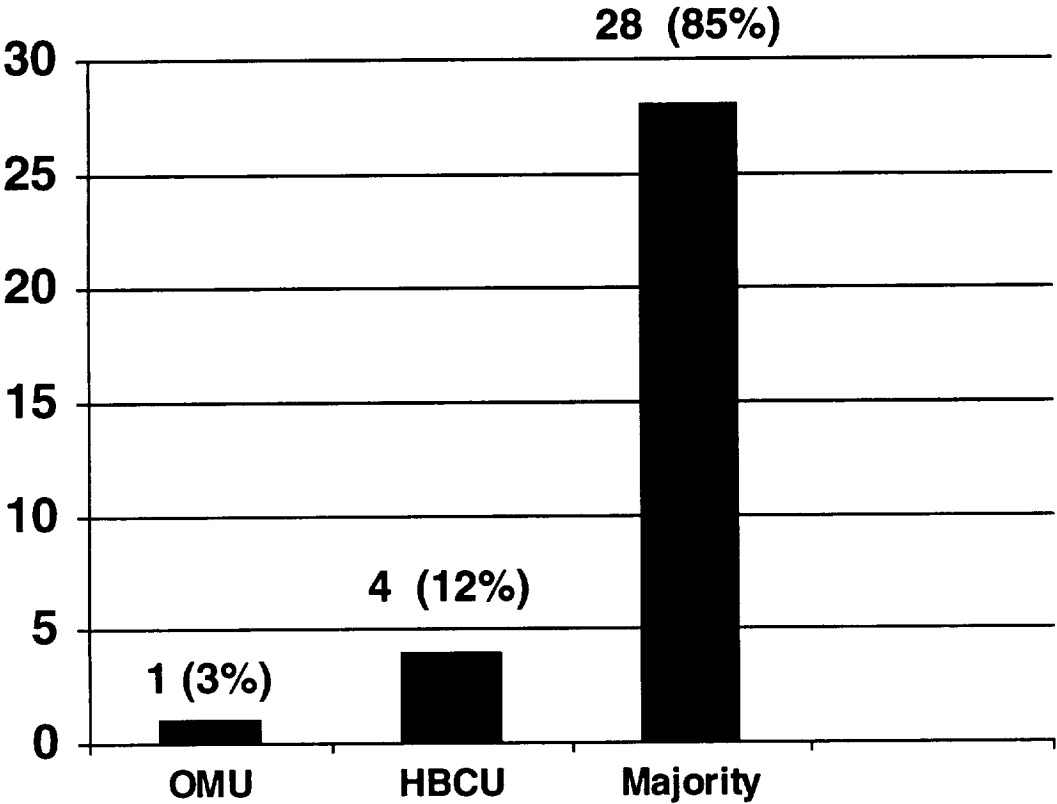


Table 3 - Distribution of 1997 ASEE Fellows by Selection

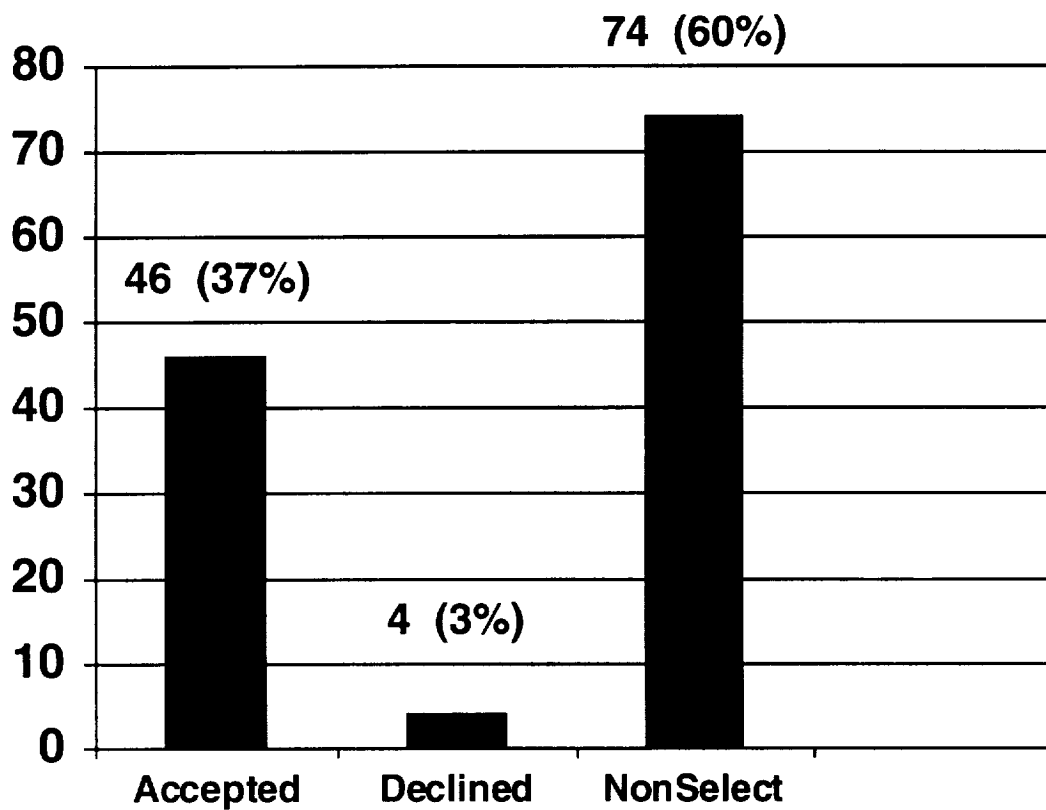
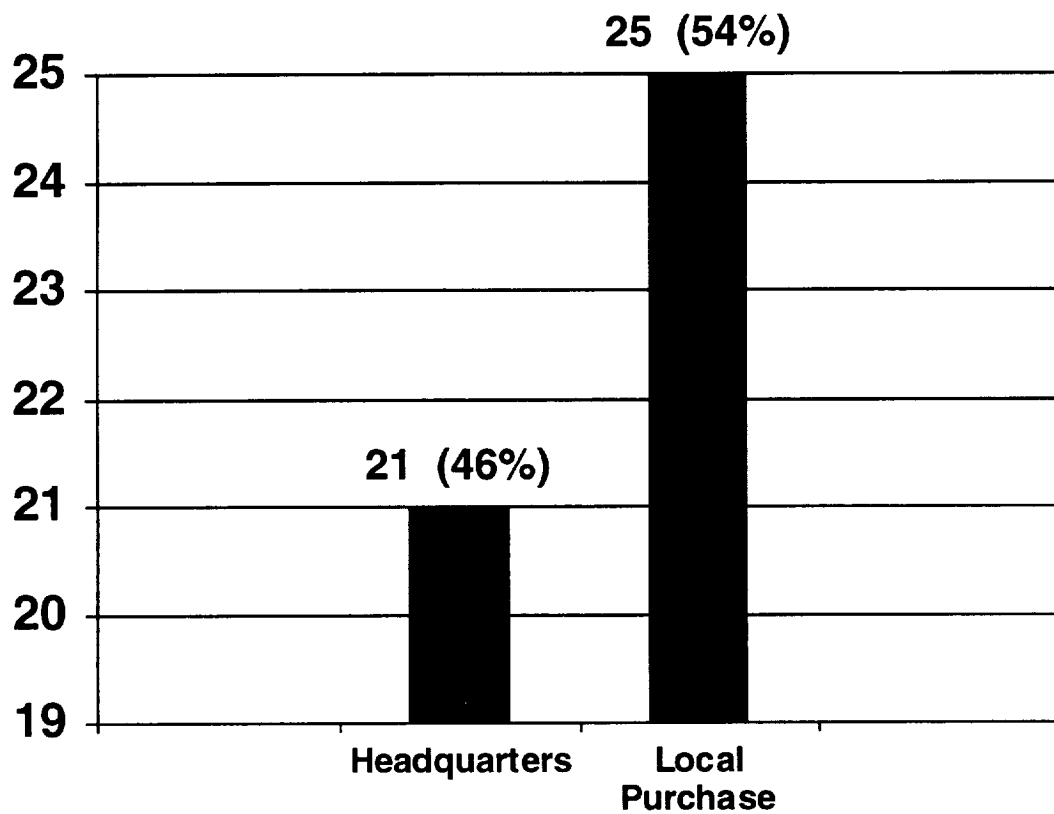


Table 4 - Distribution of 1997 ASEE Fellows by Funding



SECTION III

STIPEND AND TRAVEL

A ten-week stipend of \$10,000.00 was awarded to each Fellow. Twenty-two percent of the Fellows indicated that the stipend was not the primary motivator in their participating in the ASEE program. This is the lowest percentage in the past 10 years that averaged 53% with a high of 68% in 1987, suggesting that the importance of the stipend amount is steadily increasing. Twenty-four percent deemed the current stipend as adequate (Survey-Section VI). This stipend continues to fall short of matching what most professors could have earned based on their university academic salaries. The decision to participate in the summer faculty research program continues to reflect the willingness of the Fellow to make some financial sacrifice in order to have the experience of working with NASA's finest scientists and researchers.

Mileage or air fare expenses incurred by the Fellows from their institution to Hampton, Virginia, as well as their return trip, were reimbursed in accordance with current ODU regulations. A relocation allowance of \$1,000 was provided for the Fellows at a distance of 50 miles or more who were required to relocate.

SECTION IV

1997 ASEE SFFP ACTIVITIES

Lecture Series

The Lecture Series this summer was successful and well received. There was a total of six lectures presented. The lectures were given by distinguished Langley scientists and researchers. Some of the topics included Fire and Global Change, Future Technology, and The Effect of Rain on Airplane Performance to name a few (Appendix II).

Interaction Opportunity/Picnic

An annual Office of Education Interaction Opportunity/Picnic was held on Wednesday, June 11, 1997, for the summer program participants, their families, and invited guests. This allowed for informal interaction between the Fellows, as well as, with the administrative staff. The participants were also given the opportunity to purchase T-shirts with an ASEE design by one of the summer students.

Proposal Seminar

A Proposal Seminar was held for the Fellows on Tuesday, July 15, 1997. Dr. Samuel E. Massenberg, Director, Office of Education, presented an

overview of the proper procedures to adhere to in submitting an unsolicited proposal to NASA. The program covered both the NASA and university perspectives. Mr. Thayer Sheets gave a presentation on the Small Business Innovative Research program with emphasis on STTR "Small Business Technical Transfer Pilot Program." There was also a panel question and answer session. The panel members included Langley researchers who frequently review proposals that are submitted, and in the audience were representatives from the grants and contracting offices who also responded to questions in their field. This aspect of the proposal seminar was very well received. The most current Research Grant Handbook was distributed. (Appendix XI).

Seminar/Banquet

On Tuesday, July 29, 1997, a seminar/banquet was held for the Fellows and their spouses. The banquet took place at the beautiful Langley Air Force Base Officer's Club. ASEE end of the program information, certificates, and group pictures were presented to each Fellow at the banquet. Dr. Robert D. Braun, Aerospace Technologist, was the guest speaker for the evening.

ASEE Activities Committee

As in the past, an ASEE Activities Committee was formed to plan social outings for the program participants and their families (Appendix II). A weekly dinner was planned for those who desired to participate. Tours of Center facilities including a wind tunnel, and Langley Air Force Base were scheduled. One of the summer highlights was being invited to tour the F-117 Stealth Fighter and the F-15 Static Display. This was very well received by the Fellows. The Office of Education also sponsored a Moonlight Cruise and a Dinner Cruise aboard the beautiful Spirit of Norfolk for the Fellows and their spouses.

SECTION V

RESEARCH PARTICIPATION

The ODU-LaRC Summer Research Program, as in past years, placed the greatest emphasis on research aspects of the program. Included in this report are abstracts from the Fellows showing their accomplishments during the summer. These abstracts, together with the comments of the LaRC Research Associates with whom the Fellows worked very closely, provide convincing evidence of the continued success of this part of the program. The Fellows' comments during the evaluation of the program indicated their satisfaction with their research projects, as well as, with the facilities available to them.

The research projects undertaken by the Fellows were greatly diversified as is reflected in their summer research assignments. Their assignments were as follows:

Number of Fellows Assigned	Division
2	Aero- and Gas- Dynamics Division
1	Aeronautics Systems Analysis Division
1	Aerospace Electronic Systems Division
1	Aerospace Mechanical Systems Division
5	Atmospheric Sciences Division
3	Experimental Testing Technology Division
2	Fabrication Division
1	Facilities Program Development Office
2	Flight Dynamics and Control Division
4	Flight Electronics Technology Division
5	Fluid Mechanics and Acoustics Division
1	Hyper-X Program Office
6	Materials Division
2	Office of Chief Financial Officer
4	Office of Education
6	Structures Division

Forty-one (89%) of the participants were holders of the doctorate degree. Five (11%) held masters degrees. The group was again highly diversified with respect to background. Following are the areas in which the last degree was earned (twenty-six different disciplines):

Number	Area of Degree
2	Accounting and Information Systems
2	Aeronautics and Astronautics

4	Aerospace Engineering
1	Chemical Engineering
2	Chemistry (including 1 Analytical and 1 Inorganic)
2	Education (including 1 Multi-Cultural)
7	Electrical Engineering
1	Engineering Mechanics
1	Engineering Technology
1	Industrial Engineering
1	Industrial and Manufacturing Engineering
1	Industrial Engineering and Operations Research
1	Mathematics
2	Mechanical and Aerospace Engineering
8	Mechanical Engineering
1	Mechanical Engineering and Mechanics
1	Naval Architecture and Marine Engineering
1	Operations Management
2	Physics
1	Political Economy
1	Structural Mechanics
1	Structural Optimization
1	Urban Sciences-Management Concentration
1	Vocational Technology Education

Extensions

Per special written request by the LaRC Associate and the approval of the ASEE Co-Director, the following individual was granted an extension of tenure:

Dr. David Gosselin

Attendance at Short Courses, Seminars, and Conferences

During the course of the summer, Fellows have the opportunity to attend regularly scheduled Langley Research Center seminars and meetings, to include but not limited to ASEE Technical Lectures, Institute for Computer Applications in Science and Engineering (ICASE) seminars, World Wide Web and Internet training courses, computer training, as well as short courses or meetings within their Division. In addition, there were a number of short courses, seminars, and conferences, in which the subject matter had relevance to the Fellows' research projects. A number of Fellows requested approval to attend one or more of these conferences as it was their considered opinion that the knowledge gained by their attendance would be of value to their research projects. Those Fellows who did attend had the approval of both the Research

Associate and the University Co-Director.

Short Courses, Seminars, and Conferences Attended

James D. Baldwin: 19th Symposium of the International Committee on Aeronautical Fatigue.

H. Marshall Booker: AGATE Briefing; Technology Forum; Funding Opportunities; Center Awards Ceremony; Graduate Opportunities Program; Meet the Astronauts Program; Native American Engineering Program; Spear-Mars/Pathfinder Program Lecture Series; Summer Graduate Teachers Conference-Christopher Newport University; Teleconference: "Electronic Money."

Joseph L. Boyd: Minority Institutions of Higher Education Research Strategies and Funding Opportunities Workshop; Quarterly Meeting of the NASA Langley SDBs.

George W. Clever: Atmospheric Sciences Division seminars on: Ozone, Modeling, Clouds, Radiation, Lidar, Technology Transfer, Biomass Burning; Minority Institutions of Higher Education Research Strategies and Funding Opportunities Workshop.

S. Scott Collis: Overview seminar for Langley's Fluid Mechanics and Acoustics Division.

Edmundo Corona: 6th International Symposium on Plasticity and its Applications.

Lawrence R. Daley: Seminar on Mars Pathfinder Mission.

Steve R. Daniewicz: ASTM 29th National Symposium on Fatigue and Fracture Mechanics, June 24-26, 1997, Stanford, CA.

Jack R. Edwards: 13th AIAA Computational Fluid Dynamics Seminar; A. Leonard-contract report; Peyman Givi-grant report.

David J. Gosselin: NASA-Chief Financial Officers Conference, May 27-30, 1997, Stennis Space Center.

James M. Hereford: IEEE Microelectronics Systems Education Conference.

Paul J. Kauffmann, Jr.: Logistics Management Institute-Functional Cost Analysis Model.

Donald L. Kunz: VCES Conference, Hampton, VA; "Overview of Smart Structures Research," D. Inman.

Ellis E. Lawrence: NASA Handbook Training Program - Three Day Soldering Workshop.

Gabriel Laufer: AIAA Lighter than Air Technology, San Francisco, June 3-5, 1997.

Jonathan J. Miles: Infrared Users' Group (IRUG) Meeting sponsored by the Electric Power Research Institute (EPRI) in Richland, WA, August 21-24.

Lawrence A. Newquist: Mars Pathfinder Lecture.

Huseyin Sarper: Earth vs Fires vs Ozone

Mir S. Shirvani: Three Day Soldering Workshop.

Denise V. Siegfelddt: Nissan Fellow Program, University of Washington.

James R. Tarr: 1997 Regional American Production and Inventory Control Society, Williamsburg, VA.

J. Garth Thompson: Mars Lander Program Seminar.

Papers Presented or Anticipated

J. David Baldwin: "Stress Intensities for Corner and Through Cracks in Countersunk Rivet Holes," NASA TM-"Engineering Fracture Mechanics."

Han P. Bao: "A Cost Model for Engineering," to be submitted to ISPA/SCEA Joint International Conference, June 98.

Jonathan D. Blotter: "Powerflow Using EOH," 5th International Congress on Sound and Vibration, submitted, August, 1997.

H. Marshall Booker: "Economic and Technology Transfer," Eastern Economic Association Annual Conference, March, 1998.

Joseph L. Boyd: "Directory of Technical Capabilities of Minority Colleges," to be distributed to all NASA Technical Program Managers and Prime Contractors.

Charles F. Bunting: "Finite Element Techniques for the Analysis of a Reverberating Chamber," will submit to IEEE Transactions in Electromagnetic Compatibility in October, 1997.

George W. Clever: NASA Education and Research Opportunities for Community College Faculty and Students S.W.A.D.E. (SouthWest Association of Developmental Education) Annual Conference, Las Vegas, Nevada, October, 1997.

Kevin D. Cole: "Transient Conductivity Measurements of Titanium Honeycomb Thermal Protection Panels," anticipated paper.

S. Scott Collis: Anticipated presentation at the 1997 American Physical Society Meeting on Fluid Dynamics, November 23-25, 1997.

Steve R. Daniewicz: "Evaluating the Influence of Plasticity-Induced Closure on Surface Flaw Shape Evolution Under Cyclic Loading," submitted for ASTM symposium; "Advances in Fatigue Crack Closure," November 12-13, 1997.

Amin N. Dharamsi: Lasers and Electrooptic Society, November, 1997, accepted; Lasers 97, accepted; Journal of Physics, Lasers and Optics, submitted.

Jack R. Edwards: Possible collaboration with NASA Researchers, Phil Drummond and J. White, for a paper to be submitted to the AIAA Conference or as a NASA TM.

Mark Farris: Plans to write and submit a paper to a journal that is yet to be determined.

Frederick Ferguson: "High Altitude Aerothermodynamics of Waveriders Using DSMC."

Peyman Givi: "Large Eddy Simulation of Turbulent Combustion by the Mass Filtered Density Function," to Phys. Fluids.

David J. Gosselin: "Full Cost Implementation in a Large Government Agency," to Journal of Government Accounting.

Thomas E. Hopkins: "Fiber Optics Course Notes on Internet at NASA Langley."

Jen-Kuang Huang: "Input Design for Stochastic System Under Identification."

Paul J. Kauffmann, Jr.: "Portfolio Planning Using QFD," Research and Technology Management; "A Linear Programming Approach to Portfolio Selection," ASEM Journal; "A QFD Approach to Strategic Technology," Quality Journal.

Donald L. Kunz: "Saturation Control for Suppressing Helicopter Blade Flapping Vibrations: A Feasibility Study," AIAA/ASME/SAE/AHS/ASC Structures, Structural Dynamics and Materials Conference, April 1998.

Feng-Bao Lin: "Numerical Simulation of Damage Growth in Aircraft Fuselage Made of Graphite-Epoxy Composite."

Peter D. McQuade: Anticipated paper to be submitted to the AIAA.

Duc Thai Nguyen: "Incore and Out-of-Core Direct Sparse Solvers for Thermal-Structural Finite Element Analysis."

Huseyin Sarper: Anticipated paper, "Transactions on Engineering Management," to be submitted to the IEEE.

Denise V. Siegfeldt: All items mentioned are co-authored with Dr. Surendra N. Tiwari and Mr. Roger A. Hathaway, "Assessment of the NASA/ASEE Summer Faculty Fellowship Program at NASA Langley Research Center," submitted for presentation to the 1997 Annual Meeting of the American Society for Engineering Management, and for publication in the 18th Annual ASEM National Conference Proceedings; "Evaluation of the NASA/ASEE Summer Faculty Fellowship Program at NASA Langley Research Center," to be published as a NASA Technical Document; Plans to develop conference proceedings for ASEM into a journal article.

J. Garth Thompson: "Analytical Study of the Reliability of a General Aviation Cockpit Instrumentation System," to be presented at the AGATE Flight Systems Team meeting in Oshkosh, WI, August 7, 1997.

Nickolas Vlahopoulos: Plans to present the work as a paper at the Noise Conference 98; also in a journal paper form with the journal yet to be determined, possibly AIAA, Noise and Vibration, or Journal of Boundary Element Analysis.

Anticipated Research Proposals

J. David Baldwin: "Stress Intensities in Countersunk Rivet Holes," Boeing and USAF; "3-D Crack Propagation by Weight Function Metrics," USAF, NASA, ONR.

Han P. Bao: "Cost Estimation of Composite Manufacturing Process," to be submitted to Raytheon Aircraft.

Jonathan D. Blotter: Young Investigators Program, NRL.

Joseph L. Boyd: "Minority Entrepreneurship Technology Center (METeC)," to be submitted jointly to NASA Headquarters and NASA Langley.

Charles F. Bunting: "Numerical Analysis for Electromagnetic Effects Due to Reverberation Phenomena," NASA LaRC.

George W. Clever: Bridges to AeroSpace Engineering and Science Research for Native American Indian Students (AESRNIS), proposal idea introduced to NASA Headquarters, June, 1997. Detailed proposal to follow.

S. Scott Collis: "Receptivity and Transition in High Lift Systems," FMCB of FMAD at NASA Langley.

Edmundo Corona: Plan to possibly submit a research proposal to the Structural Mechanics Branch at LaRC.

Lawrence R. Daley: "Resin Infusion of Low-Viscosity Polyimides," Dr. Norman Johnston, NASA LaRC, Polymers and Composites Branch.

Steve R. Daniewicz: "A Strip-Yield Model for Predicting the Growth of Part-Through Cracks Under Cyclic Loading," to be submitted to NASA LaRC, RTG, Materials Division.

Willie L. Darby: "Thermochromic Compounds for Use as Sensors," to be submitted to NASA and possibly DOE.

Amin N. Dharamsi: "Characterization of O₂ A Band Spectrum," NASA LaRC; "Characterization of the Atmospheric Window at 1-6 μ ," Navy.

Jack R. Edwards: Discussing possibility of submitting proposals to several NASA branches-Aerodynamic and Acoustic Methods, Aerothermodynamics-Hypersonic Propulsion.

Frederick Ferguson: NASA-CAR (Center Proposal) to LaRC; Faculty Awards for Research (FAR) to LaRC (Aero); FAR to LaRC (Smart Structures).

James M. Hereford: "Tiger PAU: Thermally -Induced Gradient Effects Research Parameter Assessment Undertaking," NASA LaRC.

Paul J. Kauffmann, Jr.: "Performance Objective Development and Model Testing," NASA LaRC-SAB.

Donald L. Kunz: "Helicopter Rotor Dynamics Control Using Autoparametric Absorbers," Army Research Office; "Flutter Suppression Via Saturation Control," NASA.

Gabriel Laufer: "Measurement of the Vertical Distribution of Tropospheric OH," NSF/NOAA.

Ellis E. Lawrence: "Fiber Optic Training for Electronic/Communication Personnel."

James R. Tarr: "Teacher Enhancement Program - Future Funding of TEI," to NSF, NASA LaRC, CNU, and Hampton City Schools.

William D. Thacker: "Development of a PDF Based Transition Model for the Computation of High Lift Flows," NASA LaRC.

J. Garth Thompson: Plan to submit a proposal to continue the work done this summer to both NASA and FAA.

Nickolas Vlahopoulos: Plans to submit a proposal to Lockheed, Bell, Boeing, and Cessna.

W. Perry Wheless, Jr.: "Electromagnetic Aspects of Plasma-Based Drag Reduction for Hypersonic Aircraft," NASA.

Funded Research Proposals

J. David Baldwin: "Composite Materials in Disk Drives," Seagate Technology; "Fatigue in Prior Corrosion," AFOSR; "Hyperelastic Sealing Elements."

Han P. Bao: "Industrial Engineering Theory and Practices," FOSSAC, Norfolk Naval Base.

Charles F. Bunting: "Bioelectromagnetic Effects in Fruit Flies," Jeffress Foundation.

Edmundo Corona: "Stability of Structural Members Under Cyclic Loading," NSF; "Bending of Aluminum Extrusions," ALCOA.

Amin N. Dharamsi: "Characterization of O₂ A Band Lines," NASA LaRC.

Jack R. Edwards: "Numerical Simulation of Ablating Re-Entry Flowfields," North Carolina Space Grant Consortium; "Investigations and Development of CO₂-based Delivery Technologies for Polymeric Coating Materials,"-joint grant, ONR/Dupont.

Peyman Givi: "Numerical Simulation of High Speed Flow", NASA; "Modeling and Simulation of Multiphase Reacting Flow," ONR.

Gabriel Laufer: "High Temperature Composite Materials," Air Force; "High Temperature Shear Response of Built-Up Plates," NASA LaRC.

Ellis E. Lawrence: "NASA Network Training Grant," funded by NASA.

Jonathan J. Miles: "Thermal-Structures and Materials Testing Laboratory," NASA LaRC.

Duc Thai Nguyen: "New Parallel Algorithms for Structural Analysis and Design of Aerospace Structures," NASA LaRC.

James R. Tarr: "TEI Grant," NASA LaRC.

J. Garth Thompson: “Advanced Information Subsystems for Next Generation General Aviation Aircraft,” NASA EPSCoR Grant.

Nickolas Vlahopoulos: “Modeling of Beam to Plate and Spotwelded Connections in an EFEA Formulation,” Automated Analysis Corp.; “Modeling of Welding Distortion on Large Scale,” DARPA; “Sensitivity Analysis of Acoustic Response Under Random Loading,” Rackham School of Graduate Studies.

SECTION VI

SUMMARY OF PROGRAM EVALUATION

A program evaluation questionnaire was given to each Fellow and to each Research Associate involved with the program. The questions and the results are given beginning on the next page forty-six of forty-six evaluations were returned (100%).

A. Program Objectives

1. Are you thoroughly familiar with the research objectives of the research (laboratory) division you worked with this summer?

Yes	<u>45</u>	(98%)
No	<u>1</u>	(2%)

2. Do you feel that you were engaged in research of importance to your Center and to NASA?

Yes	<u>46</u>	(100%)
No	<u>0</u>	(0%)
No Response	<u>0</u>	(0%)

3. Is it probable that you will have a continuing research relationship with the research (laboratory) division that you worked with this summer?

Yes	<u>39</u>	(85%)
No	<u>0</u>	(0%)
Uncertain	<u>7</u>	(15%)

4. My research colleague and I have discussed follow-up work including preparation of a proposal to support future studies at my home institution, or at a NASA laboratory.

Yes	<u>38</u>	(83%)
No	<u>8</u>	(17%)
Uncertain	<u>0</u>	(0%)
No Answer	<u>0</u>	(0%)

5. Are you interested in maintaining a continuing research relationship with the research (laboratory) division that you worked with this summer?

Very much so	<u>46</u>	(100%)
Somewhat	<u>0</u>	(0%)

B. Personal Professional Development

1. To what extent do you think your research interests and capabilities have been affected by this summer's experience? You may check more than one.

Reinvigorated	<u>20</u>	(43%)
Redirected	<u>20</u>	(43%)
Advanced	<u>33</u>	(72%)
Barely maintained	<u>0</u>	(0%)
Unaffected	<u>0</u>	

2. How strongly would you recommend this program to your faculty colleagues as a favorable means of advancing their personal professional development as researchers and teachers?

Positively	<u>46</u>	(100%)
Not at all	<u>0</u>	(0%)

3. How will this experience affect your teaching in ways that will be valuable to your students? You may check more than one.

By integrating new information into courses	<u>37</u>	(80%)
By starting new courses	<u>7</u>	(15%)
By sharing your research experience	<u>42</u>	(91%)
By revealing opportunities for future employment in government agencies	<u>23</u>	(50%)
By deepening your own grasp and enthusiasm	<u>34</u>	(74%)
Will affect my teaching little, if at all	<u>1</u>	(2%)
No Response	<u>0</u>	

4. Do you have reason to believe that those in your institution who make decisions on promotion and tenure will give you credit for selection and participation in this highly competitive national program?

Yes	<u>34</u>	(74%)
No	<u>11</u>	(24%)
No Answer	<u>1</u>	(2%)
Already tenured at highest rank	<u>0</u>	

C. Administration

1. How did you learn about the Program? Check appropriate response.

Received announcement in the mail	19	(41%)
Read about in a professional publication	4	(9%)
Heard about it from a colleague	21	(46%)
Other (Explain below)	7	(15%)

NASA Researcher; JOVE canceled and ASEE next best thing; SACNAS Conference; Williamsburg Conference

2. Did you also apply to other summer faculty programs?

Yes	12	(26%)	No	34	(74%)
<u>0</u>			DOE		
<u>7</u>			Another NASA Center		
<u>4</u>			Air Force		
<u>1</u>			Army		
<u>7</u>			Navy		

3. Did you receive an additional offer of appointment from one or more of the above? If so, please indicate from which.

Yes	7	(15%)	No	29	(63%)	No Answer	10	(22%)
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JPL, JSC, Another NASA Center; Surface Warfare Center, MD; Air Force

4. Did you develop new areas of research interests as a result of your interaction with your Center and laboratory colleagues?

Many	12	(26%)
A few	33	(72%)
None	1	(2%)
Other	0	(0%)

5. Would the amount of the stipend (\$1,000 per week) be a factor in your returning as an ASEE Fellow next summer?

Yes	36	(78%)	No	8	(17%)	Not Sure	1	(2%)	No Answer	1	(2%)
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If not, why? Money is secondary after technical opportunities; stipend covers relocation, no net gain in salary; assume it remains same and doesn't decrease; doesn't come close to defraying living expenses-short term leases are expensive.

6. Did you receive any informal or formal instructions about submission of research proposals to continue your research at your home institution?

Yes	<u>34</u>	(74%)
No	<u>10</u>	(22%)
No Answer	<u>2</u>	(4%)

7. Was the housing and programmatic information supplied prior to the start of this summer's program adequate for your needs?

Yes	<u>40</u>	(87%)
No	<u>3</u>	(6.5%)
Not Applicable	<u>3</u>	(6.5%)

8. Was the contact with your research colleague prior to the start of the program adequate?

Yes	<u>42</u>	(91%)
No	<u>3</u>	(7%)
No Answer	<u>1</u>	(2%)

9. How do you rate the seminar program?

Excellent	<u>25</u>	(55%)
Good	<u>14</u>	(30%)
Fair	<u>6</u>	(13%)
Poor	<u>1</u>	(2%)

10. In terms of the activities that were related to your research assignment, how would you describe them on the following scale?

Check one per activity		Time Was:		
Activity	Adequate	Too Brief	Excessive	Ideal
Research	20 (43%)	9 (20%)	0 (0%)	16 (35%)
Lectures	18 (39%)	0 (0%)	13 (28%)	14 (30%)
Tours	25 (54%)	1 (2%)	1 (2%)	15 (33%)
Social/Rec.	32 (70%)	1 (2%)	1 (2%)	9 (20%)
Meetings	27 (59%)	0 (0%)	3 (6%)	12 (26%)

11. What is your overall evaluation of the program?

Excellent	<u>43</u>	(94%)
Good	<u>2</u>	(4%)
Fair	<u>1</u>	(2%)
Poor	<u>0</u>	(0%)

12. If you can, please identify one or two significant steps to improve the program.

See Fellows' Comments and Recommendations

13. For second-year Fellows only. Please use this space for suggestions on improving the second year.

See Fellows' Comments and Recommendations

D. Stipend

1. To assist us in planning for appropriate stipends in the future, would you indicate your salary at your home institution?

\$ 50,135* per Academic year x or Full year ____.
 Median Range *Based on 42 professors' salaries provided.

2. Is the amount of the stipend the primary motivator to your participation in the ASEE Summer Faculty Fellowship Program?

Yes 4 (9%) No 10 (22%) In Part 31 (67%)

Not Indicated 1 (2%)

3. What, in your opinion, is an adequate stipend for the ten-week program during the summer of 1996?

\$10K-11 (24%); \$10.5-1 (2%); \$10-\$12K-1 (2%); \$11K-3 (7%);
\$12K-10 (22%); \$12.5K-2 (4%); \$13K-1 (2%); \$14K-5 (11%);
\$15K-7 (15%); \$15-\$20K-1 (2%); \$10K for locals with \$12-\$15K for
relocators-2 (4%); \$17K-1 (2%); Not Indicated-1 (2%)
Many suggested increases in the relocation allowance varying from
\$1.5K to \$3.6K.

E. American Society for Engineering Education (ASEE) Membership Information

1. Are you currently a member of the American Society for Engineering Education?

Yes 11 (24%) No 35 (76%)

2. Would you like to receive information pertaining to membership in the ASEE?

Yes 23 (50%) No 12 (26%)

Not Indicated 11 (24%)

Fellows' Comments and Recommendations

- My experience as an ASEE Fellow has been a very positive and enlightening one. I was fortunate to have landed an exciting project for which I was adequately prepared and motivated. I will return to my university with new skills and enthusiasm which I hope to pass on to my students.
- This was the experience of a lifetime!
- The program has been interesting and stimulating. The Group has accepted me and supported my work. I believe the result of my research will be useful for the Group in future work.
- Make it a two summer attendance requirement. A seminar on IRS tax requirements for fellowships would be helpful.
- Lectures were too long. Only two of them held any attention. I think having lectures every couple of weeks is a good idea, as it helps people learn about the broader goals and missions of NASA.
- Excellent Program!
- While the seminars were generally good, I feel that by necessity, they had to be very broad because the audience consisted of both faculty and students. It would be advantageous if it was possible to have at least some of these lectures be a little more technical. These lectures could be addressed to the ASEE Fellows only.
- An excellent program. Much too short. Once I learned the NASA system and began to get fully involved in my project, time was up and it was again time for another school year. I am fortunate that I am close by and can continue to work voluntarily on the project until completion.
- Overall I had an outstanding summer. Gary Fleming and Jim Meyers in the MSTB were outstanding to work with. One major drawback is that I am leaving and take nothing with me to develop. It would be nice if there were some funds given to get some equipment, share equipment, hire a grad student and buy out some of my teaching time. I am not talking about a lot of money - \$5K would be fantastic.
- Provide a list of research topics to all Fellows by the 2nd or 3rd week.
- Allow more flexibility with start and end dates.
- Develop funding methods so that research can be continued through the academic year for first summer people.
- Set up a bus system to nearby apartments.
- Have at least one lecture on a non-scientific topic, i.e. Program Management, Management Styles, Career Development, etc.
- Have a two day break at the July 4th holiday.
- Get Centers to put some money aside to help support faculty when they return to home institution.
- Make lectures more technical and less management focused.
- Provide direct deposit to home bank. Provide travel and housing advance using loan agreement as security.
- Some programs offer 8, 10, 12 week option - You may want to consider it.
- Have a technical lecture on "The Business of NASA."

- E-mails sometimes takes 1-2 days - maybe post a Bulletin Board Sign/Service where short notices like banquet cancellations could be left.
- Reduce structured interaction with other ASEE Fellows and initiate more with NASA researchers.
- Less paperwork and more relocation allowance.
- Lectures should focus less on planning and goals with more emphasis on actual ongoing research or recently completed research.
- An increase in stipend is needed.
- Get rid of the paperwork. Too many evaluations.
- Please include some topical lectures on business, management, and operations of NASA. More and more important in today's environment.
- More lectures in the area of electronic research.
- Improve scheduling flexibility.
- Better match of research interest with research Associate.
- I can't think of a way to improve the program. It's great the way it is!
- Pay more for those who relocate. No way I'll ever apply again, it's not worth it.
- Extend the length of the program by two weeks.
- The program was well structured, well organized, and seemed to operate as it should. Program activities were well planned.
- Some lectures need to be shortened.
- In some cases, the Fellows need to be made more a part of the Division.
- Provide support to get a student when I get home while I prepare and process a proposal for more extended continuation of work.
- Need "after hours" authorization to get in enough research hours.
- ASEE seminars/lectures: less in number and more technical.
- Rotate speakers so second year Fellows do not hear the same speaker, same speech, and see the same viewgraphs.
- No suggestions other than second year Fellows have attendance requirements for lectures relaxed because of repeat lectures and apply time to research.
- Program administrator should be able to communicate and be understood by all participants.
- This was my second year with one year in between where I did not participate. The second year was much better than the first. Thanks.

SUMMARY OF ASSOCIATES' EVALUATION

The following comments and recommendations were taken from the questionnaire distributed to the ASEE Associates requesting them to evaluate the overall performance of their ASEE Fellow. Most all of the Associates responding indicated an overwhelming satisfaction with the Fellow's knowledge of their subject, diligence, interest in assignment, and enthusiasm. A total of 23 evaluations were returned. See statistics based on the number returned below:

- 100% aware of participation as Associate prior to start of program

- 100% contacted Fellow prior to start of program
- 78% stated Fellows accomplished research goals established at onset of program to a great extent or better and 13% to a moderate extent
- 100% interested in serving as Associate again (one-no due to retirement)
- 52% indicated continuation of the research efforts by Fellow through a NASA grant was likely
- 91% indicated a desire to continue research with Fellows in 1998 program
- 74% indicated their Fellow was above average when compared overall with other faculty researchers they had worked with before

Research Associates' Comments

- Senior staff member said no recommended improvements and stated of his two Fellows, "Both Professors Gosselin and Booker have been a great help in updating our business knowledge and experience."
- Dr. Corona is an outstanding researcher who openly shares his knowledge and results. The program is excellent as it is.
- The research currently being performed by David (Fleming) is an excellent complement to ongoing research within our group. He has been able to contribute technical knowledge in several topic areas and is learning a new skill, along with other members of the group.
- I think the ASEE Program is run very efficiently and have no suggestions for improvements.
- It was well worth my time to serve as a Research Associate.
- Productivity increase by the participation of the Fellow.
- Technical discussions with Fellow allow new ideas to infiltrate R&T Group.
- We now have better in-house tools for portfolio analysis.
- Fellow has acquired new insight into the real world of measurement technology. The program works OK as it is.
- In a laboratory setting it requires a fairly large amount of time on my part to get the Fellow up to speed on the operation of unique equipment. This will be the case regardless of the Fellow's experience.
- It is a good program.
- It is good for the morale of the group to have a hard working congenial researcher join us for the summer.

Research Associates' Recommendations

- Have ASEE Program set up the e-mail and phone services for all Fellows.
- Program should identify funding vehicles that would enable researchers to continue at their home institution and facilitate the application for these funds.

SECTION VII

CO-DIRECTOR'S RECOMMENDATIONS

1. It is an 100% recommendation that the program continue.
2. The calendar sets explicit dates for the program but flexibility should be allowed at the site to accommodate for school calendars and research associate schedules.
3. The lecture series be continued. If using LaRC personnel, be sure topics are more directed towards current research areas. Invite one or two distinguished scholars for special presentations. Encourage participation by all fellows to the lecture series.
4. The stipend be increased to \$12K for the ten week period. That amount represents a \$60K per year salary (based on a twelve month contract) or a \$45K academic year salary (assistant professor level).
5. Recommend \$1K relocation allowance be prepared for payment within the first week of the program.
6. The travel and relocation allowances remain at \$500 and \$1,000.
7. Pre-program contact between Fellows and Associates be emphasized. A visit by the first year Fellow to LaRC be strongly recommended.
8. Determine a somewhat formalized agenda for the reception/interaction opportunity which will facilitate more extensive introductions with a short time allowed to speak to the research interest of each Fellow on the first evening.

APPENDIX I
PARTICIPANTS - ASEE/NASA LANGLEY
SUMMER FACULTY RESEARCH PROGRAM

1996 NASA Langley ASEE Summer Faculty Fellowship Program Fellows

Name and Institution

Dr. James D. Baldwin
University of Oklahoma

Dr. Han P. Bao
Old Dominion University

Dr. Jonathan D. Blotter
Idaho State University

Dr. H. Marshall Booker (R)
Christopher Newport University

Dr. Joseph L. Boyd
Norfolk State University

Dr. Ronald B. Bucinell
Union College

Dr. Charles F. Bunting
Old Dominion University

Dr. Deborah H. Carey
Wilkes University

Ms. Caroline C. Clever
Dona Ana Branch Community College-
New Mexico State University

Mr. George W. Clever
Dona Ana Branch Community College-
New Mexico State University

Dr. Kevin D. Cole
University of Nebraska

Dr. S. Scott Collis
Rice University

Dr. Edmundo Corona
Notre Dame

Dr. Lawrence R. Daley
Hampton University

NASA Associate and Division

Dr. Robert S. Piascik
Materials

Mr. William T. Freeman, Jr.
Materials Division

Mr. James F. Meyers
Fluid Mechanics and Acoustics

Mr. Joseph R. Struhar
Office of the Chief Financial Officer

Mr. Roger A. Hathaway
Office of Education

Mr. Alan T. Nettles
Materials Division

Mr. Karl J. Moeller
Flight Electronics Technology

Dr. Billy T. Upchurch
Experimental Testing Technology

Dr. Arlene S. Levine
Atmospheric Sciences

Dr. Arlene S. Levine
Atmospheric Sciences

Mr. Kamron Daryabeigi
Structures

Dr. Ronald D. Joslin
Fluid Mechanics and Acoustics

Dr. James H. Starnes, Jr.
Structures

Dr. Tan-Hung Hou
Materials

R-Designates returnees from 1996

Dr. Steve R. Daniewicz Mississippi State University	(R)	Dr. James C. Newman, Jr. Materials
Dr. Willie L. Darby Hampton University	(R)	Dr. Billy T. Upchurch Experimental Testing Technology
Dr. Amin N. Dharamsi Old Dominion University	(R)	Dr. William P. Chu Atmospheric Sciences
Dr. Sonja D. Ebron Norfolk State University		Mr. William "Brad" Ball Facilities Prog. Development Office
Dr. Jack R. Edwards North Carolina State University		Dr. J. Philip Drummond Aero- and Gas-Dynamics
Mr. Charbel T. Fahed Northern Virginia Community College		Mr. Erik Vedeler Flight Electronics Technology
Dr. Mark Farris Midwestern State University		Dr. Fereidoun Farassat Fluid Mechanics and Acoustics
Dr. Frederick Ferguson North Carolina A&T State University		Dr. Samuel E. Massenberg Office of Education
Dr. David C. Fleming Florida Institute of Technology		Dr. Karen E. Jackson Structures
Dr. Peyman Givi State University of New York-Buffalo		Dr. J. Philip Drummond Aero- and Gas-Dynamics
Dr. David J. Gosselin Christopher Newport University	(R)	Mr. Joseph R. Struhar Office of the Chief Financial Officer
Dr. James M. Hereford Christopher Newport University		Mr. Ray D. Rhew Electronics Testing Technology
Mr. Thomas E. Hopkins Southwest Virginia Community College		Dr. Celeste M. Belcastro Flight Electronics Technology
Dr. Jen-Kuang Huang Old Dominion University		Mr. Nelson J. Groom Flight Dynamics and Control
Dr. Paul J. Kauffmann, Jr. Thomas Nelson Community College		Mr. Wendell R. Ricks Aeronautics Systems Analysis
Dr. Donald L. Kunz Old Dominion University		Mr. Paul H. Mirick Structures

Dr. Gabriel Laufer
University of Virginia

Dr. Ellis E. Lawrence (R)
Elizabeth City State University

Dr. Feng-Bao Lin
Polytechnic University

Lt. Col. Peter. D. McQuade
U. S. Air Force Academy

Dr. Jonathan J. Miles
James Madison University

Dr. Lawrence A. Newquist (R)
Cumberland College

Dr. Duc T. Nguyen
Old Dominion University

Dr. Huseyin Sarper
University of Southern Colorado

Mr. Mir S. Shirvani
New River Community College

Dr. Denise V. Siegfeldt
Hampton University

Dr. Kyo D. Song (R)
Norfolk State University

Dr. James R. Tarr
Christopher Newport University

Dr. William D. Thacker
Parks College of Saint Louis University

Dr. J. Garth Thompson
Kansas State University

Dr. Nickolas Vlahopoulos
University of Michigan

Dr. William "Perry" Wheless, Jr.
University of Alabama

Dr. Edward Browell
Atmospheric Sciences

Mr. James E. Bell, Jr.
Fabrication

Dr. James H. Starnes, Jr.
Structures

Mr. J. Larry Hunt
Hyper-X Program Office

Mr. Glen W. Sachse
Aerospace Electronics Systems

Dr. Chris A. Hostetler
Atmospheric Sciences

Ms. Kim S. Bey
Structures

Mr. Albert E. Motley, III
Aerospace Mechanical Systems

Mr. James E. Bell, Jr.
Fabrication

Mr. Roger A. Hathaway
Office of Education

Dr. Sang H. Choi
Materials

Dr. Marchelle D. Canright
Office of Education

Dr. Thomas B. Gatski
Fluid Mechanics and Acoustics

Mr. H. Paul Stough, III
Flight Dynamics and Control

Mr. Richard J. Silcox
Fluid Mechanics and Acoustics

Dr. Marion C. Bailey
Flight Electronics Technology

APPENDIX II
LECTURE SERIES
PRESENTATIONS BY RESEARCH FELLOWS
CALENDAR OF ACTIVITIES

1997 OFFICE OF EDUCATION SUMMER LECTURE SERIES

Location: H.J.E. Reid Conference Center, Bldg. 1222
14 Langley Boulevard
Time: 11:00 a.m. - 11:45 a.m. - Lecture
11:45 a.m. - 12:00 m. - Questions and Answer

<u>DATE</u>	<u>TOPIC</u>	<u>SPEAKER</u>
Tuesday, June 10	Technology - Our Future or We Are History	Dr. Joseph S. Heyman Director Technical Applications Group NASA Langley Research Center
Tuesday, June 17	Fire and Global Change	Dr. Joel S. Levine Atmospheric Sciences Division Space and Atmospheric Sciences Program Group NASA Langley Research Center
Tuesday, July 1	The Ingredients for a Renaissance- A Vision and Technology Strategy for U.S. Industry, NASA, FAA, Universities	Dr. Bruce J. Holmes Manager General Aviation/Commuter Office Advanced Subsonic Technology Program Office NASA Langley Research Center
Tuesday, July 8	The Effect of Rain on Airplane Performance	Ms. Gaudy M. Bezos-O'Connor Technical Applications Group NASA Langley Research Center
Tuesday, July 22	The Photogrammetric Appendage Structural Dynamics Experiment (PASDE): Lessons Learned from a Better, Successful "Faster, Cheaper" Flight Experiment	Ms. Sharon S. Welch Space Transportation Program Office Aerospace Transportation Technology Office NASA Langley Research Center
Tuesday, July 29	Airframe Systems Program Office Overview	Dr. Darrell R. Tenney Director Airframe Systems Program Office NASA Langley Research Center




Next Lecture
 H.J.E. Reid Conference Center
 July 29, 1997
 11:00 a.m.

presented by
 Dr. Darrell R. Tenney
 Director
 Airframe Systems Program Office
 NASA Langley Research Center

NASA Langley Research Center

ASEE Summer Faculty Fellowship Program
 and
 Langley Aerospace Research
 Summer Scholars (LARSS) Program

Office of Education
 Summer Lecture Series

July 22, 1997
 11:00 a.m.

**Ms. Sharon S. Welch
Space Transportation Program Office
Aerospace Transportation Technology Office
NASA Langley Research Center**

Sharon S. Welch joined NASA Langley in 1986 as an aerospace engineer in the Spacecraft Controls Branch. Between 1986 and 1996, she performed research into the development of optical sensor systems for controls applications. During this time, she led the development of the optical Measurement System for the Large Gap Magnetic Suspension System (LGMSS) and directed branch research in optical sensing for controls. In March 1994, she developed the Photogrammetric Appendage Structural Dynamics Experiment (PASDE) which was selected as a Space Station Risk Mitigation flight experiment to fly on STS-79. She and Michael Gilbert served as principal investigators for PASDE which flew successfully in November, 1995. From 1995 to 1997, she served as Chair of the AIAA Sensor Systems Technical Committee. Ms. Welch holds an M.S. degrees in Physics (1981) and Mechanical Engineering (1986) and has authored or co-authored more than 30 technical papers.

**The Photogrammetric Appendage
Structural Dynamics Experiment (PASDE):
Lessons Learned from a Successful
"Faster, Better, Cheaper" Flight Experiment**

The Photogrammetric Appendage Structural Experiment (PASDE) was developed to mitigate technical risk and cost associated with photogrammetric measurements of solar array and other flexible appendage structural responses for the International Space Station (ISS) program. Photogrammetric measurement offers an alternative to conventional on-board sensors such as strain gages or accelerometers for obtaining structural response time histories. Currently, accelerometer measurements of the ISS primary truss are planned for loads validation and model verification, but accelerometer measurements of solar array response are not being considered because of cost and resource impacts. With the success of PASDE, an alternative measurement has been validated for use in determining the structural responses of ISS solar arrays. In addition to the technical success of PASDE, the experiment also proved a success as an example of "faster, better, cheaper." From concept to flight, it took less than two years with the Langley engineering team designing, fabricating, testing, and delivering the flight hardware in eight months for a cost of 1.3 million dollars. Lessons learned from the PASDE provide insight into the development of successful and less expensive future space flight experiments.

**1997 American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program Final Presentations
and
Best Research Presentation Competition**

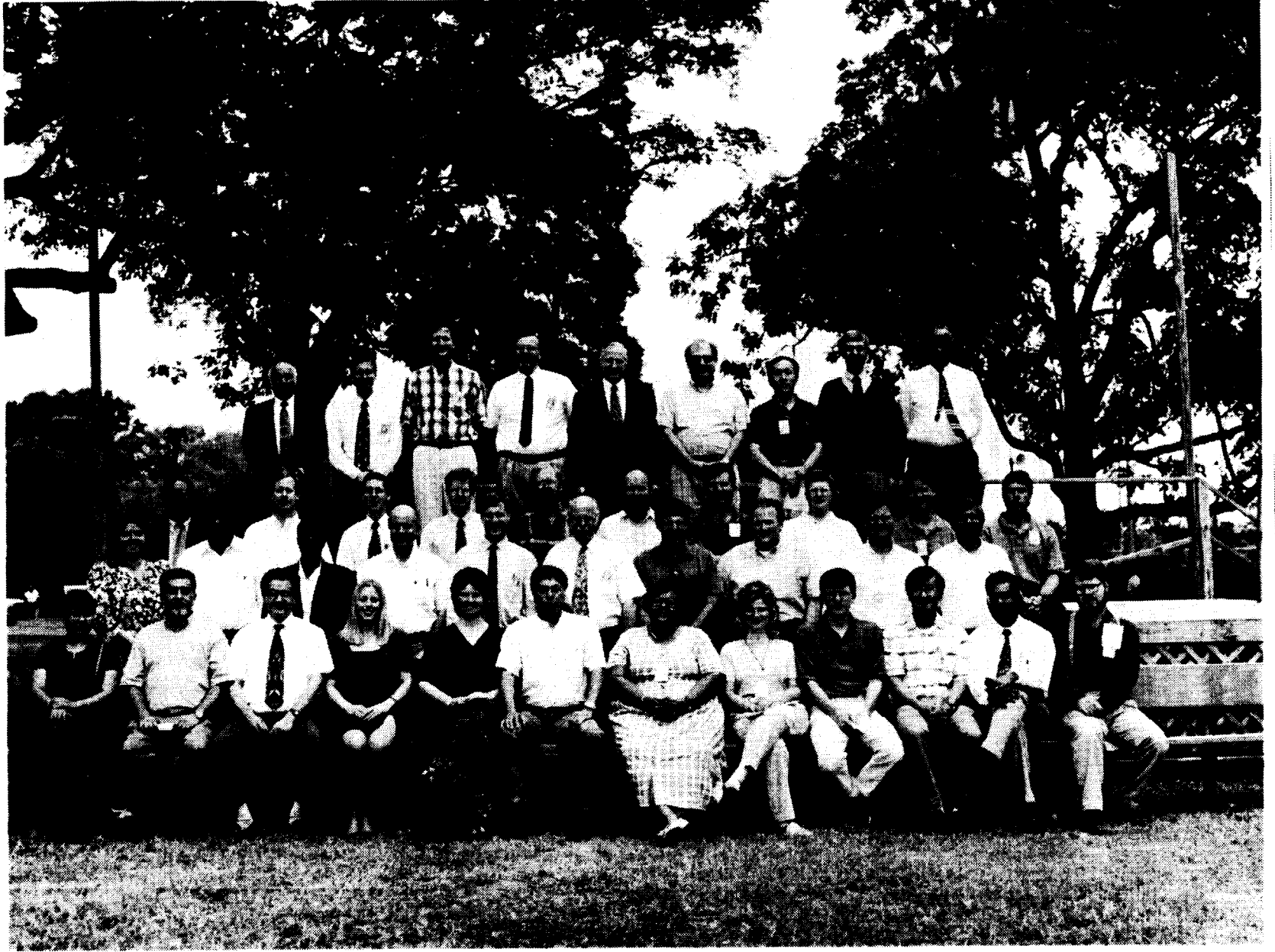
**Wednesday, August 6, 1997
H.J.E. Reid Conference Center
8:30 a.m. - 12:30 p.m.**

8:30 a.m.	Welcome	Dr. Surendra N. Tiwari ASEE Co-Director
8:35 a.m.	Comments	Dr. Samuel E. Massenberg Director LaRC Office of Education
8:40 a.m.	“A Research Portfolio Analysis Tool”	Dr. Paul J. Kauffmann, Jr. Airframe Systems Program Office Thomas Nelson Community College
9:10 a.m.	“Velocity Measurements Using EOH and Denoising Images Using Wavelets”	Dr. Jonathan D. Blotter Research and Technology Group Fluid Mechanics and Acoustics Division Idaho State University
9:40 a.m.	“TIGER PAU: Applying Genetic Algorithms to the Thermally-Induced Strain Problem”	Dr. James M. Hereford Internal Operations Group Experimental Testing and Technology Division Christopher Newport University
10:10 a.m.	Break	
10:20 a.m.	“Evaluating the Influence of Plasticity-Induced Closure on Surface Flaw Shape Evolution Under Cyclic Loading Using a Modified Strip-Yield Model”	Dr. Steve R. Daniewicz Research and Technology Group Materials Division Mississippi State University
10:50 a.m.	“GEO-Imaging for Tropospheric CO Measurement”	Dr. Jonathan J. Miles Internal Operations Group Aerospace Electronics Systems Division James Madison University
11:20 a.m.	“All-Speed Flow” Enhancements for the VULCAN General-Purpose Navier- Stokes Code”	Dr. Jack R. Edwards Research and Technology Group Aero- and Gas-Dynamics Division North Carolina State University
11:50 a.m.	Presentation of Certificates	
12:00 noon	Closing Comments	Mr. Edwin J. Prior Deputy Director LaRC Office of Education
12:10 p.m.	Group Photo of Presenters	
12:30 p.m.	Dutch Lunch for ASEE Fellows at the LAFB Officer’s Club	

1997 ASEE/LARSS Calendar of Activities

Date	Function
Monday, June 2, 1997	ASEE/LARSS Orientation Program* H.J.E. Reid Conference Center 14 Langley Boulevard
Monday, June 2, 1997 5:00-7:00 p.m.	*ASEE Meeting-Omni Hotel-This is considered a continuation of the Orientation. Please plan to attend. See Directions in package.
Thursday, June 5, 1997	Center Tour of Three Facilities (Fab Division, Landing Dynamics Facility, Wind Tunnel)
Tuesday, June 10, 1997	Lecture-H.J.E. Reid Conference Center
Wednesday, June 11, 1997 4:00 p.m. - 8:00 p.m.	Picnic-H.J.E. Reid Conference Center Picnic Grounds
Tuesday, June 17, 1997	Lecture-H.J.E. Reid Conference Center
Thurs/Fri, June 19-20	Simulator Tours
Friday, June 27, 1997	Spirit of Norfolk Moonlight Cruise
Tuesday, July 1, 1997	Lecture-H.J.E. Reid Conference Center
Friday, July 4, 1997	Holiday
Tuesday, July 8, 1997	Lecture-H.J.E. Reid Conference Center
Wednesday, July 9, 1997	Langley Air Force Base F-15 and Stealth Tour
Tuesday, July 15, 1997	ASEE Proposal Seminar-H.J.E. Reid Conference Center
Tuesday, July 22, 1997	Lecture-Pearl Young Theater
Thursday, July 24, 1997	ASEE/LARSS Banquet-LAFB O'Club
Thursday-Friday July 24-25, 1997	LARSS Graduate School Seminar SHARP Undergraduate School Seminar
Tuesday, July 29, 1997	Lecture-H.J.E. Reid Conference Center
Sunday, August 3, 1997	Spirit of Norfolk Dinner Cruise
Tuesday, August 5, 1997	ASEE Final Presentations
Friday, August 8, 1997	Last Day of Program

APPENDIX III
GROUP PICTURE OF RESEARCH FELLOWS



Those pictured in group photograph from left to right are:

Front Row Sitting: Mrs. Maxie Herrera (Summer Co-Op for ASEE), Mr. Mir S. Shirvani, Mr. Charbel T. Fahed, Dr. Denise V. Siegfeldt, Mrs. Caroline C. Clever, Mr. George W. Clever, Dr. Willie L. Darby, Dr. Deborah H. Carey, Dr. Jonathan D. Blotter, Dr. Kyo D. Song, Dr. Frederick Ferguson, Dr. James D. Baldwin

Second Row: Ms. Debbie Young (ASEE Admin. Asst.), Dr. Ellis E. Lawrence, Dr. Sonja D. Ebron, Dr. Lawrence R. Daley, Dr. James R. Tarr, Dr. H. Marshall Booker, Dr. David J. Gosselin, Dr. David C. Fleming, Dr. Ronald B. Bucinell, Dr. Amin N. Dharamsi

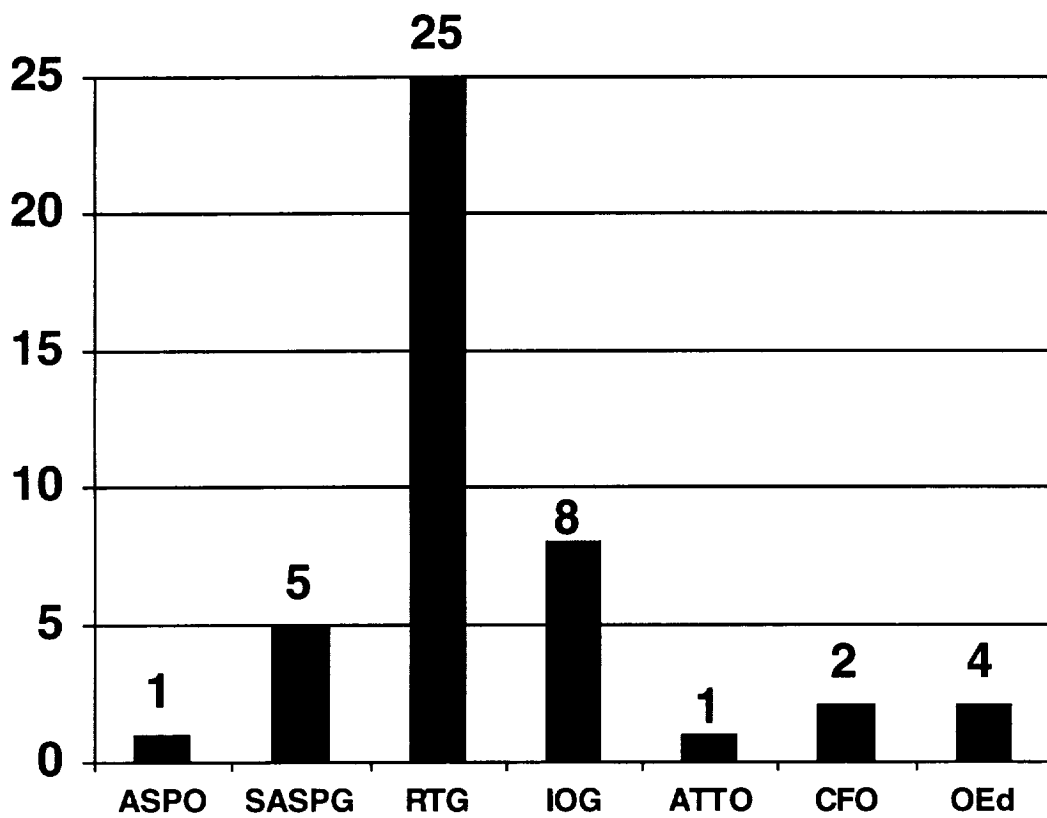
Third Row: Dr. Joseph L. Boyd, Dr. William D. Thacker, Lt. Col. Peter D. McQuade, Dr. James M. Hereford, Dr. Mark Farris, Dr. Lawrence A. Newquist, Dr. Huseyin Sarper, Dr. S. Scott Collis, Dr. Jonathan J. Miles, Dr. Steve R. Daniewicz

Fourth Row (On Stage): Dr. Surendra N. Tiwari (ASEE Co-Director), Dr. Charles F. Bunting, Dr. Paul J. Kauffmann, Jr., Dr. William "Perry" Wheless, Jr., Dr. J. Garth Thompson, Mr. Thomas E. Hopkins, Dr. Feng-Bao Lin, Dr. Kevin D. Cole

Not Pictured: Dr. Han P. Bao, Dr. Edmundo Corona, Dr. Jack R. Edwards, Dr. Peyman Givi, Dr. Jen-Kuang Huang, Dr. Donald L. Kunz, Dr. Gabriel Laufer, Dr. Duc T. Nguyen, Dr. Nickolas Vlahopoulos

APPENDIX IV
DISTRIBUTION OF FELLOWS BY GROUP

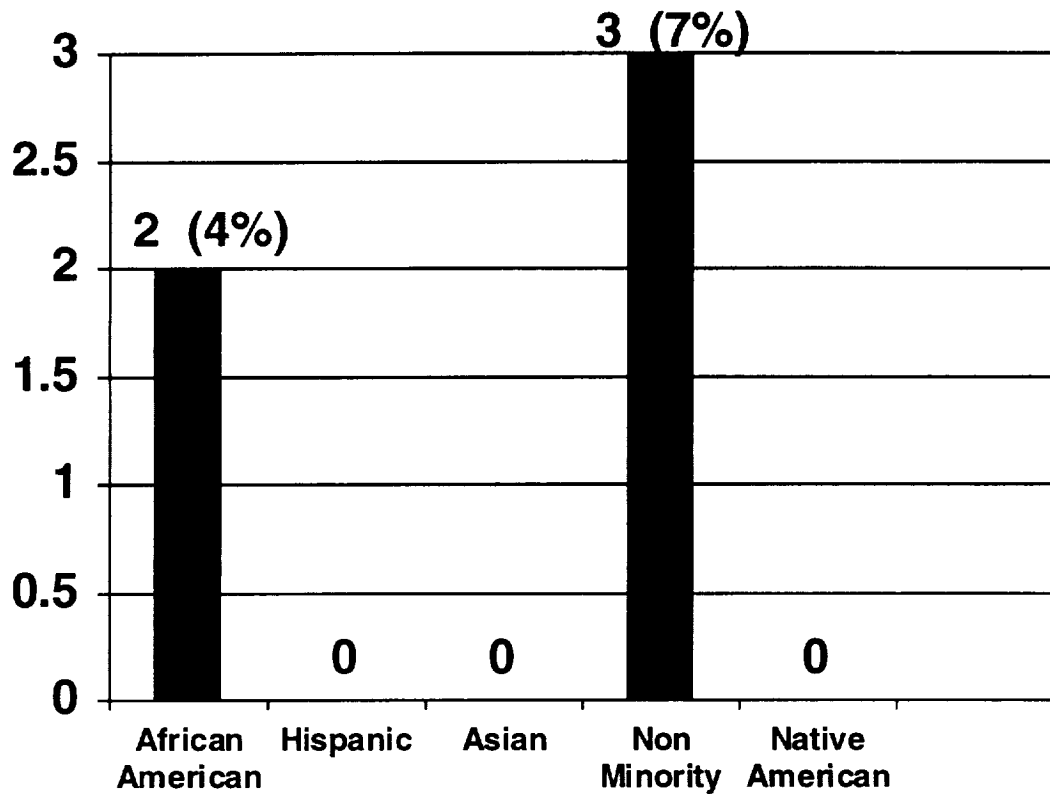
Distribution of 1997 ASEE Fellows by Group



APPENDIX V
DISTRIBUTION OF FELLOWS BY ETHNICITY/FEMALE

Distribution of 1997 ASEE Female Fellows by Ethnicity

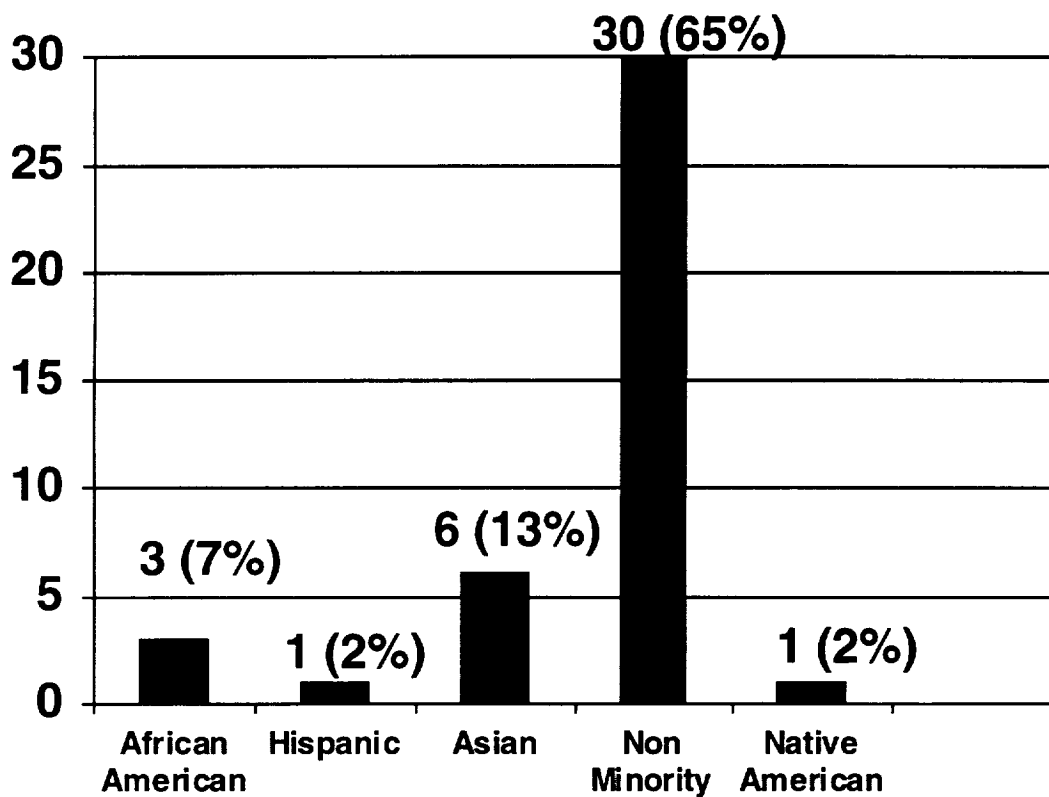
5 Female Participants
(Represents 11% of all participants)



APPENDIX VI
DISTRIBUTION OF FELLOWS BY ETHNICITY/MALE

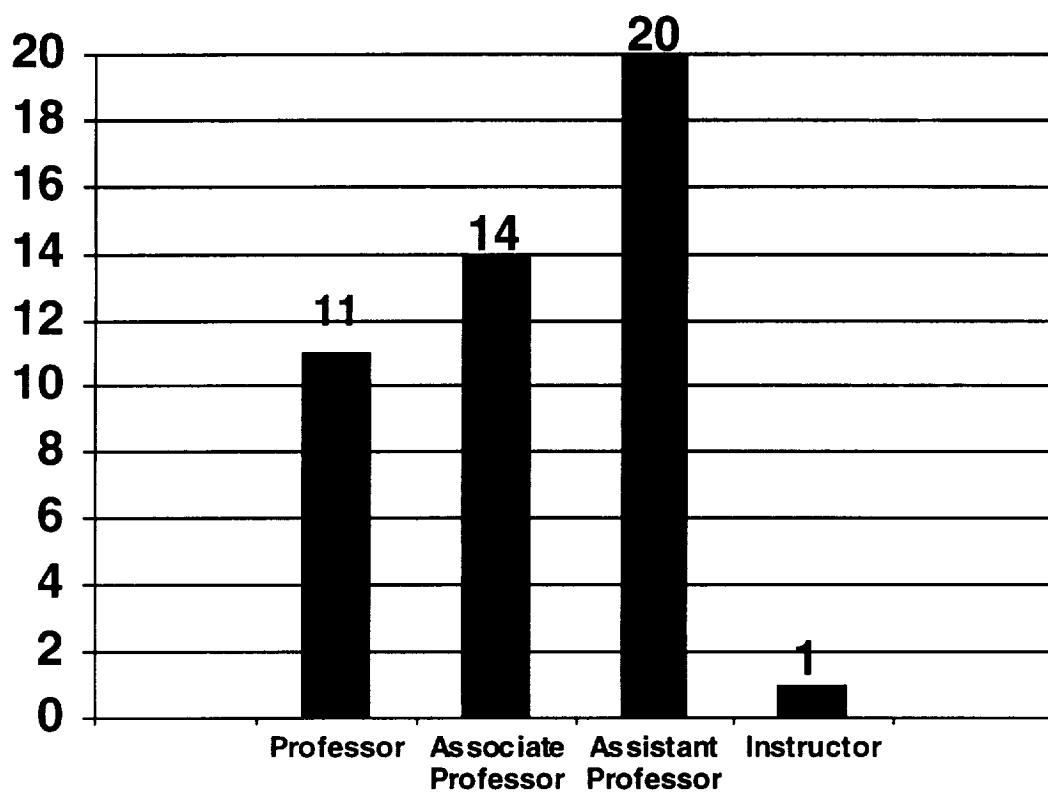
Distribution of 1997 ASEE Male Fellows by Ethnicity

41 Male Participants
(Represents 89% of all participants)



APPENDIX VII
DISTRIBUTION OF FELLOWS BY UNIVERSITY RANK

Distribution of 1997 ASEE Fellows by University Rank



APPENDIX VIII
DISTRIBUTION OF FELLOWS BY UNIVERSITY

1997 ASEE SUMMER FACULTY FELLOWSHIP PROGRAM INSTITUTION PARTICIPATION

<u>UNIVERSITY/COLLEGE</u>	<u>NO. OF FELLOWS</u>
Christopher Newport University	4
Cumberland College	1
^Dona Ana Branch Community College-New Mexico State University	2
*Elizabeth City State University	1
Florida Institute of Technology	1
*Hampton University	3
Idaho State University	1
James Madison University	1
Kansas State University	1
Midwestern State University	1
Mississippi State University	1
New River Community College	1
*Norfolk State University	3
*North Carolina A&T State University	1
North Carolina State University	1
Northern Virginia Community College	1
Old Dominion University	6
Parks College of Saint Louis University	1
Polytechnic University	1
Rice University	1
Southwest Virginia Community College	1
State University of New York-Buffalo	1
Thomas Nelson Community College	1
U. S. Air Force Academy	1
Union College	1
University of Alabama	1
University of Michigan	1
University of Nebraska	1
University of Notre Dame	1
University of Oklahoma	1
University of Southern Colorado	1
University of Virginia	1
Wilkes University	<u>1</u>

Total Number of Fellows **46**

Total Number of Institutions Represented **33**

*Indicates a **H**istorically **B**lack **C**ollege or **U**niversity (HBCU).

^Indicates a **H**ispanic **S**erving **I**nstitution (HSI).

APPENDIX IX
ABSTRACTS - RESEARCH FELLOWS

Stress Intensity Factors for Corner and Through Cracks in Countersunk Rivet Holes

J.D. Baldwin

1997 ASEE Summer Faculty Fellowship Program

NASA Langley Research Center

Abstract

The growth of small cracks is an important consideration in structural integrity analyses of aging aircraft. The processes by which small cracks nucleate and propagate have been shown to occupy a significant portion of the total life of a structure. By small cracks, we typically refer to small surface flaws of circular or elliptical shape.

The goal of this project was to compute stress intensity factors for corner and through cracks at countersunk rivet holes. This geometry is predominant in aircraft fuselage and wing skin structure and is a known source of cracks in those structures. Previous efforts have focused either on straight bore (i.e., not countersunk) through holes or on elliptical corner cracks in a countersunk hole. To date, there is no data addressing the stress intensity factors for through cracks extending into the countersink region. Once developed, the stress intensity solutions will be available for use in post-processing short crack growth experimental data collected from single edge notch tension (SENT) test specimens with open countersunk notches. The stress intensities will allow the data to be presented in standard da/dN versus ΔK format for use in subsequent fracture mechanics analysis of riveted joints.

Here, we used a boundary element code to compute the stress intensity factors for circular corner cracks and through cracks with both straight and circular crack fronts. These two crack front models for the through cracks are intended to simulate the actual crack front shapes found in previous experiments. By using two different shapes, we hope to explore the difference in shape on stress intensity value at the mid-thickness of the countersink. It is at that position in the countersink that future experimental results will be correlated.

The stress intensity solutions for the through cracks show a predictable variation across the countersink thickness for both the straight and circular crack front models. Specifically, the straight front models display higher stress intensities at the straight back side of the hole (opposite the countersink) and lower values at the countersink surface. The circular crack front models, on the other hand, have higher stress intensity values at the countersink than at the back side. Both of these behaviors are consistent with the difference between the proposed crack shape (i.e., straight or circular) and the actual crack fronts found by previous experiments. The models have not been subjected to a complete mesh refinement study, so the solutions are to be considered preliminary. It should be noted that as the through cracks grow across the countersink, the difference between a mesh and a further refined mesh become less pronounced. This implies that coarser meshes are satisfactory for longer cracks. Shorter cracks on the other hand, are much more sensitive to the mesh density, particularly on the crack front and where the crack intersects the surface. Results for corner cracks are much less refined at this point. The difficulties in representing a sufficiently refined mesh for very small cracks have limited the results found for those cases.

COST ESTIMATION OF COMPOSITES MANUFACTURING PROCESSES THROUGH PROCESS COST ANALYSIS DATABASE ((PCAD)

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Norfolk, Virginia 23529
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It is now well understood that most of the major fabrication costs are fixed by the end of the early design phase. Hence designers must be aware of the cost impacts of the objects of their creation while they are designing them. The powerful message of the new design paradigm is to design concurrently with processes and costs in mind.

With a commitment to make design engineers aware of costs, the Structures Technology Program Office at NASA Langley Research Center has initiated the development of a conceptual and preliminary designers' cost prediction model. One of the major results of this initiation was the publication of two software products: COSTADE (Cost Optimization Software for Transport Aircraft Design Evaluation) and PCAD (Process Cost Analysis Database). COSTADE is a multidisciplinary evaluation and optimization tool that includes a set of analyses from the major groups affecting the structural design of aircraft parts. These groups include structural analysis, design, load redistribution, optimization and blending, weight, manufacturing, and cost. COSTADE cost algorithms were developed in such a way that any cost model equations can be input to COSTADE so long as they follow a specified file format. PCAD, which was developed independently from COSTADE, is one such cost model since the generation of a cost data deck that is totally compatible with COSTADE is one of its natural products.

The goal of this project is to explore the capabilities of PCAD in dealing with a variety of part designs and material forms ranging from metal to composites. In the first application, an aluminum part is to be machined using a NC milling machine. Because none of the process steps required by this part are included in the current database of PCAD, new cost equations must be built from scratch. In the second application, a composite part requiring the well-known manual lay-up process is the subject of study. A mixture of existing and new cost equations is required for this part. Finally for the third and last part, its process plan requires a total of 43 steps. Being a complex part, it is truly an exhaustive test case for PCAD as far as characteristics such as versatility, flexibility, and capability are concerned. Currently the PCAD result for the last part is being studied by industry.

Various cost estimation models exist since the beginning of industry and commerce. What is novel about this research is the concept that treats cost as if it is a physical process governed by some constants. First developed by MIT, this concept has started to generate applications in the aircraft industry. The challenge is to see whether the concept can be accepted by the engineering design community, and treated like a regular physical parameter to be involved in a global optimization scheme that includes both functional and cost criteria.

Velocity Measurements Using EOH And Denoising Images Using Wavelets

Jonathan D. Blotter

Acknowledgment: Gary A. Fleming and James F. Meyers

Abstract

The focus of this research is two-fold. First, the denoising of Electro-Optic Holography (EOH) images using wavelet techniques was investigated. Second, a technique for extracting a complex representation of the velocity field using Electro-Optic Holography (EOH) was developed.

EOH is a non-intrusive displacement measurement technique capable of whole-field measurements on objects subject to either static or dynamic loads. The static measurements are performed using a double exposure hologram interferometry method while the dynamic measurements are based on a time-averaged technique. EOH holograms are recorded and processed electronically using a CCD camera instead of conventional media. Figure 1 illustrates a typical EOH setup.

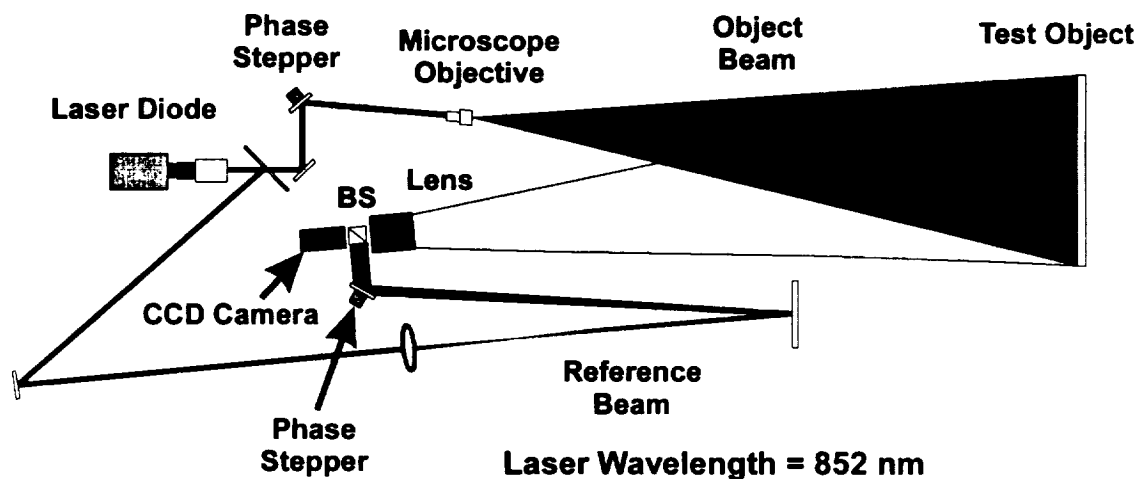


Figure 1, Electro-Optic Holography Schematic

For dynamic measurements the EOH process can be separated into 3 steps as shown by Figs. 2. Figure 2a illustrates the operating shape of the vibrating structure. This is the image that is shown on the computer monitor during the data acquisition process. The bright fringes in these images represent the node lines or locations of zero displacement. Figure 2b shows the image after it has been processed and denoised. This image is now phase unwrapped and the displacements are computed as shown in Fig. 2c. It is important to note that in these images one complete fringe line represents a displacement equal to one wavelength of the light source. In these images an 852 nm light source was used which implies that each fringe represents a displacement of 852 nm. Although 3D capabilities are possible with the EOH technique, this work focuses on out-of-plane motion only.

The first part of this research effort was to investigate the effectiveness of using wavelets to denoise the EOH images which is part of the processing between Figs. 2a and 2b. It was determined that wavelets are not as effective

as other techniques such as a median filter approach for the following reasons: 1. The noise is not detected as completely high frequency and it is difficult to separate out in the wavelet coefficients; 2. The optimum wavelet, length of the filter, type of thresholding, and the thresholding value will be different for each image; 3. EOH images are cosine based and inherently the DFT-IDFT approach will result in cleaner images; 4. Wavelet thresholding can significantly change the relative image values.

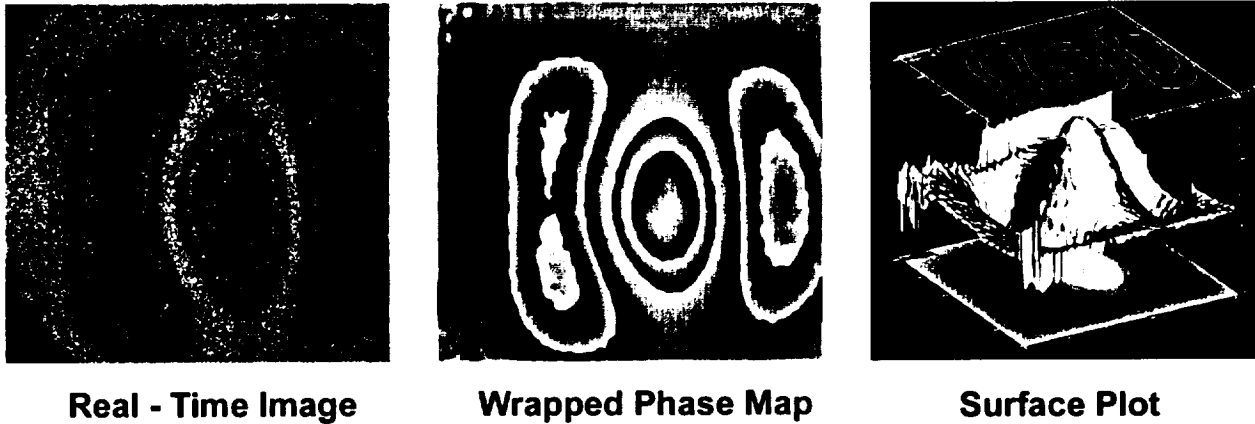


Figure 2, EOH 3 step process

Figures 3a, 3b, 3c, and 3d, respectively present, the raw image which is to be denoised, the results of the present denoising technique which is based on a FFT-IDFT approach, the denoising results using a 9x9 median filter approach, and the denoising results of the wavelet technique using a combination of both hard and soft thresholding. From a visual inspection it is evident that the median filter and the FFT-IDFT approaches provide a much cleaner result.

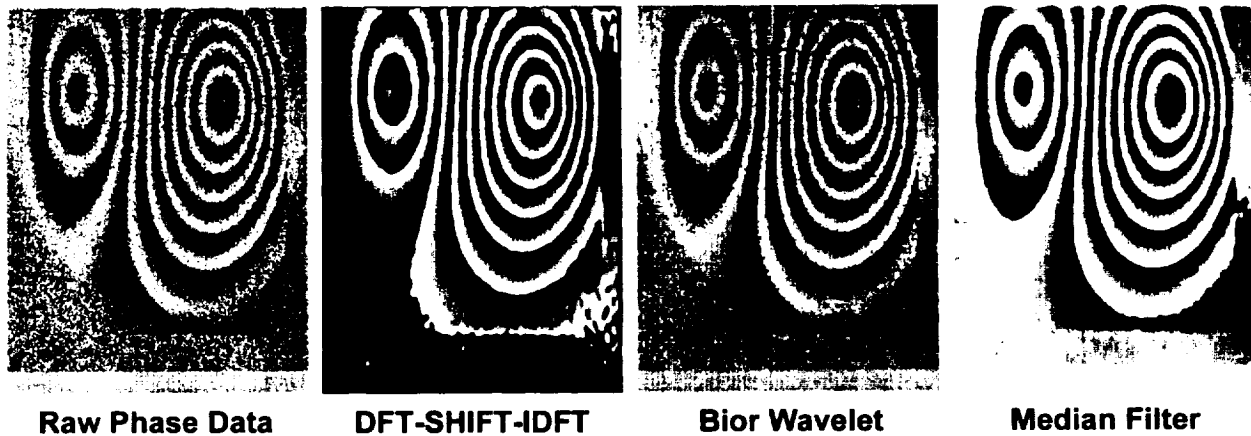


Figure 3, Raw and denoised images

The second phase of this research effort consisted of developing a method to extract a complex representation of the velocity field based on the EOH system. Previous to this development only time-averaged values of the displacement field were extracted using the EOH technique.

When taking dynamic measurements either phase stepper shown in Fig. 1 is forced with the same frequency as the vibrating structure. This generates a stroboscopic effect and the zero order fringe is shown to be stationary. The method we developed to extract a complex representation of the velocity field consists of creating a beat frequency by slightly changing the frequency of the phase stepper. When this beat frequency is imposed the zero order fringe begins to oscillate. This modulation is sampled from which the relative phase can be determined. Once the phase has been determined, a cosine based time signal model can be used to determine the complex representation of the velocity field. From the time-averaged displacement field and the complex representation of the velocity field, the power flow, which represents the net energy transfer in the structure can be determined.

Although, EOH is still in its infancy, the technique shows promise for becoming an effective technique for computing the power flow in vibrating structures. Applications for this type of research will extend to areas such as active noise and vibration control, dynamic characterization, and nondestructive evaluation.

I. Chief Financial Office Critical Career Pathway Analysis

II. Feasibility Study to Determine Realities of Economic Value of NASA-LaRC Technology Developments

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I. This investigation focused on a number of major issues concerned primarily with an analysis and determination of critical career pathways in the Chief Financial Office NASA-LaRC. The basic objective of the program is to provide CFO professionals with a consistent and high quality career progression and development plan to identify and chart career guidance systems and identify opportunities for future career growth. The program is arranged in four distinct phases. The initial phase of the investigation was to design and construct a program that would accommodate an electronic interview system for retrieval of necessary career benchmarks from current CFO personnel. This was addressed using the basics of FileMaker Pro.

The pilot test group was composed of six senior management level personnel in the Chief Financial Office. Each person was contacted and asked to participate in the program. All six respondents were then given explicit instructions over the e-mail system and given a time frame in which to complete the electronic interview. All respondents completed the process efficiently and timely giving a real-time data base to analyze, which allowed minor modifications to the program before the major data-block was collected. In phase two, a total of thirty-seven full-time CFO personnel were chosen to provide career data through the electronic interview technique. Due to travel and other extenuating circumstances thirty-five of thirty-seven were able to complete the interview.

In phase three, this data base is analyzed to determine historical trends involving critical career pathways, opportunities, detours, fast tracks, etc. Phase four allows these documented trends to be analyzed to design future career pathways, identify major benchmarking signals, diagram various pathways on the CFO Roadmap, and designate determined proficiencies and skills and recognizable opportunities for advancement.

II. The main focus of this investigation was to determine the feasibility of a full stage analysis of the economic value of NASA-LaRC developed original technologies through transferal, adoption and adaptation into the private commercial sector. The first phase of the study was the development of the methodology to be used and the identification of the challenges such an endeavor would initially face. NASA-LaRC technologies can be identified through numerous sources including **Technology Briefs**, **NASA Facts**, **NASA "Spinoff"** annual editions and through specialized publications such as the **"Thirty Year Commemorative Edition"** of **NASA Spinoffs** as well as numerous archival records in the Langley Research Library and others such as the archival files at the National Air and Space Museum. Additionally much can be gained through direct interviews with long-term employees of the Center and their collective corporate knowledge.

The recommendation of this study is primarily a modification of existing techniques to allow the development of a "forward" model that would lend some predictability to an economic forecast evaluation of technologies rather than concentrate on specific past technologies and their contributions to commercial economic development. The recommendation is for the development and construction of an economic model using the traditional historical base available in addition to the employment of fuzzy systems and neural networking. This feasibility study indicates the challenge of constructing such a cohesive yet amorphous economic evaluation model of technology use is well worth the effort especially when systems analysis and operations research are such major components of the NASA-LaRC mission and effort.

CONTRACT CAPABILITY SURVEY OF MINORITY COLLEGES

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School of Business and Entrepreneurship
Norfolk State University
2401 Corprew Avenue
Norfolk, Virginia 23504

The purpose of this study was to address Public Law 101-144/101-507 requirement that NASA annually award at least 8 percent of its contracts and subcontracts to Small and Disadvantaged Businesses (SDB's). In the legislation, the definition of SDB's was expanded to include Historically Black Colleges and Universities, Hispanic Colleges and Universities, and Tribal Colleges and Universities. NASA plans to strive to award high quality contracts and subcontracts under this legislative initiative.

To assist NASA in meeting the above mentioned contracting goals a comprehensive survey was developed and submitted to over 250 minority colleges. The purpose of the survey was to ascertain the contracting and subcontracting capabilities of these minority colleges. The survey requested the following major categories of information:

- ...Institution demographic data
- ...Contract research and development points of contact
- ...Academic data with regard to scientific majors, degrees offered and faculty composition
- ...Major scientific laboratories, institutes and centers including value and major equipment
- ...Contract history NASA and other Federal agencies
- ...Subcontract history -Aerospace and Scientific related

From the survey responses a directory will be published outlining the technical capabilities at minority institutions that relate to the NASA program. The directory will be distributed to all NASA technical program managers and prime contractors for their use in contracting and subcontracting activities.

In addition to the foregoing, this study will also aid NASA in accomplishing one of its major goal of securing the participation of minority colleges in transferring and commercializing advanced aeronautics, space and related technologies. A MINORITY ENTREPRENEURSHIP TECHNOLOGY CENTER (METeC) will be established to assist these colleges in developing satellite technology transfer centers on their campuses.

Damage Accumulation in Closed Cross-Section Composite Structures Subjected to Compressive Loading

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All three of NASA's Pillars for Success emphasize advances in composite material technology. To achieve these advances, a fundamental understanding of the behavior of the damage accumulation process in composite materials is needed. To this end, test methods are needed that will isolate the phenomenon associated with the damage accumulation process. The project performed during this summer's program first evaluated the use of a newly developed test method for the evaluation of composite materials in compression without the influence of free-edges and secondly generated data to be used to study the damage accumulation process in closed cross-sectioned composite structures.

The newly developed test method uses a 9 inch long, 2 inch diameter, tube with co-cured fiber glass end tabs. For this summer's project, tubes were manufactured using AS4 fibers in a 3506-6 resin. The laminate geometry for the tubes was $[\pm 45/0/90]_s$ and $[\pm 45/90/0]_s$. The fixtures used in the evaluation were designed and manufactured at Union College. During the test method evaluation phase of the project, each tube tested use fitted with eight strain gages. The gages were configured in a rectangular configuration at the 0 degree mark, uniaxial gages at the midsection at the 90 and 270 degree marks, and at mid section and one inch above and below the 180 degree mark. The gages were configured to detect bending and buckling. During the data generation phase of the project the tubes were not configured with any gages.

The results from the test method evaluation phase of the project showed experimentally that no buckling or bending was occurring in the tube during compressive loading. The mean failure load for the ten tubes tested (five of each laminate geometry) was 100 ksi. The majority of the tube failures were in the center half of the tube. Only one of the tube failures could be classified as an end-tab type failure. A finite element evaluation of the first five Eigenvalues for the tubes in buckling show that the critical load is at least a factor of three higher than the failure load for the tubes. This same analysis illustrated that the highest stresses and strains occur in the gage section of the tubes.

During the data generation phase of the project, three tubes of each laminate geometry were loaded to 45%, 60%, 75%, 90%, and 95% of the ultimate load. Cross-head stroke and load were collected electronically during the testing. After the load was applied and removed, the specimens were cut along the length, a dye penetrant was applied to the edges, and the specimens were x-rayed. The x-rays provide record of the damage present in each of the tubes. This data will be used to develop composite damage accumulation and reliability theories.

An Analysis of Reverberation Chambers

Using the Finite Element Method

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The application of reverberating, or mode-stirred, chambers to the determination of electromagnetic susceptibility has matured significantly over the past several years. In the application of reverberation chambers to measure the susceptibility of avionic equipment to pulses, RTCA document DO-160D specifies a 150 V/m pulse modulated at 0.1% duty cycle and 1 kHz repetition frequency, which corresponds to a rise time of 400 ns. Due to the high quality factor (Q) associated with mode-stirred chambers, the rise time criteria cannot be achieved without modifying the test environment. NIST currently recommends loading the chamber with absorbing material to reduce the Q of the chamber and thereby decrease the rise time. A known cost of the NIST solution is that increased power is required to meet DO-160D specifications. The fields in a reverberation chamber are typically statistically characterized due to the large number of modes and the mechanical stirring of the fields. An unknown factor associated with loading the cavity is the effect on the field uniformity. The field structure in a typical reverberation chamber is based on a high Q environment which, although certainly producing a worst case environment may, in fact, never be realized in practice. By utilizing a numerical analysis scheme such as finite elements the effects of introducing loss can be accurately simulated. A two-dimensional simulation is performed since the three-dimensional simulation is computationally expensive. The two-dimensional model may yield considerable insight into the nature of the loss experienced on real airframes, and also provide an error measure on data in the ideal mode-stirred chamber.

The specific problem addressed in this investigation is the examination of a two-dimensional finite element model to simulate the fields in the cavity. The model is sufficiently general to allow general absorptive loads to be placed within the computational domain. The results may then be used to determine the error associated with loading the cavity. The concept of a reverberation chamber is defined along with a brief review of several important analysis techniques used to further the understanding of the chamber characteristics. The development of the finite element formulation that will be used for analysis of the representative two-dimensional structure is explored. The results of the finite element analysis to the two-dimensional chamber will be examined, focusing on statistical measures. A brief development of the mode density for two-dimensional cavity is also examined.

Polymer Matrices for Luminescent Dyes in Pressure Sensitive Paints

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ABSTRACT

Pressure sensitive paints (PSPs) are used to provide a continuous pressure mapping of aerodynamic surfaces in wind tunnels. Traditionally, "pressure taps," which consist of a small piece of tubing connected to an electronic pressure sensor, are placed at various locations on the surface of interest. Sometimes it requires as many as 1000 pressure taps to obtain a sufficient mapping of the changes in pressure over an entire surface. The PSP, which consists of a polymer and luminophore, is capable of providing a detectable, qualitative method for surface flow visualization. The partial pressure of oxygen through the polymer matrix is inversely proportional to the luminescence intensity of the luminophore, which can be used to measure the changes in pressure under airflow. The driving force behind this research project was to explore different polymer/luminophore combinations that would improve the current applicability of PSPs used in wind tunnel measurements.

In general, PSPs are prepared by dissolving both the polymer and luminophore in an organic solvent, such as methanol, trichloroethane, or toluene. The paint can be applied to a surface by spraying, brushing, or dipping. After the solvent evaporates, a uniform thin film of the polymer remains on the surface. The paint adheres to the surface, however, the polymer may affect the photophysical behavior of the luminophore. Since this interaction between the polymer and luminophore has not been studied extensively, it requires the initial method of trial and error to find the optimal combination for a paint matrix. A good polymer binder for a PSP must be permeable to oxygen, easy to apply, and possess a smooth, transparent finish after curing.

In characterizing the usefulness of a PSP, the change in the luminescence emission intensity of the luminophore was monitored as a function of the change in pressure using a fluorescence spectrometer. From the collected data, the Stern-Volmer constant, which describes how sensitive the paint is to changes in the partial pressure of oxygen, was calculated. The Stern-Volmer constant, A_1 , is described by the slope (K) of the linear equation:

$$I_{ref}/I = A_0 + A_1(P/P_{ref})$$

In this equation, P_{ref} is the pressure at some reference point, usually the pressure under ambient conditions in air (14.7 psia). A plot of the ratioed luminescence emission intensities against the change in pressure should yield a linear line, where the slope is equal to the Stern-Volmer constant, A_1 . In our calculations, the Stern-Volmer reference constant, A_0 , has been normalized to equal 1.00. A typical PSP for wind tunnels measurements has a Stern-Volmer constant (A_1) in the range of 0.1 to 0.3 psia⁻¹ in air.

It was the purpose of this summer research project was to identify a polymer and luminophore combination that possessed a Stern-Volmer constant A_1 larger than 0.3 psia⁻¹. Several potential polymers reported in the literature were identified and tested for their feasibility as good polymer matrices for luminescent dyes in PSPs.

The Atmospheric Sciences Division - Creating a Booklet -

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The National Aeronautics and Space Administration (NASA) Mission to Planet Earth (MTPE) Program has selected the Atmospheric Sciences Division (ASD) at Langley Research Center (LaRC) to be the lead Center in meeting the challenge of understanding the ever-changing atmosphere of the Earth.

The Earth's atmosphere is incredibly complex. Many interactions between the Earth's system of air, water, land, and life remain clouded in uncertainty. Data on many of Earth's processes are sparse. This lack of knowledge means that it is not currently possible to explain why major climate events occur, how often they occur, or what global impact they will have.

Human activities are capable of affecting the planet. As Earth's population grows and economic activity expands, the ability of humanity to cause global scale changes in the atmosphere increases. While it is not known precisely how this expansion will affect the global atmosphere, it could result in regional or global environmental changes as significant as the current depletion of ozone in the upper atmosphere.

The ASD is collecting data and conducting world class research which improves the knowledge of the current state of Earth's atmosphere, as well as the understanding of human-induced and naturally occurring changes in the atmosphere of the Earth.

As ASEE Fellows, mentored by Dr. Arlene Levine, Manager of Outreach and Education for the ASD, we were asked to create a booklet which describes the goals and organization of the ASD, the major current research challenges, projects, and accomplishments of the ASD, and the outreach activities of the ASD. The booklet is intended for use by other divisions at LaRC, other NASA Centers, government agencies, universities, and industry.

The creation of the ASD booklet was accomplished in three phases: design, information procurement, and editing.

As mathematics professors with no prior formal atmospheric science background, we could not begin designing the ASD booklet without first understanding the goals and nature of the research accomplished by the ASD. We could not understand the goals and nature of the research without a knowledge of the basic concepts of atmospheric science. To aid us in our quest for knowledge, Dr. Levine arranged for us to receive private atmospheric science tutorial sessions with scientists. These gave us the understanding we needed to draft a table of contents and make preliminary decisions about what we believed would be valuable to include in the booklet.

Once a basic design was agreed upon, we began the process of procuring information. NASA Public Mail documents, NASA, LaRC, and ASD website information, scientific journals, and most importantly formal and informal input from science team members were sources from which information was gathered.

After a first draft was completed, division members were asked to proof those sections pertinent to them or their research and given the opportunity to make comments about the entire booklet or any portions of it. Using the resulting requests for changes, a final draft, including over seventy pages of body and over sixty pages in appendices, was completed.

It is our sincere desire that our efforts toward the creation of this booklet will make a contribution toward furthering the scientific endeavors of the ASD, LaRC, and NASA.

Abstract.

Transient Experiments for Thermal Conductivity of Titanium Honeycomb Panels

Kevin D. Cole
University of Nebraska Lincoln

1997 ASEE Summer Fellowship
Thermal Structures Branch
NASA Langley Research Center
Hampton, VA

work made possible by
Kamran Daryabeigi, ASEE Associate
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On the proposed high-speed civil transport, the thermal protection system current design of a titanium honeycomb panel has been found to have a larger-than-expected thermal conductivity by steady-state measurements. The theory used to predict the thermal conductivity is based on Langley research of Swann and Pittman (1961). The task is to attempt to explain the discrepancy between theory and steady measurements by re-examining the theory and predictive calculations, and by re-measuring the thermal conductivity with an independent measurement method.

Examination of the predictive theory showed that it includes the known heat transfer phenomena that contribute to thermal conductivity under the conditions of the steady tests (conduction only, negligible convection or radiative contribution). However the prediction is based on bulk thermal properties of the panel components; a working hypothesis is that the thermal properties of the titanium foil are larger than the bulk values used for the prediction, perhaps by processing or plating of the foil during the manufacturing process.

A variety of transient heating experiments were carried out on two sample honeycomb panels with titanium cores, the same two sample panels used in the previous steady tests. Convection heat transfer (buoyancy-driven gas motion inside the cells) was ruled out by two tests that gave identical results—in the first test the panel was heated from above, and in the second test the panel was heated from below.

Thermal conductivity is determined by a data analysis method called parameter estimation, a statistical approach that involves minimizing the sum-of-square error between the transient experimental data and a transient predictive model of the panel. Preliminary analysis of the data with a simple uniform-panel model supports previous steady measurements of higher-than-expected effective thermal conductivity of the panel. Data analysis with a three-layered model is in progress that should provide an estimate of the thermal conductivity of the titanium core.

Numerical Simulation of Receptivity Compared to an Experimental Transition Database

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Numerical simulation is used to study the receptivity phase of laminar-to-turbulent transition for conditions which model those of an ongoing transition experiment in the NASA Langley $2' \times 3'$ boundary layer wind tunnel. The objective of the experimental investigation is to study the generation of instability waves (i.e. receptivity), their subsequent evolution, and eventual transition to turbulence in a two-dimensional boundary layer on a wing section subjected to free-stream acoustic disturbances. It is expected that the experimental results will provide a database for validating transition prediction methodologies and evaluating transition models.

The careful design and controlled conditions of the experiment provide a unique opportunity to conduct numerical simulations to provide independent validation of the receptivity and early instability phase to transition. Furthermore, the high-resolution and precise environmental conditions of the simulations allow for results which are difficult, if not impossible, to obtain experimentally. For example, the numerical simulations provide both mean and disturbance results upstream of the the point where boundary layer measurements are possible. Thus the numerical results complement the experimental results by providing more complete flow-field information.

Numerical solutions are obtained using a multi-step process. First a steady potential-flow solution is obtained for the experimental conditions and geometry by computing a conformal mapping of the airfoil to a circle. Doing so allows for the generation of an exact incompressible potential solution for the airfoil. Next, the potential solution is used as input to the steady boundary-layer equations to obtain the mean viscous flow over the wing. In the incompressible limit (the experimental Mach number is 0.06), the acoustic wavelength becomes infinite and the unsteady acoustic field about the airfoil at a given frequency is given by the potential flow now modulated in time. This unsteady potential field is used along with the mean viscous flow as input to the linearized unsteady boundary layer equations which solve for the unsteady viscous "Stokes" layer. The unsteady Stokes layer and the unsteady potential fields are combined to generate an approximation to the acoustic forcing which is valid both in the far-field and at the wing surface. This acoustic forcing is used as a source term in the linearized Navier-Stokes solver to compute the boundary layer response which consists of both decaying and growing instability waves in the boundary layer.

Using these computational techniques, both the meanflow and unsteady acoustic forcing fields have been generated for the experimental conditions. Comparisons of the computed mean boundary layer solution and early experimental results show good agreement. Using these solutions the acoustic forcing field has been generated and linearized Navier-Stokes solutions are underway to compute the boundary layer response.

Collapse of Elastic-Plastic Cracked Plates Under Biaxial Loads

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As older aircraft continue to operate past their original expected service life of approximately 20 years, it has become important to consider a wide range of issues regarding their maintenance and operation. One such issue is the degradation of their structural integrity as aging occurs due to factors such as skin lap joint bond degradation, cracking of the skin, corrosion, etc. The present study was motivated by such "aging aircraft" issues and focuses on the effects that the presence of cracks in thin-walled structures have on their load carrying capacity. The objective of the present study is to conduct a preliminary investigation of the load carrying capacity of cracked aluminum flat plates under biaxial loading, taking into account the effect of geometric and material nonlinearities, with emphasis on the effect of the latter.

The problem considered consists of a rectangular flat plate of aspect ratio four containing a central crack of given length, aligned with the long sides of the plate. Two sets of boundary conditions have been considered: clamped with respect to transverse displacements on all four sides and pinned along the long edges while clamped along short edges. The plates are loaded in tension in the direction transverse to the crack and in compression in the direction along the crack. This simulates a loading state which could be seen in a fuselage segment, with the tensile load due to pressurization and the compressive load due to fuselage bending. The bulk of the study has been conducted on plates with thickness of 0.090 in. Although this is a bit thick for fuselage applications, it has been used in order to highlight the effect of material nonlinearity due to yielding. The occurrence of tearing was not considered. The analysis was carried out using the finite element program STAGS (S_TStructural Analysis of General Shells) which was developed for the analysis of thin-walled structures.

The results indicate that, as expected, yielding of the material induces a limit load instability in the response of the plates and therefore makes them collapse critical. The length of the crack influences the collapse load, which decreases as the crack length increases. The effect of increasing the tensile load is to decrease the compressive collapse load of the plates. This effect can also be attributed to the nonlinear behavior of the material. Another interesting finding of the investigation is that, at least for uniaxially compressed plates, the collapse load decreases as the position of the crack moves towards one of the long edges of the plate.

The results of the study, although preliminary, indicate that the material and geometric nonlinearities present in this problem do influence the calculated collapse loads of the plates studied.

Resin Infusion of Low-Viscosity Polyimides

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This investigation's purpose was to explore methods of making composite panels of graphite fiber cloth and low-viscosity polyimide resins (3-10 poise at processing temperatures).

A new film infusion "pressclave" (small autoclave suitable for mounting in a laboratory press) was made operational and connected to a two-zone temperature controller. Parameters were established for three-mode proportional control. A method was developed to achieve good (within 10 degrees C) temperature uniformity in the pressclave. A sealing procedure was developed to allow pressurization to 100 psig. Several methods were investigated to prevent excessive resin bleed from the graphite cloth.

Graphite fiber cloth was unsized T650-35-3K harness satin weave, provided by Cytec. Resins included: LaRC LV-113, provided by B. Jensen, CPB; LaRC PERA-1, provided by J. Connell, CPB.

General problems encountered in handling these low-viscosity materials included retaining resin in the graphite cloth and preventing plugging of the vacuum ports with resin, as well as maintaining nitrogen pressure in the pressclave to enable laminate bonding at cure temperature.

Recommendations are made for improved seal design and temperature control, as well as continued study of cure schedules and resin retention.

EVALUATING THE INFLUENCE OF PLASTICITY-INDUCED CLOSURE ON SURFACE FLAW SHAPE EVOLUTION UNDER CYCLIC LOADING USING A MODIFIED STRIP-YIELD MODEL

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The part-through semi-elliptical surface flaw is commonly encountered in engineering practice. Models enabling the accurate prediction of the growth of this type of flaw under cyclic loading represent an essential element in any damage tolerant design methodology. In metallic materials, a growing surface flaw will remain closed or partially closed along the crack front for a portion of the applied cyclic load as a consequence of plastically deformed material left in the wake of the growing crack. Proper characterization of this plasticity-induced crack closure is needed when predicting flaw shape development for the part-through semi-elliptical surface flaw.

Surface flaws exhibit a level of closure which varies along the crack front. Both the extent and variation of this closure have not been well characterized. Plasticity induced fatigue crack closure has attracted the interest of many researchers. However, due to the complex nature of the surface flaw, the majority of this research activity has focused on through-crack geometries such as the compact tension specimen and the center-cracked panel.

Modified strip-yield models have found wide application for prediction of crack closure and subsequent fatigue crack growth in planar geometries with through-cracks. While approximate in nature, these type of models exhibit high computational efficiency when compared to more rigorous finite element based models. A slice synthesis methodology was used to construct a modified strip-yield model for the surface flaw, enabling prediction of plasticity-induced closure and subsequent fatigue crack growth. Using coupled modified strip-yield model analyses, concurrent crack closure assessments for the surface flaw at both the surface point and deepest point of penetration were performed. To date, use of the slice synthesis methodology has been limited to stress intensity factor and crack surface displacement computation.

Using the model, predictions of aspect ratio evolution were compared with experimental data for a LT60 steel plate under constant amplitude cyclic bending. The model predictions were observed to correlate well with experimental data. The model was also used to predict stress level and mean stress effects on crack shape evolution.

Synthesis and Characterization ThermoChromic Transition Metal Complexes For Use In Temperature Sensitive Paints

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The measurement of heat transfer is a very important research tool used in the study of thermal properties of the surfaces of various materials. To this end, liquid crystal techniques, infrared imaging and thermographic phosphors have been used. Recently considerable attention has been given to temperature sensitive paints. The temperature sensitivity of the paints currently in use is based on fluorescence. The development of temperature sensing paints based on thermoChromic transition metal complexes would add a new source of TSP's.

The transition temperature (the temperature at which the color change occurs) is dependent on the transition metal used and the ligands and counterions attached to it. Thus, several transition metal complexes were synthesized with transition temperatures less than 200 °C. The compounds prepared include $\text{Cu}(\text{N,N-dmen})_2(\text{NO}_3)_2$, $\text{Ni}(\text{dmen})_2(\text{ClO}_4)_2$, $\text{Cu}(\text{N,N}'\text{-dmen})_2(\text{NO}_3)_2$, (where dmen=dimethylethylenediamine). Complexes of the type, ML_2X_2 , (where L=diethylethylenediamine, M=Cu and X= NO_3^- , ClO_4^- , BF_4^- , when M=Ni, X=Br-, ClO_4^- , BF_4^-) were also prepared. A tin(IV) complex with salicylidene-8-aminoquinoline was prepared and characterized. All of these complexes exhibited reversible thermoChromism, with transition temperatures ranging from 20-180°C. The thermoChromism has been attributed to temperature-dependent changes in the stereochemistry of the complex and depends on the nature of the central metal ion and the ligand.

The solubilities of the complexes were measured in dichloromethane, tetrahydrofuran, methanol, and acetonitrile. These solvents were chosen because they have been found to be very good solvents for the paint matrices used. Most of the complexes were found to be soluble in the solvents listed but were not soluble enough in the paint and polymer matrix to give an intense color when painted. Therefore the complexes were suspended in the polymer matrix and used as pigments. Several of the complexes lost their reversible thermoChromism when mixed in IEMA (isobutyl-2-ethylhexyl methacrylate). Bis(N,N'-diethylethylenediamine)copper perchlorate, $[\text{Cu}(\text{dieten})_2](\text{ClO}_4)_2$ showed reproducible reversible thermoChromism.

Colorimetry is defined as the science of the quantitative measurement of color. Color can be described by three characteristics: 1) hue, can be described by the words red, yellow, blue, etc.; 2) value, can be described by the terms light, dark, etc.; 3) chroma, the extent which a color differs from a gray of the same value. Tristimulus colorimetry is a method used to measure changes in the three color characteristics, therefore it can be used to detect slight changes in "color" that often can not be seen with the naked eye. Thus, it was the method chosen to measure the temperature dependent color changes in the complex, Bis(N,N'-diethylethylenediamine)copper perchlorate, $[\text{Cu}(\text{dieten})_2](\text{ClO}_4)_2$.

The variable temperature tristimulus values were measured using a MacBeth "Color Eye" 580 Colorimeter. The temperature was varied using a specially designed hot plate fitted with a West 2810 Temperature Controller. It was found that the tristimulus values changed with increase in temperature.

Accurate Characterization of Oxygen A-Band Line Parameters for Applications in Remote Sensing of the Atmosphere

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Accurate characterization of Oxygen A-Band lines was begun under a Summer Faculty NASA-ASEE Fellowship that was awarded in the Summer of 1996. That work led to a grant proposal that was funded by the NASA Langley Research Center Aerosol Research Branch of the Atmospheric Sciences Division. The research performed during the tenure of the current (Summer 1997 Fellowship) is a continuation of this effort.

The research undertaken uses a very sensitive method for accurate characterization of gaseous molecular absorption lines. The technique employs wavelength modulation spectroscopy using diode lasers to obtain line-widths, radiative cross-sections and variations of the line-widths as well as line-centers with pressure. The method uses modulation of a diode laser beam by injecting a modulated current, followed by phase-sensitive detection. Demodulation is performed at one of the harmonics of the modulation frequency.

The work performed in the Summer of 1996 demonstrated the advantages of using higher harmonic detection in modulation spectroscopy. Specifically it was shown that increased wavelength resolution could be obtained and that there was a resultant increase in sensitivity to density fluctuations also.

The work performed under the current award successfully measured line separation between several Oxygen A band line pairs. Experiments demonstrated that the use of higher harmonic detection led to a measurement of such separations that was more accurate than possible by direct absorption spectroscopy, upon which the HITRAN data base is founded. Specific signatures of overlapping lines are obtained with higher harmonic detection that cannot otherwise be obtained, and this leads to a better resolution. Experimental and theoretical results were obtained.

Simultaneously with this work, we undertook to increase the sensitivity of wavelength modulation spectroscopy by reducing the effects of "etaloning" that often plague such experiments. We successfully modeled such fringing, and found theoretical and experimental results that indicate that the ratios of the Q factors of the line being monitored to that of the Fabry-Perot fringing that leads to etaloning, is an important parameter in wavelength modulation experiments. Preliminary experimental and theoretical results indicate that there is a region of phase space for which the effects of etaloning can be reduced substantially, by simply using higher harmonic detection.

A GIS Tool for Facilities Management

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The electric distribution system at NASA's Langley Research Center (LaRC) has wide geographic coverage, a fact that motivates the use of a geographic information system (GIS) for facilities management. In a GIS, physical constraints are embedded within a user-transparent spatial data model, accessible by computer programs. Mathematical models of topology are not needed, which greatly reduces the complexity in problem modeling. GIS applications for facilities management are state-of-the-art at many utility companies, including LaRC's electricity supplier.

This report describes the development of an *ArcView*[™] GIS application called Facilities Utilization Support System (FUSS) that accesses spatial and other data on buildings and electrical facilities from LaRC's Facilities Utilization Electronic Database (FUED). Specific project tasks included collection of relevant data, design of a GIS map of LaRC's electric distribution system, development of a graphical user interface and control scripts for the application, and computer coding of a state estimation algorithm. Although the prototype was developed for proof-of-concept purposes only, FUSS is designed to support future network analysis modules.

Power system state estimation is an iterative technique based on the weighted least squares algorithm. The algorithm minimizes the error between a set of measurements and a corresponding set of equations that relate the measurements to the *state* of the system. Generally, power demand is measured at specific points in a system, then compared to values calculated on the basis of estimated voltages (the state of a power system). By minimizing the error between measured and calculated power demand at each meter, the actual voltages at all points can be determined. The power demand at all points can then be calculated. Since a high degree of metering correlates to highly accurate state estimates (and *vice versa*), the algorithm also provides a tool for identifying the number and placement of additional meters for a specified level of accuracy.

FUSS will serve as a platform for future application development and may become integrated with a CAD platform. Potential applications for facilities management include

- geographical work-order processing and in-service inspection tracking,
- real-time power flow for security assessment, overload detection and relief,
- relay placement for supervisory control and data acquisition (SCADA),
- analyses for water, steam, sewage, gas, and waste utilities.

Full development of FUSS may increase the use of GIS for facilities management throughout NASA and other federal agencies, thereby securing LaRC's place as a NASA center of excellence in GIS.

**“All-Speed Flow” Enhancements for the VULCAN General-Purpose
Navier-Stokes Code”**

**Jack R. Edwards
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Conventional density-based CFD codes rapidly lose their efficiency and accuracy when applied to very low-speed flows (local Mach numbers less than about 0.05). Efficiency loss is due to the ever-widening disparity between the convective and acoustic wave speeds as the Mach number approaches zero (infinite condition number), while accuracy loss is generally due to an inappropriate construction of the numerical diffusion terms necessary for stability. One approach toward alleviating this problem is through the use of time-derivative preconditioning, which re-scales the acoustic speeds so that the condition number remains bounded as the Mach number approaches zero.

This presentation will describe addition of a time-derivative preconditioning approach to the VULCAN Navier-Stokes code, developed at LaRC and at WPAFB. Issues to be covered include explicit and implicit formulations of the method designed for accuracy at all speeds, and the extension of the techniques toward mixtures of reacting gases. Results highlighting the “all-speed flow” capability of the modified VULCAN code will be presented.

Extending the current 27-37 GHz Ka Band Capability for the Hydrostar Antenna

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The Hydrostar Antenna

Hydrostar is a Satellite Radiometer which will orbit the Earth, measuring L-Band emissions for various science applications, such as soil moisture, ice mapping, and ocean salinity. The actual L-Band antenna for the radiometer will be over 10 meters across. It will consist of 4 slotted waveguides array elements to achieve the desired beam shape. To make practical measurements in the antenna, we made a scale model at the Ka-Band, which is 50 cm in length.

Existing System

Measurements and experimentations are conducted in the compact range anechoic chamber in the Electromagnetic Research Branch. The existing system designed by Ohio State University is capable of covering 6 - 18 GHz continuously, in 10 MHz steps.

Implementation

Using a frequency doubler we have achieved 12 - 36 GHz. But frequencies below 27 GHz are below the waveguides band for Ka. The desired 37 GHz frequency was then realized by selecting proper external mixers and using an IF frequency in the 2 - 18 GHz band. An external LO was used to supply the additional frequency needed to meet our goal. By experimenting and calculations, we discovered that the LO should operate below 26 GHz so that we were enabled to use desirable low loss connector cables.

Problems Encountered

Originally, we tried to assign 20 GHz to the LO plus 17 GHz to the IF in order to provide the necessary 37 GHz required for our measurements. But, since those frequencies were too close to each other, the filters used could not make a proper distinction, and we settled on LO=25 GHz and IF=15 GHz. Other problems we solved involve choice of amplifiers to accommodate for the dB loss through cabling, attenuators, synthesized source drifting slightly in frequency, calibration, and positioner stability.

Measurements

Data was collected in the E and H planes using a single stick. Different orientation and polarization were selected. Mutual coupling provided patterns with dummy stick load.

Mean Curvature of the Influence Surface in Supersonic Noise Prediction

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This project concerns prediction of the noise produced by a propeller or fan blade moving at supersonic speeds. Using data produced by Computational Fluid Dynamics and a classical Green's function technique, the acoustic pressure can be expressed as a double integral. My work with Feri Farassat involves analyzing terms in this integral to isolate their geometrical content. The goal of this project is to express this integral in a way that lends itself to numerical evaluation.

If the moving surface that comprises the noise source is given by $f(y,t) = 0$, then a straightforward representation of the Kirchhoff integral over this surface becomes singular when the Mach number in the observer direction reaches unity. Another approach is to realize this integral as one over the influence surface, given by $F(y) = f(y,t-r/c)$. In this approach the only singularity occurs the Mach number in the observer direction is one and this velocity coincides precisely with the unit normal to the moving surface. Such a singularity typically occurs at isolated points.

The integrand in this influence surface Kirchhoff integral contains the mean curvature of the influence surface. This expression has been computed by F. Farassat, but his formulation involves terms which depend on the frame of reference. My work included a new derivation of this mean curvature with all terms involving only factors that are independent of the choice of coordinate system. In addition, this new derivation does not make use of rigidity of the source surface.

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Abstract

"An Interdisciplinary Framework for Workflow Management in a Multi-Disciplinary Optimization Environment"

In the area of MDO using extensive Computational Design procedure, we are attempting to optimise the industrial design of complex systems based on a number of constraints, a large number of objectives, and thus, an expensive objective function. The elementary designed an open framework for configuring workflow logic, and carrying out optimisation using the users' design process as the objective function has been outlined. The entire system will be built using Object Oriented methodologies, and will be controlled from a dynamically configurable GUI.

In an exemplar project six different research groups are working on the case studies involving a typical Hypersonic Vehicle.

Modeling Delamination Growth in Composite Structures using MSC/DYTRAN for Improved Crash Modeling

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Commercial codes are available for modeling crash behavior of structures. While such codes have gained acceptance in the automotive industry, their use in studying flight vehicle crash dynamics has been limited. Among the difficulties in applying these codes to aerospace vehicles is the modeling of composite components. Although existing codes have capability for modeling composite structures and include in-plane damage models, currently available codes do not allow for delamination or disbonding failure modes.

The present research is an effort to implement delamination modeling in a commercial transient dynamic finite element code, MSC/DYTRAN. This is accomplished by using techniques of fracture mechanics. Where delamination is anticipated, a laminate is modeled by separate sublaminates joined by spring elements. The properties of the connecting springs are determined from the interface properties. Delamination growth is controlled by failure of the springs, which is determined by calculating strain energy release rates using the modified crack closure technique. Procedures for calculating the strain energy release rates and predicting failure are implemented by way of a user defined spring property subroutine. No special modifications of the existing DYTRAN code are required.

Results are compared with experimental dynamic fracture mechanics tests reported in the literature and possible applications to the modeling of composite components and structures are discussed.

Filtered Density Function for Large Eddy Simulation of Turbulent Reacting Flows

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Abstract

A methodology termed the “filtered density function” (FDF) is developed and implemented for large eddy simulation (LES) of chemically reacting turbulent flows. In this approach, the effects of the unresolved scalar fluctuations are taken into account by considering the probability density function (PDF) of subgrid scale (SGS) scalar quantities. A transport equation is derived for the FDF in which the effect of chemical reactions appears in a closed form. The influences of scalar mixing and convection within the subgrid are modeled. The FDF transport equation is solved numerically via a Lagrangian Monte Carlo scheme in which the solutions of the equivalent stochastic differential equations (SDEs) are obtained. These solutions preserve the Itô-Gikhman nature of the SDEs. The consistency of the FDF approach, the convergence of its Monte Carlo solution and the performance of the closures employed in the FDF transport equation are assessed by comparisons with results obtained by direct numerical simulation (DNS) and by conventional LES procedures in which the first two SGS scalar moments are obtained by a finite difference method (LES-FD). These comparative assessments are conducted by implementations of all three schemes (FDF, DNS and LES-FD) in a temporally developing mixing layer and a spatially developing planar jet under both non-reacting and reacting conditions. In non-reacting flows, the Monte Carlo solution of the FDF yields results similar to those via LES-FD. The advantage of the FDF is demonstrated by its use in reacting flows. In the absence of a closure for the subgrid scalar fluctuations, the LES-FD results are significantly different from those based on DNS. The FDF results show a much closer agreement with filtered DNS results.

**DAVID J. GOSSELIN Ph.D.
ASEE FELLOW
NASA LANGLEY RESEARCH CENTER - 1997**

ABSTRACT

PROJECT #1

Full Costing as a way of doing business in NASA. Directed and worked on the test phase of the implementation of Full Cost accounting and budgeting at NASA Langley Research Center. Also involved in the refinement of the whole full cost process agency wide. Involved with the capital issues team as a reviewer of the theoretical soundness of suggested proposals in the team's final report. The capital issues team is an offshoot of the Full Cost initiative.

PROJECT #2

Researched, developed and wrote two educational packets of material to be used by NASA as an agencywide method to inform people at various levels about the basics of (1) Capital Budgeting (what it is?, methods of capital budgeting?, advantages/disadvantages, etc). (2) What is meant by depreciation?, what it is, what it is not.

TIGER PAU: Applying Genetic Algorithms to the Thermally-Induced Strain Problem

Dr. James Hereford, ETTD/MISB

Christopher Newport University

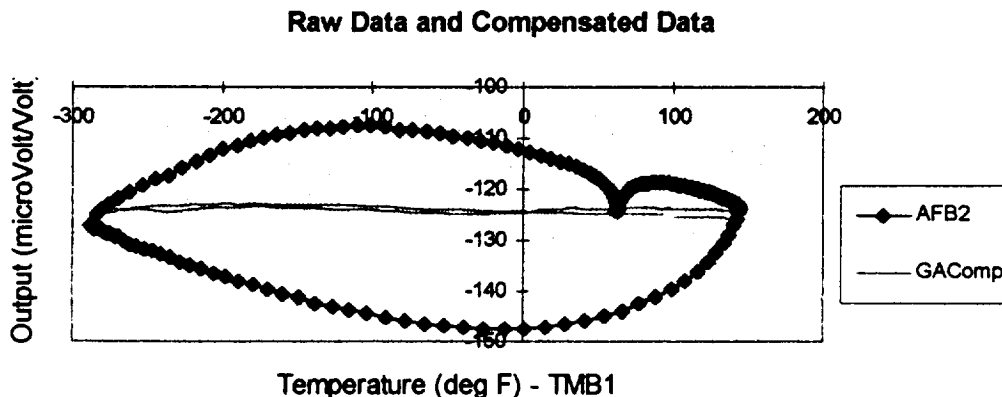
When wind tunnel measurements are made at non-ambient temperatures (e.g., at the National Transonic Facility), a thermal gradient on the measurement balance causes a strain that affects the measured load on the model. To address this problem, LaRC has initiated a research program called Thermally-Induced Gradient Effects Research (TIGER). The ultimate goals of the TIGER program are to (a) understand the physics of the thermally-induced load and (b) develop a robust thermal gradient compensation technique. The net effect will be more accurate and precise data, more efficient use of the NTF, and an overall cost savings to NASA.

One part of the TIGER program is a Parameter Assessment Undertaking (PAU). The goal of PAU is to analyze the data from a research balance, which contains 118 temperature sensors, and determine which temperature parameters have the most affect on the (apparent) load on the balance. Once the most important temperature measurements have been determined, then a thermal gradient compensation algorithm can be applied and tested.

The initial step in the PAU program was a feasibility study which was done to determine the best method or technique to use to assess the primary temperature parameters. Four techniques were considered: neural network, linear regression, eigenvector decomposition, and genetic algorithm. The genetic algorithm was chosen because of its suitability to the task of finding optimal or near-optimal solutions in a multivariable search space.

The genetic algorithm inputs are a set of "strings" or weight vectors that specify the weight (ranging from -1 to 1) to apply to each temperature sensor on the balance. The principles of the genetic algorithm (selection, reproduction, mutation) are then applied to determine a weight vector that gives the best performance. Best performance is defined as the combination of sensor weights that most closely match the apparent load measurements from the balance, i.e., have the highest correlation with the apparent load measurements.

Initial results from TIGER PAU show excellent compensation for thermal gradient effects using outputs from the genetic algorithm. In the figure shown below, the wide curve is the apparent load with no aerodynamic load applied. Clearly, the apparent load varies greatly as the temperature of the measurement balance changes and there is considerable hysteresis. The narrow curve shows the results after compensation using weights derived from the genetic algorithm. The overall improvement is 10-fold, which corresponds to a decrease in thermally-induced no-load output from 4% of full-scale to .4%.



The Development and Design of a 100MBps Fiber Optical Backplane Utilizing a Passive Optical Star Coupler

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The project addressed the development and design of a 100MBps fiber optic backplane utilizing a passive star coupler. The system is based on the fly-by-light concept being developed for future aircraft control systems. The system will be utilized in the High Intensity Radiation Field Lab(HIRF) for determining the upset effect of high intensity radiated fields have on the unit. The results will be compared to the fly-by-wire results for determining if the high intensity radiation fields have the same effect on the fly-by-light unit. The backplane is unidirectional read bus at this time. The backplane is for the interconnection of the Test Bench Redundancy Management Units (TB-RMU) and Test Bench-Bus Interface Units (TB-BIU) through an optical star coupler. The TB-RMU is the transmitting unit and the TB-BIU is the receiving unit. The system will be comprised of four Test Bench Redundancy Management Units and from one to 32 Test Bench-Bus Interface Units connected to each Test Bench Redundancy Management Unit utilizing a star coupler and multimode graded index optical fiber. The four Test Bench Redundancy Management Units will be interconnected utilizing a star coupler and multimode graded index optical fiber. The fiber optical cable lengths will be 1m between the TB-RMU and the star coupler, and 0.3km between the optical star coupler and the TB-BIUs.

The first phase of the project was to determine sources, specifications, configurations, and cost for the star coupler. There were two configurations of the star coupler considered. Two sources were found for each configuration. The first configurations were from 4 x 4, 6 x 6, 8 x 8, 16 x 16, and 32 x 32 ports. The cost varied from \$280.00 to \$517.00. The insertion loss for each configuration varied from 8.0dBm to 19.0dBm. The second configurations were from 1 x 4, 1 x 6, 1 x 8, 1 x 16, and 1 x 32 ports. The cost varied from \$202.00 to \$362.00. The insertion loss for each configuration varied from 7.4 dBm to 18.0dBm.

The second phase of the project was to design a fiber optic system using a transmitter with -18.0dBm output power and a receiver with -33.5dBm input sensitivity. The transmitter and receiver were specified using 125/62.5 μ m. The power budget for the system was determined to be -15.5dBm. Several different star coupler configuration were developed. Due to the high insertion losses of the larger star couplers it was determined that a 8 x 8 and 1 x 8 or smaller configuration were feasible with the power budget. It was determine in order to minimize the system losses the optical fiber used for the optical star coupler and the interconnection optical fiber needed to be 125/62.5 μ m. This was done because the transmitter power and receiver sensitivity was specified using 125/62.5 μ m optical fiber.

The Development, Design, and Implementation of a Class Titled “Introduction to Fiber Optics”

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The project addressed the development, design, and implementation of a class titled, “Introduction to Fiber Optics” for the staff of the Assessment Technology Branch at NASA Langley Research Center. The objective of the course was to introduce basic fiber optic concepts and terminology to the staff. The course was developed utilizing Microsoft Power Point, Autodesk AutoCAD, and Hewlett-Packard scanner software. The software was learned during the project. The course was held for two hours, two times a week, and for six weeks. The Course was comprised of twelve subject modules. The methods of instruction were lecture, demonstration and a field trip. The lecture presentation was done utilizing Power Point software for view- graphs on the computer utilizing a projection system. The demonstration was for showing how to terminate fiber using connectors and splices. The field trip was to the Sensor Research Branch, Fiber Optics Laboratory at the NASA Langley Research Center. The field trip showed the class fiber optics applications, components, and test equipment.

On Identification of Linear Stochastic Systems

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This investigation focuses on study of a new linear system identification method which can be applied to the identification of magnetic suspension systems. The Large Angle Magnetic Suspension Test Fixture (LAMSTF) has been assembled by NASA Langley Research Center for a ground-based experiment that will be used to investigate the technology issues associated with magnetic suspension at large gaps, accurate suspended-element control at large gaps, and accurate position sensing at large gaps. This technology is applicable to future efforts that range from magnetic suspension of wind-tunnel models to advanced spacecraft experiment isolation and pointing systems.

A new system identification method is studied. This method involves a unique input design for systems under identification. To obtain the plant input/output data, feedback control is required to ensure overall system stability since the LAMSTF system is highly unstable. The identification algorithm is developed to identify a state-space model of the system from the input to the plant and the corresponding output test data during a closed-loop operation.

The system identification algorithm includes the following steps. First, the coefficient matrices of an ARX model are estimated from the plant random input/output data via the least-squares method. Second, a new input signal is designed based on the estimated ARX coefficients and used to obtain a new system output through experiments. An updated ARX coefficients is then calculated by repeating the first step. Third, the system and Kalman filter Markov parameters are computed from the updated ARX coefficients in a recursive way. Finally, the system matrices are then realized from Hankel matrices formed by the system Markov parameters via the singular-value decomposition method.

Preliminary numerical simulations show that this new identification algorithm generates very small modeling errors for linear stochastic systems corrupted by significant system disturbances and measurement noises.

**A Research Portfolio Analysis Tool
NASA Langley - Systems Analysis Branch
Paul Kauffmann**

Abstract

Recent literature indicates that research portfolio models are most effective when they promote organizational participation and involvement in decision processes. This supports development of consensus for and understanding of organizational goals and performance metrics. To achieve this result, a portfolio model should exhibit three attributes. First the model should provide analytical insight without the distraction of excessive complexity. Second, the model should use operational and management information that is currently available and used by the organization; it should have minimal requirements for new, special purpose managerial data. Finally, the model should provide benefits that exceed the difficulty and effort required for model development and maintenance. This paper describes a portfolio model that achieves these objectives by integrating two analytical tools: Quality Function Deployment (QFD) and Linear Programming (LP).

QFD originated in the quality movement and is an analytical methodology that has demonstrated success in evaluating the ability of technical product design parameters to meet customer requirements. The portfolio model developed in this research applies QFD methods in a strategic context to analyze combinations of technical programs (work packages) and their impact on a set of strategic objectives. Output from the QFD model provides a range of managerial information including identification of technical programs that are critical to meet organizational goals.

LP is a process of optimizing a value function based on varying values of decision variables subject to actual, physical constraints. It has wide acceptance as a basic operations research tool to optimize resource allocation. Building upon the model data, an objective function is defined based on work package technical importance and milestone progress. LP is applied to optimize the allocation of funding resources based on maximizing the objective function.

The portfolio model described in this presentation provides management information and decision tools to support the organizational analysis and consensus required to develop a research portfolio with a strategic focus. In the longer term, the model structure provides a flexible platform to accommodate the development of additional features and refinements as organizational needs evolve.

Feasibility of Using Saturation Control for Reducing Rotor Vibrations

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This investigation addressed the feasibility of using the saturation phenomenon to suppress flapping vibrations of helicopter rotor blades. Reduction of the vibratory loads transmitted to the fuselage of a helicopter from the rotor system is a problem that has plagued designers for many years. Many techniques, passive and active, rotating and nonrotating, have been proposed to control the large vibratory loads produced by rotor blade flapping. However, a simple, lightweight, practical means for reducing rotor vibrations has still not been devised and implemented.

Under certain conditions, the nonlinear coupling in an autoparametric dynamic systems can be used as an energy bridge to siphon energy from the primary system (plant) to a secondary system (controller). When the excitation of the plant reaches a critical amplitude, the linear response of the plant becomes saturated, loses stability, and much of the energy from the excitation force is transferred to the controller. Since the plant response is saturated, the energy from further increases in the excitation amplitude is also transferred to the controller. The objective of this investigation was to assess the feasibility of implementing saturation control as a vibration suppression concept.

In order to implement saturation control, there were several issues that had to be addressed. The linearized equations of motion for a rotating, flapping helicopter blade contain excitation terms with multiple frequencies. Also, the stiffness and damping terms have periodic coefficients. In order to eliminate these issues, the equations were limited to the hovering flight condition. Two issues were still left to be addressed with the hover equations. First, the flapping natural frequency is usually not exactly equal to the excitation frequency. Therefore, the sensitivity of the saturation phenomenon to frequency variations had to be investigated. Second, the damping term in the flapping equation is not small, so the sensitivity of saturation to damping levels also had to be investigated.

While the saturation phenomenon was found to be quite sensitive to frequency variations, it turned out that the nominal flapping frequency of an articulated blade still falls within an acceptable frequency range. The high level of damping present in the flapping equation, rendered saturation ineffective. Principally, this is results from the fact that the saturation phenomenon has only been investigated for systems with small values of damping.

These results suggest three avenues for future research. The first is to investigate saturation control for inplane vibration reduction, since lag damping is small. Second, saturation control may be a candidate for suppressing ground resonance, without having to use lag dampers. Finally, further analytical work could be performed to investigate the possibility of using an autoparametric vibration absorber (without saturation control) to control system with high levels of damping.

Development of Light Weight LIDAR Instrumentation for Remote Measurements of Aerosol and Water Vapor Densities from UAVs.

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A research for the development of light weight LIDAR instrumentation for remote measurements of aerosol and water vapor densities from unmanned aerial vehicles (UAVs) was proposed for this NASA-ASEE fellowship. The proposed work was intended to be partly completed under the fellowship and then to continue as part of the sabbatical leave of the PI from the University of Virginia. Therefore, the following represents only an interim report.

The development of a light weight LIDAR system operating on board of a UAV requires the integration of three separate systems: a laser transmitter, a large aperture telescope and a UAV. Owing to the limited lifting capabilities of UAVs and their small size, both the laser system and the collection and detection systems must be light weight, compact, and must operate efficiently to reduce both power consumption and subsequent cooling requirements. Furthermore, to allow reliable remote operation both optical systems must be ruggedized and stable thereby suggesting that the laser and all system electronics be solid state. As part of an ongoing effort in the Atmospheric Science Division (ASD), a laser manufacturer was identified for the development of the transmitter. The system under development includes a diode pumped Cr:LiSAF oscillator seeded by a tunable laser to operate at the wavelength of one of the absorption lines of H₂O near 820 nm. Both the laser, its seeder, and their pumping devices are solid state. By tuning the laser to one absorption line and then away from that line the net effect of absorption by H₂O can be measured. Presently, the operation of the laser system was demonstrated when pumped by a single diode stack. Operation with 8 diode stacks that are needed for full power is yet to be demonstrated.

The optical detection system includes a 12" modified Cassegrainian telescope. The telescope, which is under development in the ASD, includes only the large aperture primary mirror. To reduce weight and space requirements, the secondary mirror is replaced with a optical fiber receiver. The design is presently being evaluated.

The third component of the system, the UAV will likely be either the Altus or the Perseus B. Both aircrafts are designed to operate at an altitude of 20 km, carrying a payload of 150 kg, payload volume of > 0.7m³ and payload power of >1.5 kW. In addition, adaptation of the system for use in the pod of the ER-2 is also considered.

The objective of the remainder of this project will be integration of all three components into one operating system. This will include accommodation of the payload in the aircraft while maintaining its flight stability as well as the LIDAR system's functionality, insulation of all system components from electromagnetic interferences and power surges, insulation of the optical system from undesired vibrations and high temperature transients, high operational flexibility, adaptation to available data transfer rates and more.

LaRC-SI in the Flex Circuit Manufacturing Process

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This investigation addressed three processes for making flexible circuits using Langley Research Center-Soluble Imide (LaRC-SI). We attempted to laminate copper foil to LaRC-SI flexible film. Polyimide film is an ideal substrate for conductor patterning due to its high temperature performance and dielectric properties. Circuit patterning and etching were performed on the laminates where bonding was successful.

The first process dealt with hot roll film lamination. The hot oil fed rollers were purchased from a manufacturer with the intent of feeding copper and LaRC-SI between the rollers at certain temperatures in an effort to determine the strongest bond and develop a continuous laminating process. The qualifying tests used to develop the processing parameters are: the peel test, visual inspection under the microscope, patterning, etching, and actual functioning as a circuit. Unfortunately, the purchased piece of equipment failed to yield the results desired; thus, modification was necessary. The modification included using a higher temperature oil, changing from a belt and pulleys to a chain and sprockets, incorporating a 500-watt heat lamp, and exchanging heaters.

The second process involved using a pressure autoclave. Several samples with registration marks were tested at different temperatures and pressures for thirty minutes under a vacuum of twenty inches of mercury. Under this process and the one that follows, efforts were made to develop a two dimensional matrix which would yield a range of "best" temperatures for bonding LaRC-SI to copper. From the matrix a mathematical model will be constructed. This model will aid in formulating data sheets which are needed by the manufacturers of flex circuits.

The final and most promising process was the use of a two hundred ton hydraulic hot press operated by a programmable controller. Samples were tested at different temperatures and pressures. We were successful in determining a point where bonding between LaRC-SI and copper (a single-sided circuit) was achieved. The research found a temperature and pressure where adhesion between two layers of copper with LaRC-SI in between the layers was possible at 225 °C at a force of approximately 66,000 pounds. The registration marks indicated the dimensional change of LaRC-SI. These points (pressure and temperature) were used as starting points for developing the matrix. This research is being continued to find needed manufacturing data for single, double, and multi-layered flex circuits using LaRC-SI.

**Numerical Simulation of Damage Growth in Aircraft Fuselage
Made of Graphite-Epoxy Composite**

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Composite materials have been used extensively in many non-structural components and secondary structures of aircraft. The development of their usage in primary structures, such as wings and fuselage, is one of the major goals in the design of the next generation aircraft. In the serving life of an aircraft, its structural components are highly possible to have a certain degree of damage caused by various sources. For instance, a low-speed impact damage may be induced in wings or fuselage due to a gravel impact when the aircraft is landing or taking off. To answer such questions as stiffness degradation, strength reduction, and stress and strain redistribution caused by certain damage in a structural component is essential in the design of a safe and cost-effective aircraft. Insufficient knowledge on damage tolerance is one of the main reasons that restrict the composite materials to be used in aircraft primary structures.

Under the NASA Advanced Composites Technology program, a series of damage tolerance tests on laminated graphite-epoxy composite structures have been conducted at NASA Langley Research Center. Various sophisticated instruments and techniques were utilized to investigate the behaviors of undamaged, discrete-source (crack) damaged, and impact-damaged specimens. In their numerical analyses, finite element codes capable of nonlinear large deformation modeling were used to simulate the test results with and without discrete-source damage. The experimental responses of specimens with impact damage were not yet numerically simulated in their studies.

While experimental results lead to the development of analytical theories, a well-established analytical model can predict structural behavior without running costly experiments. Thus, the main objective of this study is to use STAGS program to simulate numerically the damage growth in graphite-epoxy composite structures and to predict their structural behavior based on strain-softening damage models.

Preliminary results indicate that the STAGS finite element program is particularly powerful in stability analysis of plate and shell structures, but it fails to generate a convergent result in the strain-softening damage analysis. The reasons may be related to the iteration scheme used in the program or the White-Bessiling plasticity model, the only nonlinear constitutive model available in STAGS. A strain-softening damage model suitable for graphite-epoxy composite materials and a numerical iteration algorithm capable of handling strain-softening constitutive relationship shall be incorporated into the program. In order to obtain realistic results, the localization problems associated with a finite element damage modeling such as spurious mesh sensibility and incorrect energy dissipation have to be addressed.

Preliminary Boost Trajectory Design For Hyper-X Mach 7 Mission

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This study sought to optimize the boost trajectory for NASA's Hypersonic Experimental Vehicle (Hyper-X) research aircraft. This vehicle is a functioning scale model of a hydrogen-fueled 2-D scramjet-powered aircraft, and will be air-launched by an Orbital Sciences Pegasus booster. Pegasus will deliver the Hyper-X to an altitude of about 100,000 ft at Mach 7, where the Hyper-X will separate, stabilize itself, then conduct a short-duration test of the scramjet engine. Considerations in the optimization process included: ensuring the specified aerodynamic conditions for the engine test were met; ensuring cowl and wing heating were kept low; and ensuring pull-up from the test "window" could be done. The optimizations were performed on "Program to Optimize Simulated Trajectories" (POST). A number of optimization strategies were used, including: minimizing variance of dynamic pressure during the engine test window; minimizing cowl heating; minimizing wing heating; and minimizing linear combinations of these quantities. In addition, parameterizations were done to investigate the effects of increased coast time, maneuvering during coast time, and changes in angle of attack during the test window. Results of the study indicated that cowl heating is very sensitive to flight time. In addition, achieving the desired aerodynamic conditions in the test window requires very precise trajectory tailoring. The best trajectory found was one which used a relatively shallow flight path elevation at time of Pegasus/Hyper-X separation. This trajectory provided the best tradeoff between minimal heating and stable aerodynamic conditions in the test window. The study was performed by members of the Langley Research Center's Hyper-X Guidance, Control, and Trajectory team.

GEO-Imaging for Tropospheric CO Measurement

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6 July 1997

The Aerospace Electronic Systems Division (AESD), Sensor Systems Branch (SSB), at NASA Langley Research Center has proposed a new mission, GEOstationary TROpospheric Pollution SATellite (GEOTROPSAT), to address critical science questions of tropospheric chemistry. The troposphere is a complex system, comprising "point" and distributed sources of natural and anthropogenic origin; complicated transport processes, both lateral and vertical; and photochemistry driven by UV flux, temperature, atmospheric composition, and other variables. GEOTROPSAT will be implemented about a geostationary Earth orbital (GEO) position at the equator between 60° and 120°W longitude to observe the Americas and large portions of the oceans of either coast. This mission will advance our knowledge of the atmosphere by capturing the high temporal and spatial variability of tropospheric phenomena which is undetectable from low Earth orbit.

A pre-prototype imaging CO sensor, operating within a narrow spectral band about 4.7 μm , was built, demonstrated, and is being evaluated. A future, space-certified generation of this instrument will provide GEOTROPSAT one of several components needed to produce a full complement of measurements from orbit. The pre-prototype system produces digitized, differential images comprised of 4096 pixels, each representing a single CO mixing ratio quantity as inferred from gas-filter radiometer data. Associated tasks accomplished include specification for the next-generation prototype system which will operate in the 2.3- μm CO band; characterization of a 64 \times 64 InSb FPA imager; design and fabrication of a rotating filter wheel assembly; and software development.

Laboratory evaluation of this system involves imaging of a test cell placed in the path of radiant flux emanating from a blackbody source to simulate the upwelling radiation from Earth in real application. The cell is evacuated for system balancing, and charged with specified quantities of CO to provide a means for system characterization. Planned demonstrations will use reflected sunlight to test the system, and the Moon as a background to measure column CO through at least one Earth air-mass.

GEOTROPSAT will provide latitude-longitude maps of its science products to aid in understanding of tropospheric chemistry at accuracies comparable to existing low Earth orbit (LEO) ozone, CO, and aerosol measurements. At GEO, however, the combination of continuous temporal access and large two-dimensional imaging arrays will provide high temporal and spatial resolutions as required to advance tropospheric studies, with accurate visualizations of source and transport processes.

A Slant Lidar Technique for Determining the Optical Thickness and the Volume Backscattering Coefficient as a Function of the Altitude

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Climate models require a knowledge of the optical properties of the material present in the atmosphere. In particular, there is evidence that radiative forcing due to anthropogenic aerosols occurs because of the reflection of some incident solar radiation back into space. This provides a cooling mechanism to counteract, at least in part, warming due to greenhouse gases. To attain a better understanding of this radiative forcing mechanism, it is necessary to obtain the optical properties of these aerosols. A slant lidar system was used to determine average values for the optical depth and the volume backscattering coefficient as a function of the altitude. An eight-inch Schmidt-Cassegrain telescope was used in conjunction with a Nd-YAG laser operating at 532 nm. The system was rotated through zenith angles to 60 degrees. A nonlinear least squares analysis was used on the normalized data. By acquiring radiosonde data near the time that slant lidar data was acquired, the molecular component of the optical depth and the volume backscattering coefficient was removed.

INCORE AND OUT-OF-CORE DIRECT SPARSE SOLVERS FOR COMPUTATIONAL MECHANICS

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Extended Abstract

In the past years, a lot of efforts have been devoted in the developments of efficient parallel and vector equation solvers (on both shared and distributed memory computers) which exploit the skyline and/or variable bandwidth of the coefficient matrix. On a single node computer processor with vectorized capability, however, it is generally safe to say that equation solvers which are based upon sparse technologies are more efficient than ones which are based upon skyline and/or variable bandwidth storage schemes. Few, limited research efforts have also been directed to the development of parallel sparse equation solvers. In this work, however, emphasis will be placed on the development of highly efficient, fully vectorized sparse (incore and out-of-core) equation solvers (including the modified version of Oakridge sparse, incore Choleski solver) for single processor computers with vectorized capability (such as the Cray-YMP, Cray C-90, IBM-SP2, IBM-R6000/590 workstation etc...).

In the full-length version of our paper, Choleski and LDL factorization (of symmetrical and full matrix) is first reviewed. The corresponding skelaton FORTRAN code for LDL factorization is also given. Sparse storage schemes, and efficient sparse symbolic factorization is then explained. Direct incore, sparse numerical factorization is then discussed, and its corresponding skelaton FORTRAN code for "sparse" LDL factorization is presented. Detailed explanation on the use of "master" (or "super") degree-of-freedom to enhance the vector speed (by using loop-unrolling technique), and its corresponding skelaton FORTRAN code for "sparse with loop-unrolling" LDL factorization is given in the next section. Out-of-core sparse strategies are then discussed. Modifications of Oakridge's incore sparse solver is then discussed.

High Speed Civil Transport (HSCT) aircraft, Solid Rocket Booster (SRB), and Thermal-Structural finite element models are used to evaluate the numerical performance of various sparse solvers. Our numerical results have indicated that:

- (a) In terms of the total time (= reordering + factorization + forward/backward phases), our modified version of Oakridge's incore sparse solver is the most efficient. The optimum choice for "unrolling level", and "cache size" are 4, and 64 Kbytes, respectively (for the IBM-R6000/590 workstation).
- (b) In terms of forward/backward solution time, the ODU incore Choleski sparse solver is the most efficient one. Thus, this sparse solver is

recommended for those applications where factorization needs be done only once (or few times), but the forward/backward phases needs be done repeatedly.

- (c) In terms of broad applications (for example, large-scale problems with limited incore memory available, the coefficient stiffness matrix can be either positive, or negative definite), the ODU out-of-core LDL solver is highly recommended.
- (d) All ODU (incore/out-of-core, Choleski/LDL) and modified Oakridge's sparse solvers can be executed on different computer platforms (such as Sun Sparc, SGI, and IBM-R6000/590 workstations). Only trivial modification needs to be done on the "timing subroutine", which is machine dependent.

RISK ASSESSMENT of NASA PROJECTS

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As the public demands more return on its investments and progressively fewer funds are available for NASA, it has become much more important to analyze each potential project with greater care. Various NASA Langley Research Center and other center projects were attempted for analysis to obtain historical data comparing pre-phase A study and the final outcome for each project. This attempt, however, was abandoned once it became clear that very little documentation was available. In addition, many projects seemed to continue without any clear formal end.

Next, extensive literature search was conducted on the role of risk and reliability concepts in project management. Probabilistic risk assessment (PRA) techniques are being used with increasing regularity both in and outside of NASA. The value and the usage of PRA techniques were reviewed for large projects. It was found that both civilian and military branches of the space industry have traditionally refrained from using PRA, which was developed and expanded by nuclear industry. Although much has changed with the end of the cold war and the Challenger disaster, it was found that ingrained anti-PRA culture is hard to stop. Examples of skepticism against the use of risk management and assessment techniques were found both in the recent literature and in conversations with some technical staff at NASA Langley Research Center.

Program and project managers need to be convinced that the applicability and use of risk management and risk assessment techniques is much broader than just in the traditional safety-related areas of application. The time has come to begin to apply these techniques. The whole idea of risk-based system can maximize the 'return on investment' that the public demands.

Also, It would be very useful if all project documents of NASA Langley Research Center, pre-phase A through final report, are carefully stored in a central repository preferably in electronic format.

Application of Thunder as a Tunable Vibration Sensor

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My project was to design a system to demonstrate the use of Thunder as a vibration detector. The first phase of this project was to generate a vibration. The second phase was to detect the magnitude of this vibration through electrical (voltage, current) and audiovisual means.

To begin with Thunder is an acronym for **THIN LAYER UNIMORPH FERROELECTRIC DRIVER AND SENSOR**. Thunder is a new ultra-high displacement actuator developed by scientists at NASA Langley Research Center. Thunder, when used as an actuator, significantly improves the state-of-the-art piezoelectric technology, and provides an inordinately large mechanical displacement. When used as a sensor it can generate an output voltage greater than existing sensing devices. Thunder is made of alternating layers of adhesive and aluminum on one side of a piezoelectric wafer. However in my application, additional layers of adhesive and copper were added on the other side of the piezoelectric wafer, to improve the output mechanical motion. These layers are heated and then cooled, causing the Thunder to become pre-stressed. Then the pre-stressed results in a curved shape.

For this project, two pre-stressed rectangular shaped Thunders' were used. The two Thunders' are joined to each other at both ends, in opposite mechanical motion. The purpose of using two Thunders' was to have one to generate a vibration (mechanical displacement), and the second to detect the vibration. In other words, when one was vibrating it caused the other to vibrate as well. Next, for this demonstration, a tunable sine wave generator and a power amplifier were designed and used to actuate the first Thunder in terms of magnitude and frequency. Then the output of the second Thunder was connected to a sample-and-hold, to sample the voltage that is generated by the vibration and an ammeter, used for measuring the current generated, due to the vibration. A pre-amplifier is then used for driving the loud speaker and an LED. The speaker is used for an audio detection, and the LED is used for a visual display.

This project was successfully completed. It demonstrated that the Thunder is an ideal choice for vibration sensors. Future applications of Thunder can be in the fields of aeronautics, industrial buildings, and earthquake sensors, due to its cost-effectiveness, simplicity, high performance, and durability.

Evaluation of the NASA/ASEE Summer Faculty Fellowship Program at NASA Langley Research Center

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Program evaluation of federal agencies is critical to determine the extent to which they have met the goals and objectives that are specified in their strategic and performance plans and to make programmatic improvements. These results-oriented evaluations are required under the Government Performance and Results Act of 1993.

One of the strategic outcomes that is expected from NASA's mission is educational excellence. The American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program (SFFP) was established by NASA as part of its educational excellence program. The purpose of this research project was to conduct a program evaluation of the ASEE SFFP at LaRC. This program has the following objectives: 1) further the professional knowledge of qualified engineering and science faculty members; 2) stimulate an exchange of ideas between Fellows and employees of NASA; 3) enrich and refresh the research and teaching activities of participants' institutions; and 4) contribute to the research objectives of the Center.

Program documents were analyzed and a model of the ASEE SFFP at LaRC was developed to guide the evaluation. Program components that were chosen for evaluation consisted of the Fellows' work with their Research Associates, lectures, ASEE final presentations and the proposal seminar. A survey was developed and administered to the Fellows which included a section that focused on their expected versus perceived outcome from participating in the ASEE SFFP in terms of their teaching, advising, grant writing, research, and careers. Another survey was developed and administered to the Research Associates to generate both quantitative and qualitative data on program outcome and expected outcome.

A combination of stratified and random sampling was utilized to select 11 Faculty Fellows and their Research Associates for follow-up interviews. These interviews generated qualitative data that included indirect benefits of the ASEE program. The ASEE final presentations and the proposal seminar will be evaluated using additional surveys because these activities are carried out towards the end of the ASEE summer program.

Statistical analysis of the quantitative data that has been generated thus far has revealed statistically significant outcomes and expected outcomes from the ASEE program in many areas. These outcomes were supported by qualitative results from interviews with Faculty Fellows and their Research Associates.

System Upgrade Potential of Atomic Oxygen (AO) Generator

ASEE Summer Faculty Fellow
at NASA Langley Research Center
(May 27 – August 8, 1997)

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Abstract

The purpose of this research is to upgrade an Atomic Oxygen (AO) system at the Environmental Interaction Branch at NASA Langley Research Center. An interest in space materials damaged by atomic oxygen has been stimulated as the interest on space missions increased. To provide a simulation capability for the Natural Space Environment (NSE) at ground, an AO generating system was developed. However, the capability of the AO system was not fitted to simulate the conditions of NSE for atomic flux density and the energy. To improve the capability, a mass spectrometer is installed and operated with a Dycor 1000 interface to the existing AO system. In order to upgrade physical parameters such as the AO flux density and the energy, physical parameters such as input power of the RF generator, flowrate and pressure have been changed. As results, AO flux density is increased to 19 times ($5.01 \times 10^{16}/\text{cm}^2/\text{sec}$) and the energy has been increased to 25 times (1 eV). The higher efficiency operation of the system was obtained at 0.4 SCCM of the flowrate. At 1.6 SCCM flowrate, however, there was no dissociation or glow observed. The upgraded system has the capability to provide real-time mass information such as base impurity, vacuum status, erosion rate of space materials. The detail experimental data and recommendation of further improvement are discussed in the final report.

Problem-Based Learning in Mathematics and Science

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This investigation addressed the effectiveness of using problem-based learning (PBL) to effectively implement a math or science unit in an elementary or middle school environment. The vehicle for this research was the 1997 Summer Teacher Enhancement Institute (TEI) conducted at NASA Langley Research Center (NASA LaRC).

The Teacher Enhancement Institute is a three-week workshop for elementary and middle school teachers in science, mathematics and technology using the Problem Based Learning model through the theme of aeronautics. The Institute provides teachers with hands-on telecommunications experience, research experience, special presentations and tours. Post-institute follow-up activities are programmed to ensure implementation of the Institute's strategies and to provide modeling standards among teachers for successful PBL transfer to school systems.

The PBL scenario presented at this year's Institute asked the teachers to develop a presentation to educate the general public in the field of aeronautics and aviation safety. The scenario was presented in context as part of Vice President Al Gore's Commission on Aviation Safety and Security. The teachers were divided into several groups. Each group made a presentation on how best to inform the public on aviation safety using one type of media. The teachers prepared for their presentations using the TABA and Need To Know Boards and various other PBL strategies. Each group conducted research using the scientific method and presented the results to a group of NASA LaRC evaluators.

Immersing the teachers into a PBL problem provided several benefits, it: 1) addressed all best practices; 2) embedded aeronautical content; 3) promoted early bonding of participants; 4) gave a purpose to learn; 5) provided ownership to participants 6) eliminated grade level distinction and 7) increased quality of presentation products.

Proper Modeling of PBL is essential to the implementation of a PBL unit. Key activities include: 1) Providing a variety of PBL articles—one for each team to read, review and critique; 2) Discussing PBL articles as an introduction to PBL instruction; 3) Provide reinforcement of PBL principles using an external expert and 4) Provide a PBL lesson plan template

Debriefing of a PBL unit is the key to understanding. Reinforced understanding of PBL structure and implementation is accomplished by debriefing at the scenario's culmination using the Need-To-Know board format.

The success of this year's institute can be expanded into three areas of further research: 1) Include high school and or university instructors in future institutes; 2) Develop seminars for principals, superintendents and other administrators and 3) Create a longitudinal study to analyze the long term effects of PBL on student performance. It is hoped that this study will encourage the use of PBL at various school systems throughout the country.

PROGRESS IN THE DEVELOPMENT OF A PDF BASED TRANSITION MODEL

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ABSTRACT

A recent study (C. L. Rumsey et. al. AIAA 97-2260) indicates that prediction of the turbulent transition location and modeling of the transition are important for the computation of high-lift flows. The goal of this project is to develop a model that encompasses the laminar, transitional and turbulent flow regimes in a rigorous manner.

A turbulence model is a set of equations that describes averaged properties of the stochastically fluctuating velocity and pressure fields. Laminar flow, on the other hand, is smooth and deterministic. This raises the question of how to interpret fluctuations in the laminar and transitional flow regimes.

In any flow situation there is an inevitable uncertainty in initial conditions, leading to the consideration of ensembles of flows. The mean initial condition corresponds to stationary laminar flow. The ensemble viewpoint provides a consistent interpretation of fluctuations in the laminar, transitional, and turbulent flow regimes, as deviations from the ensemble mean. Fluctuations have the same nature in the three flow regimes, but their dynamical behavior is different; they are damped in the laminar regime, oscillatory in the transitional regime, and stochastic in the turbulent regime.

The single point statistics of an ensemble of incompressible flows are contained in the joint probability distribution function (pdf) of the velocity. The pdf obeys an exact evolution equation describing a system of fluid particles convected by a velocity field which evolves according to the Navier Stokes equation. This exact pdf evolution equation contains conditional expectation values for the effects of the fluctuating pressure and velocity, which need to be modeled.

The PDF method is based on a set of stochastic differential equations, called the generalized Langevin model (GLM), for the fluid particle system. A modeled evolution equation for the pdf is derived from the GLM. For every GLM there is a Reynolds stress closure model (RSM) derived from the pdf evolution equation. The GLM for the turbulent regime is known.

A class of fluid particle models, linear in the velocity fluctuation to lowest order, is considered for the laminar/transitional regime. The modeled stability equations lead to an eigenvalue problem, where the real and imaginary parts of the eigenvalues are identified with the growth rate and frequency of the fluctuation mode. An expression relating the eigenvalues with the model parameters is obtained in the parallel flow approximation, and the most unstable mode from linear stability theory is used to determine the parameters. The model parameters lead to a modification of the production and dissipation rate terms in the kinetic energy equation.

**Analytical Study of the Reliability of a
General Aviation
Cockpit Instrumentation System
Abstract**

August 2, 1997

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Prepared for
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A prior study of the cockpit information system architecture of current single-engine single-pilot aircraft (SESPA) was performed to establish a baseline for the evaluation of the reliability of new cockpit systems being developed through the Advanced General Aviation Transport Experiments (AGATE) program. That study defined a "typical" General Aviation (GA) cockpit information system architecture consisting of 38 components making up 32 subsystems. It also developed a reliability (fault tree) model for the system.

Fault tree reliability models have gained wide acceptance since their introduction in the 1960's to analyze the probability of success of military defense systems. Fault trees use logic gates to express the relationships between failures of the components and resulting failures of subsystems and of the system.

The objective of the work presented in this report was to develop an analytical model corresponding to the specific cockpit system reliability model and to implement it in a spreadsheet format. The goal was to develop a tool to allow a user to modify the component reliability parameters and recompute the system reliability. In addition to the system reliability equation, all of the subsystem reliability equations were also derived. From the analytic reliability model, the sensitivities of all of the subsystem and system reliabilities to changes in the component reliabilities were derived. These equations were also implemented in the spreadsheet tool. The resulting tool allows a user to modify the component reliability parameters and compute and display the system and subsystem reliabilities and the sensitivities of these reliabilities to changes in the component reliabilities.

This paper describes the SESPA cockpit information system reliability model, explains the derivation of the analytical model for reliability and sensitivity computation, discusses the insight obtained from the analytical model, and presents the application of the spreadsheet tool.

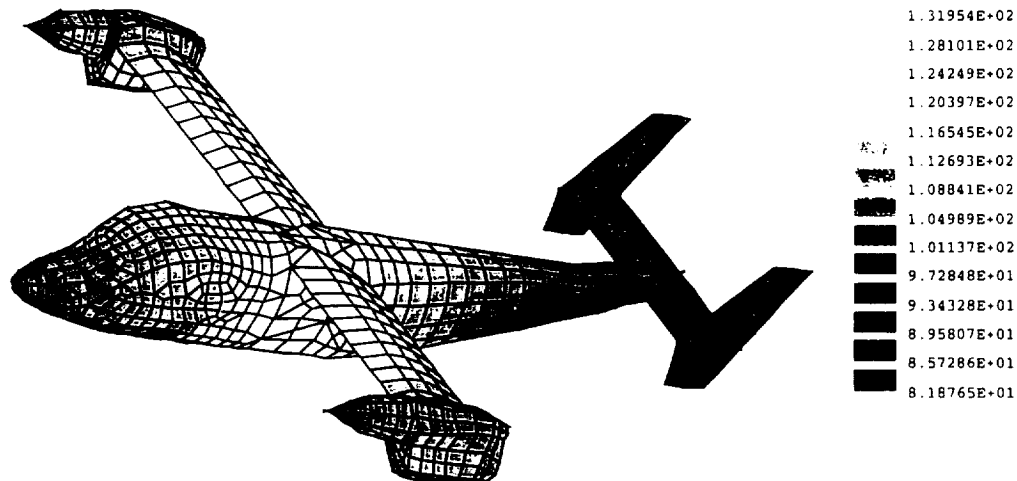
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Development of a Formulation for Modeling the Propeller of an Aircraft as an Acoustic Source in a Boundary Element Analysis

A new formulation was developed for representing the operation of a propeller of an aircraft as excitation in an acoustic Boundary Element (BE) analysis. The result of this simulation process was the acoustic loading on the fuselage of the aircraft (see Figure). This information can be utilized as excitation for a vibro-acoustic analysis predicting the vibration on the fuselage due to the acoustic load from the propellers, and the noise transmitted in the interior. The performance of a design can be improved as a result of this simulation process.

For a BE analysis, the surface of the propellers and the fuselage were discretized with elements and comprised the BE model. Each propeller was represented as two closely located circular disk surfaces. One side represented its top face, and the other its bottom face. A velocity condition in the frequency domain was assigned as boundary condition on each element of the model representing the propeller. The kinematics of the propeller were utilized in generating this information. The geometry of the propeller (in terms of distribution of airfoil sections, and twist of the blade), the collective angle, the speed of the aircraft, and the rotating speed of the propeller were utilized to compute the angle of attack and the distribution of the normal velocity over the top and bottom surface of each airfoil section. The center of each element of the BE model representing the propeller was considered as a stationary point in space. As the blades of the propeller pass by each point, they create a disturbance in the fluid. This was expressed in terms of a velocity time history associated with each point. It constitutes the mechanism for generating the noise. An algorithm produces this information for each element of the propellers. It takes into account the number of blades, the rotational speed, the number of propellers, their relative motion, the direction of rotation, the velocity distribution over the airfoil sections of the propeller, the location of each stationary point, and the time delay with respect to a time reference. An FFT algorithm transforms this information in the frequency domain. It creates the frequency domain components of the velocity on each element. The latter, constitutes the boundary conditions for the BE acoustic analysis. This algorithm was implemented into software.

The numerical model of a tiltrotor aircraft was developed. Geometrical information about the fuselage was extracted from a CFD model. Based on it, an acoustic BE model was developed for the fuselage. The BE model for the propellers and the velocity boundary conditions were generated automatically from the developed software. The two models (fuselage and propellers constitute the entire BE model). BE acoustic analysis was performed and the numerical results for the acoustic loading on the fuselage were compared successfully to test data collected previously during flight conditions.



Plasma-Based Drag Reduction for Hypersonic Aircraft

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Numerous reports, mostly arising from the former Soviet Union, indicate that a weakly ionized plasma environment is capable of increasing hypersonic shock standoff distance, concurrent with a significant reduction in net drag. The ionization levels and electron temperatures associated with these reports are on the order of 1 part per million and 1 eV, respectively. The validity of the standoff and net drag reduction claims is being investigated as a study of basic plasma physics from a purely fluids perspective under the direction of Dr. A. Auslender at Langley Research Center (LaRC). Dr. Auslender's project does not include any electromagnetic (EM) interactions, and assumes that weakly ionized plasmas with specified properties are automatically available on demand. In addition, there is a experimental effort underway at LaRC; a Mach 6 wind tunnel experiment is planned to occur under the direction of Dr. R. Exton before the end of 1997, with the possibility of follow-on experimentation to occur later.

Plasmas associated with the reported phenomenon in the literature must be created in open-air environments using EM excitation. Microwave induced plasmas in enclosed (cavity) environments are reasonably well known, but there are extensive new engineering problems associated with the initiation, growth, heating, maintenance, and control of plasmas for open environment applications. The problem is complicated by the apparent need for non-equilibrium plasmas which are anisotropic and collision-dense (in contrast to the frequent assumption of collisionless). A conclusion from this investigation is that separate pulsed high-power microwave sources, operating at different frequencies, will likely be needed to create and maintain the weakly ionized plasmas.

To support detailed technical design and planning of experiments, as well as interpret measured data, reliable computer-based tools for the analysis and prediction of microwave induced plasmas are needed for the future. However, appropriate hybrid Computational Electromagnetics/ Computational Fluid Dynamics (CEM/CFD) computer codes for this important class of problems are not available. A survey of the literature, furthermore, suggests that such code development is not actively in progress elsewhere.

This research project investigated the EM aspects of plasma-based drag reduction for hypersonic aircraft at a programmatic level. The nature and scope of appropriate near-term EM research in this emerging field was assessed, and a research proposal for LaRC Director's Discretionary Fund (DDF) support for a three-year period of performance was completed. The principal objective identified by the DDF proposal is to develop a functional hybrid CEM/CFD code which will serve the highest priority needs of experimentalists in the short term, and smoothly merge with the results of the (Auslender) plasma fluids analysis as that research matures.

APPENDIX X
PROGRAM ORIENTATION EVALUATION REPORT

1997 ASEE PROGRAM ORIENTATION EVALUATION REPORT
(Thirty-nine Orientation evaluations were returned.)

1. Was the Orientation notification received in a timely manner?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 0%
- 4 - Good - 5 (13%)
- 5 - Excellent - 34 (87%)

2. Were the meeting facilities adequate?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 0%
- 4 - Good - 10 (26%)
- 5 - Excellent - 29 (74%)

3. Was the Welcome Package beneficial?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 0%
- 4 - Good - 9 (23%)
- 5 - Excellent - 30 (77%)

4. How do you rate the Program Breakout Session?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 1 (3%)
- 4 - Good - 9 (23%)
- 5 - Excellent - 29 (74%)

5. Was the information and knowledge gained at the Orientation helpful?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 2 (5%)
- 4 - Good - 7 (18%)
- 5 - Excellent - 30 (77%)

6. In general, how do you rate this Orientation?

- 1 - Poor - 0%
- 2 - Fair - 0%
- 3 - Average - 1 (3%)
- 4 - Good - 7 (18%)
- 5 - Excellent - 31 (79%)

7. Comments:

- Very Informative. • Nice Job. • Microphone should be louder. • Start earlier and move faster in general session. • It was really great. • A LaRC's map with building numbers would be helpful.
- I am very satisfied with the Orientation. • Very well organized and easy to follow. • Helped me very much. • Would it be possible for Fellows to receive any part of the relocation allowance or travel fund before coming? The cost of apartment, furniture rental, deposits, etc., is a lot to come up with for professors who are generally 9 month faculty with no normal summer income.

APPENDIX XI
POLICIES, PRACTICES, AND PROCEDURES MANUAL

**NASA LANGLEY AMERICAN SOCIETY FOR
ENGINEERING EDUCATION (ASEE) SUMMER
FACULTY FELLOWSHIP PROGRAM**

1997

POLICIES,

PRACTICES,

and

PROCEDURES

MANUAL

A Handbook for ASEE SFFP Fellows

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Introduction

Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators, whereby faculty members spend ten weeks working with professional peers on research.

The ASEE Program is administered by a collaborating university. Either a Co-Director from Old Dominion University (ODU) or Hampton University (HU), on alternate years, works with the NASA Langley Research Center (LaRC) University Affairs Officer, who is the Technical Monitor.

The faculty member will participate in three primary elements of the ASEE Program which are (1) a research project in cooperation with a NASA Associate, (2) a study program consisting of technical lectures and seminars given by distinguished scientists and engineers from NASA, academia, or industry presented to program participants, and (3) a technical presentation and paper. Additional elements of this program include tours of LaRC wind tunnels, computational facilities, and laboratories. Library and computer facilities will be available for all participants.

The objectives of the program are (1) to further the professional knowledge of qualified engineering and science faculty members, (2) to stimulate an exchange of ideas between teaching participants and employees of NASA, (3) to enrich and refresh the research and teaching activities of participants' institutions, and (4) to contribute to the research objectives of the Center.

The Policies, Practices, and Procedures Manual sets forth the conditions of your award, your responsibilities as an ASEE Fellow, and the procedures observed by the Universities and the LaRC's Office of Education (OEd) in supporting and implementing your summer research program.

1.0 Definitions

1.1 ASEE Summer Fellow

As an ASEE Summer Fellow you are a faculty member, competitively selected by the LaRC Groups in a national competition, who has been offered a fellowship to perform scholarly research on a problem of interest to NASA in the ASEE Summer Faculty Fellowship Program.

You enjoy the status and privileges of a guest summer faculty Fellow at LaRC. You are not an employee of LaRC or the sponsoring Group and do not perform personal services for either organization.

1.2 Langley Research Center

For the purposes of the ASEE Program, the terms “Center” and “LaRC” are used to refer to NASA’s Langley Research Center.

1.3 ASEE Associate

An ASEE Associate is the scientist, engineer, or other Program support area at the Center with whom you will work most closely. All matters relating to your research program will fall under his or her purview. The Associate also assists, as needed, in securing space, equipment, or technical support.

1.4 ASEE Co-Director

The ASEE Co-Director from Old Dominion University (ODU), working in conjunction with the LaRC University Affairs Officer as Technical Monitor, is responsible for the proper administration of the ASEE Program. The Co-Director is available to discuss all aspects of the program with you, and he is your prime contact person in the OEd.

1.5 ASEE Administrative Assistant

The ASEE Administrative Assistant is a support-staff member working closely with the ASEE Co-Director in the administration of the program, and acting as his representative in his absence. The Administrative Assistant is also available to answer any questions.

1.6 Approval

Throughout this handbook, various procedures are cited that require the exclusive approval of the Co-Director. The use of the word “approval” means written approval. Any document requiring the Co-Director’s approval must have the concurrence of the appropriate Associate. Any actions taken on the basis of verbal concurrence are not binding on the Co-Director unless followed by appropriate written authorization.

2.0 Accepting a Fellowship and Beginning Tenure

2.1 Notification of a Fellowship

You will be notified of your ASEE Fellowship by an official selection letter that states the conditions of your fellowship, information concerning your stipend, and the period of your tenure at LaRC which will be for ten weeks.

2.2 Acceptance Letter

Once you receive your selection letter, please notify us of your decision to accept or decline the fellowship not later than the date specified in your award letter. If your acceptance letter is not received by the specified date, your fellowship may be withdrawn.

If you are requesting an alternate start or end date, please do so in your acceptance letter. The approval of both the Co-Director and the Group with whom you will be working is required before your tenure may officially begin. These approvals are necessary to ensure compliance with the Center's scheduling of research and its availability of support facilities.

You **must** also return the completed Name Check Request Form 531 in order to facilitate a security background check.

2.3 Information Package

Included with your selection letter is an Information Package. The purpose of this package is to provide you with information which will facilitate your stay at LaRC. Included in this package is the following:

- (a) Policies, Practices, and Procedures Manual
- (b) Name Check Request, NASA Form 531 and Sample
- (c) NASA Fact Sheet
- (d) Map of the Area
- (e) Directions to NASA
- (f) Housing Information
- (g) Travel Expense Voucher
- (h) Tentative Timeline
- (i) Activities Interest Survey
- (j) Federal Regulation Form

2.4 Working with the ASEE Associate

You are expected to maintain close contact with your assigned Associate who will offer guidance in all aspects of your technical activities and assistance in acquiring research support facilities.

2.5 **Change of ASEE Associate**

If for any reason your assigned ASEE Associate changes, you and the Associate must notify the Co-Director immediately in writing. The change will not be effective until the Co-Director and OEd have concurred with the request.

2.6 **Conforming to Center Policies**

ASEE Fellows are expected to conform to all established policies and procedures of the sponsoring Center as they pertain to guest researchers and the safety and health of individuals working at the Center.

2.7 **Extensions of Tenure**

There will be no paid extensions of tenure. The only exception is at the **sole discretion and written approval of the Co-Director**. In order for him to consider an extension, he must receive a written memorandum submitted by the LaRC Associate. This memorandum must outline the critical need for the extension well in advance of the program end date. At that point, the Co-Director will consider the request and may approve depending on funding availability.

3.0 **Stipend**

3.1 **Federal Funding Regulation**

*****Please Note: Fellows must understand that it is *illegal* to receive stipend or salary payments from other Federal funding sources including research grants and contracts while participating in a government sponsored summer faculty fellowship. Failure to comply with this regulation may, at a minimum, result in termination of your fellowship. In addition, you may want to check the regulations at your institution regarding receipt of supplemental funding.*****

3.2 **Stipend Amount**

The amount of your stipend is \$1,000.00 per week. Stipends are paid on the basis of a 5-day 40-hour work week and are issued biweekly, beginning the third Tuesday of the ASEE Program (actual stipend payment schedule provided upon arrival). Therefore, all ASEE Fellows should be prepared to provide for themselves financially the first two weeks of the program (Refer to Section 4.0).

3.3 **Acceptance Letter**

Your acceptance letter must be received by the Co-Director before stipend payments can be authorized.

3.4 **Locator Form**

In the orientation package you receive on the day of your arrival, you will receive a Locator Form. This form must be completed and returned to the Administrative Assistant as soon as possible following your arrival. On this form, you will be requested to supply your local address and phone number, a person to contact in case of an emergency, and your actual physical location on Center, including Mail Stop, building address, building number, room number, and extension. **Once this form has been turned in, this office must be notified immediately if any changes are made.**

3.5 **Receiving Stipend Payments**

Your biweekly stipend payments are not available for deposit by electronic funds transfer (EFT). They must be picked up in person from the ASEE Administrative Assistant. In order to receive your stipend payment, you must bring your badge for proof of identification and sign the form confirming receipt of payment.

Final stipend payment will be made only after you have submitted your Final Abstract, the Program Questionnaire, the Final Report Forms, the Final Checkout Form with appropriate signatures, your badge and pass, and any additional information required. If you will not be on Center the last day when stipend checks are available, submit to the Co-Director a signed memo indicating the address to which your check is to be mailed if different from your permanent home address.

3.6 **Cashing Your Stipend Checks**

Nations Bank: Your stipend checks are cut from Nations Bank and you may cash it at any of their branches free of charge.

Langley Federal Credit Union (LFCU): LFCU offers check cashing privileges for a fee. Due to their policy, you will be unable to open an account or cash personal checks.

4.0 **Relocation Allowance and Travel**

4.1 **Relocation Allowance**

A relocation allowance of \$1,000 will be provided to any Fellow who is required to relocate their residence because their home/school address is more than 50 miles from NASA Langley Research Center. This is provided to assist in the additional expenses incurred in relocating to the Tidewater area. No receipts are required.

4.2 Travel Reimbursement

Fellows are reimbursed for their travel under the following terms:

- Round trip coach air fare (receipt required) or,
 - Round trip mileage up to the cost of coach air fare, maximum \$500.
- Meals and overnight accommodations are the Fellow's responsibility. The travel expense form provided in this package should be filled out and returned to the Administrative Assistant at the Orientation in order to ensure prompt processing. Both the relocation allowance and travel reimbursement will be provided at the next pay date following submission of your information if time allows.

5.0 Insurance

5.1 Health and Medical Insurance

It is the responsibility of the ASEE Fellow to have the appropriate health and medical insurance coverage. The ASEE Program does not provide any insurance coverage. Experience has shown that coverage for you and your dependents is extremely beneficial. Unless you already have insurance coverage, you are advised to weigh carefully the cost/risk factor in reaching a decision to participate in this program.

5.2 Worker's Compensation Type Insurance

ASEE Fellows are not covered by any type of Worker's Compensation Insurance through the ASEE Program. If injured while on duty, however slight, immediately notify your Associate and the Co-Director at (804) 864-5215. Medical assistance is provided in the Clinic-Occupational Health Services Facility. Hours of operation are from 7 a.m. to 3:30 p.m. In any medical emergency, dial extension (804) 864-2222 or go directly to Building 1149 at 10 West Taylor Street.

5.3 Automobile Insurance and Driver's License

You must have a valid driver's license, automobile insurance, and a current inspection sticker certifying your automobile is safe.

6.0 Taxes

6.1 Federal Tax Liability of United States Citizens

Since you are not an employee of NASA LaRC or ODU, but are an ASEE Fellow and considered self-employed, neither the OEd nor ODU withhold taxes from stipend payments to you. You will receive from the university, a form 1099

indicating your total stipend.

You should refer to the pertinent tax publications and plan ahead to meet any tax obligations, both federal and state, if applicable, and file your returns as required by Federal law. The responsibility for the payment of your income taxes rests solely with you. The OEd and ODU cannot provide information or consultation concerning income taxes.

6.2 Social Security Taxes

Since you are not an employee of NASA LaRC or ODU, but are an ASEE Fellow and considered self employed, neither the OEd nor ODU withhold Social Security Taxes from your stipend payments. You should refer to the pertinent publications on Social Security Taxes to determine whether you have incurred any tax obligation. Although Social Security Taxes are not withheld from stipend payments, you are nonetheless required to have an assigned Social Security Number.

6.3 State Tax Liability

You may be liable for state income taxes and should file the appropriate tax return in compliance with the laws of the state in which you reside. You should consult a local government tax authority at the beginning of tenure for further details concerning this liability.

7.0 Leave

7.1 Leave

As a guest researcher in the 10-week ASEE Program, you are not eligible for annual leave, sick leave, or personal leave.

If there are reasons why you need to be absent from work during the summer research experience, there are a few steps you must take **prior** to the absence. First, you must clear this absence with your LaRC Associate. Next, submit a memo to the ASEE Co-Director indicating your Associate's concurrence requesting approval for your absence. This is to include any conferences or presentations of papers. If this absence is directly related to your summer research and a memo to that effect is submitted by your Associate, then time approved can be considered a part of your ten week tenure. If you are approved to attend a conference not related to your summer research, then the time away **must be made up** before receiving your final stipend check. **If you are aware, prior to the start of the summer program, of a meeting or conference you desire to attend during the 10-week period, we ask that you request approval for this absence as soon as possible to allow for timely processing.**

7.2 **Work Hours**

The typical work schedule is from 8 a.m. to 4:30 p.m. Once you arrive on Center, you will need to conform to the schedule applicable to your Division, as schedules may vary.

7.3 **Working After Hours**

After hours work is discouraged; however, in special situations in order for you to work after hours, several steps must be taken. You must first have the approval of your Associate. Your Associate must submit to Security a request for you to work after hours. Also, your Form 531 and the background check must have been completed. This information is subject to change.

8.0 **Housing**

8.1 **Housing Package**

The ASEE Office provides information on short-term leasing to those Fellows who require housing while in the ASEE Program. Included with your award letter is a Housing Package with pertinent information.

8.2 **Disclaimer**

It is the Fellow's responsibility to contact the apartment complex, etc., to finalize all housing arrangements. You are strongly encouraged to make these arrangements as early as possible since short term leases are in great demand during the summer due to the influx of people into the area. **Neither ASEE, NASA, ODU, nor any staff representatives shall intercede in the lease agreement made between the tenant and the landlord.** This information is provided for the sole purpose of assisting you in making your transition to the Tidewater area easier. Once again, the only form of financial assistance provided for your housing is the relocation allowance (See Section 4.1). It is recommended that as soon as you know your departure date, you submit this information **in writing** to the complex management.

9.0 **Lecture Series**

9.1 **Attendance**

Weekly attendance at the Lecture Series by all Fellows is **strongly** encouraged. The purpose of the Lecture Series is to expand the knowledge of the professors with hopes of enhancing their classroom teaching and to give a greater knowledge of NASA's special research activities being conducted at the Center.

9.2 **Distribution of Information**

The weekly Lecture Series will also be used as an avenue to distribute pertinent program information.

10.0 **Activities Committee**

A voluntary activities committee will be formed at the onset of the program. This committee will plan various after work activities for the Fellows and their families. Participation in any activity is solely on a voluntary basis, and neither NASA nor ODU assume any responsibility for any events.

11.0 **Security**

11.1 **Security Requirements**

A NASA National Agency Check (NASA NAC) shall be conducted on all summer ASEE Fellows requiring access to LaRC and its facilities. Complete the NASA Form 531, Name Check Request, which is included in your Information Package, prior to reporting to NASA LaRC. Complete the NASA Form 531, using instructions provided, and return same as soon as possible. To prevent delay in processing NASA Form 531, use your full name, to include middle name, and no initials. It is imperative that you include all information requested in order to prevent any unnecessary delays upon your arrival to LaRC. Even though you are not considered employed by NASA, if you had prior affiliation with LaRC or any other NASA Center, please note under "Employment" on the NASA Form 531. If you have access to a fax, the Form 531 may be faxed to the LaRC Security Office at 804-864-8868.

11.2 **Langley ASEE Summer Faculty Fellows**

Upon arrival at NASA LaRC, all Fellows must report to the Badge and Pass Office at the Main Gate, Building 1228, 1 Langley Blvd., to obtain identification badges for access to LaRC facilities. At this time, your photo will be taken and a temporary badge will be issued. You will return within three business days to pick up your permanent summer badge. **Please note: Before a badge can be issued, your Name Check Request Form 531 must have been in with all information being legible and accurate.**

Additionally, when reporting to LaRC, bring your driver's license for the issuance of a vehicle pass. If the vehicle you are driving is registered to another party, a signed letter authorizing you to drive the vehicle will be required. **On the morning of June 2, 1997 only, ASEE Orientation Day, vehicle passes will be issued at the H.J.E. Reid Conference Center.** If you arrive at any other time, the vehicle pass will be issued at the Badge and Pass Office.

If additional information is required, feel free to contact the NASA LaRC Security Office at 757-864-3437/3535.

12.0 Safety

12.1 Safety Program

The objective of this program is to ensure each Fellow a safe and healthful working environment that is free from unacceptable hazards which could result in property damage, injury, or loss of life. The Langley Safety Manual is a compilation of documents which sets forth procedures pertinent to the safety operations of the Langley Research Center.

Each facility/building has a designated Facility Safety Head and Facility Coordinator (published in the LaRC Telephone Directory) responsible for ensuring adherence to safety rules and regulations.

12.2 Hazardous Communications Training

All Fellows are required to receive Hazardous Communications Training. This training provides awareness of dealing with chemicals which are physical or health hazards.

12.3 Safety Clearance Procedures

These procedures are used to ensure personnel or equipment safety during installation, maintenance, or in any situation where an equipment configuration must be temporarily maintained for the protection of personnel or equipment. The red tag may be placed upon any device which could, if actuated, cause personnel or property to be endangered. The red tag may also be used to forbid entrance to dangerous areas.

No person, regardless of position or authority, is to operate any switch, valve, or equipment which has a red tag attached to it, nor will such tag be removed except as directed by an authorized authority.

12.4 Accident Reporting

Fellows shall immediately report all job-related accidents, injuries, diseases or illnesses to the supervisor and the Office of Safety, Environment and Mission Assurance (OSEMA), (804) 864-SAFE ((804) 864-7233). Also notify Ms. Young in OEd. Obtain medical treatment from the Occupational Medical Center, Building 1149, or call extension (804) 864-2222 for emergency medical assistance.

12.5 Personnel Certification

It is LaRC policy to certify Fellows performing tasks which could be potentially hazardous to either the individual or co-workers. These requirements vary with

the type of activity being performed, and consequently are described in detail in the LaRC Safety Manual dealing with the specific topic/hazard. Particular research assignments may require training, certification, and medical surveillance requirements. Examples of these types of research assignments are chemical, radiation and/or pyrotechnic operations.

13.0 Mail Center

13.1 Official Mail

The LaRC mail system is only to be used for official mail. All offices are assigned a Mail Stop to which mail is routed. ASEE Fellows typically share a Mail Stop with their Associates. One mail delivery is made each day to in/out boxes located near the mail stop custodian. Distribution of packages and boxes which are too large for internal mail distribution are made to a designated table located in each facility.

Messenger envelopes are used to send mail internally. Before placing the envelope in the mail system cross out the previous name and Mail Stop, fill in the addressee's name and Mail Stop. Internal mail can not be delivered without a Mail Stop.

If you change your work site, it is your responsibility to complete NASA Langley Form 41, "Langley Research Center (LaRC) Directory Change Notice," (located in the back of the Langley Telephone Directory). This form is used to place your name on internal mailing lists, and it is necessary that this information be kept up-to-date.

13.2 Personal Mail

Personal mail may be placed in the U.S. Post Office boxes located in front of the Cafeteria and Langley Federal Credit Union. Additionally, the Langley Exchange Shop, located in the cafeteria, will mail your personal packages.

13.3 Additional Items to Remember:

- Do not use official Government envelopes for personal mail.
- For fastest delivery by the post office: address envelopes in all capital letters, no punctuation, use state abbreviations, and zip code.
- Each piece of mail requiring postage must be stamped with the mail stop of the originating organization for identification.
- Do not use NASA Langley Research Center as a mailing address for personal mail.
- Do not send personal mail (cards, chain letters, job resume, etc.) in the internal mail delivery system.

- When addressing messenger envelopes, use first and last name. Do not use nicknames.
- Do not use room numbers in place of mail stops on messenger envelopes.
- Mail Stops are required for delivery of internal mail.

If you have any questions, please call the Mail Manager, 757-864-8159.

13.4 **Electronic Communications**

The LaRC telephone, fax, and electronic mail system is to be used for official use only. LaRC conducts random monitoring of telephone lines and all electronic mail systems for unauthorized use. If you have any questions, please call the Network Support Office at extension 757-864-7777.

14.0 **Library**

The Langley Technical Library serves the information needs of the NASA Langley personnel with its Technical Information Specialists, information systems for user desktop access, on-site collection, and access to worldwide resources and databases. The library is aggressively pursuing the goal of "Electronic Library" to maximize the desktop delivery of customized information databases, products, and services.

Currently, the library holds a comprehensive collection of materials in both print and electronic formats, covering the areas of aeronautics, structures and materials, space science, atmospheric science, and management. This includes 70,000 books, 600 journal subscriptions, over 2 million technical reports and access to more than 500 commercial and government electronic databases. At present, the library's information systems include an on-line catalog and information system known as NASA GALAXIE; a CD-ROM database network; NASA Research Connection (RECON); and journal table-of-contents current awareness services.

To attain access to library services and computer systems, participants must be listed on the official American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program roster issued by the Office of Education. Basic services include loan of books and documents, access to the library's on-line systems, and literature searches by Information Specialists. **ASEE participants must return all loaned materials to the library 2 weeks prior to the conclusion of the program. If materials are not returned, there will be a delay in receipt of the final stipend check.**

15.0 Cafeteria

15.1 NASA Exchange Cafeteria

Locations:	16 Taylor Drive, Building 1213 and 5 North Dryden, Building 1202
Hours of Service:	Monday thru Friday
Breakfast:	6:15 a.m. - 8:30 a.m.
Lunch:	10:45 a.m. - 1:30 p.m.
Holidays:	Closed

15.2 Additional Items to Remember

Busiest Time: 11:30 a.m. to 12:15 p.m.

Reservations: None Accepted between 11:30 a.m. to 12:30 p.m.
Large groups after 12:30 p.m.

15.2 Check Writing Policies

Maximum amount checks are cashed for is \$20.00. Participants must have a badge and obtain management approval.

15.3 Area Tickets Available

Discount tickets for Busch Gardens, Water Country, Kings Dominion, AMC Theaters, and Colonial Williamsburg can be obtained at the Exchange Shop in the Cafeteria. If you are interested in tickets, call 757-864-1585.

16.0 H.J.E. Reid Conference Center

16.1 Conference Center

The Conference Manager serves as a consultant and advisor for conferences and technical meetings. Reservations can be made for the following locations:

H.J.E. Reid Conference Center (Auditorium, Langley, Hampton, and Wythe Rooms)

14 Langley Boulevard
Pearl I. Young Theater
5A N. Dryden Street

Executive Conference Center (Rooms 107, 205, & 209)
3 S. Wright Street

7 X 10 Facility - Room 200
17 W. Taylor Road
Call 757-864-6362 for reservations.

16.2 Picnic Shelters

There are two picnic shelters on the grounds of the Reid Conference Center that can be reserved for office picnics. You are welcome to use a table anytime one is available. For reservations, call 757-864-6369.

16.3 NASA Gym

The NASA Gym is open from 11:00 a.m. to 1:00 p.m. Tuesday and Thursday, and 12:00 noon to 1:30 p.m. Monday, Wednesday, and Friday. Also, there is a free aerobics class from 11:00 a.m. to 11:45 a.m. Monday, Wednesday, and Friday.

The Langley Activities Association sponsors Bingo on Thursday nights, a Social Hour every other Friday evening, and a dance every other Saturday evening beginning at 7:00 p.m.

16.4 LaRC-sponsored clubs:

Aerobics Club
Astronomy Club
Basketball League
Bowling League
Flag Football
Golf Association
Radio Model Club
Science Fiction Club
Tennis Club

Amateur Radio Club
Apiculture Club
Bicycle Safety Club
Conservation Club
Garden Club
Karate Club
Runners Club
Softball League
Volleyball League

16.5 Additional Information

If you would like to see exhibits on NASA or view the featured film in an IMAX theater, you can visit the Virginia Air & Space Center in downtown Hampton.

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13. ABSTRACT (Maximum 200 words) Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society for Engineering Education supervises the programs. Objectives: (1) To further the professional knowledge of qualified engineering and science faculty members; (2) To stimulate and exchange ideas between participants and NASA; (3) To enrich and refresh the research and teaching activities of participants' institutions; (4) To contribute to the research objectives of the NASA center. Program Description: College or university faculty members will be appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA Langley Research Center. The Fellow will devote approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program will consist of lectures and seminars on topics of interest or that are directly relevant to the Fellows' research topics. The lectures and seminar leaders will be distinguished scientists and engineers from NASA, education, and industry.				
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