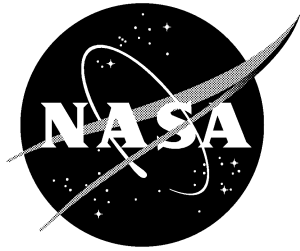# 2002 NASA-HU Faculty Fellowship Program

Compiled by:

Douglas J. DePriest
Hampton University, Hampton, Virginia

Deborah B. Murray
Old Dominion University, Norfolk, Virginia

Jennifer J. Berg
Hampton University, Hampton, Virginia

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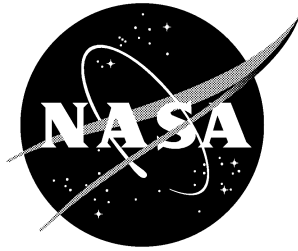- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

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NASA/CR-2004-212687

2002 NASA-HU Faculty Fellowship Program

Compiled by:

Douglas J. DePriest
Hampton University, Hampton, Virginia

Deborah B. Murray
Old Dominion University, Norfolk, Virginia

Jennifer J. Berg
Hampton University, Hampton, Virginia

January 2004

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(Appendix VII)

SECTION 1

ORGANIZATION AND MANAGEMENT

The 2002 Hampton University (HU)-NASA Langley Research Center (LaRC) NASA Faculty Fellowship Program, the thirty-eighth such institute to be held at LaRC, was planned by a committee consisting of the University Co-Director, LaRC Administrative Officers (AOs) from the research Competencies and Program Offices, 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 Competency the applicant's credentials should be circulated for review. Once this determination was made, an application distribution meeting was scheduled with the AOs where applications were distributed and instructions concerning the selection process were discussed. At a later date, the AOs notified the NFFP office of the selections made within their Competency or Program Office.

The Program Manager then contacted each selected Fellow by phone extending the individual a verbal appointment, which was followed up with a formal letter of confirmation from ASEE Headquarters. Once acceptance was confirmed, a roster was sent to each AO 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 encouraged to contact his or her Research Associate or representative of the branch.

Each Fellow and Research Associate received a 2002 NFFP Guidance Package 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.

At the Orientation meeting, Mr. Edwin J. Prior, Deputy Director, Langley Office of Education, provided a welcome on behalf of Dr. Samuel E. Massenberg, Director, Office of Education, and presented an overview of Langley Research Center. Introductions of the Administrative Staff and a program overview were presented by Mr. Roger A. Hathaway, University Affairs Officer. Mr. James R. Hall provided a security briefing followed by a presentation on Export Control and Information Protection provided by Mr. John M. Franke, LaRC's Assistant Center Export Administrator. A Health Briefing was provided by Dr. Leroy P. Gross. Mr. Richard A. Vogel, Jr., provided a Safety Briefing. An Information Technology Security Briefing was given by Mr. Geoffrey M. Tennille, Information Technology Security Manager for LaRC. Following a short break, a program breakout session was next on the agenda, enabling the NFFP administrative staff (Dr. Douglas DePriest-NFFP Co-Director, and Mrs. Debbie Murray-NFFP

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Program Manager) to meet with the 2002 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 (Appendix VIII).

Throughout the program, the University Co-Director served as the principal liaison person and had frequent contacts with the Fellows. The Program Manager worked closely with the NFFP Co-Director in the administration of the program, and acted as his representative in his absence. Site visits were conducted with selected Fellows and their NASA Associates to discuss the success of the project, as well as any concerns.

At the conclusion of the program, each Fellow submitted an abstract describing his/her accomplishments (Appendix VII). Each Fellow gave a talk on his/her research within the Competency. The Competency AOs then forwarded to the Co-Director the names of the Fellows recommended within their Competencies for the Final Presentations. Seven excellent papers were presented to the Fellows, Research Associates, and invited guests. For the eighth 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 where the winner was announced and presented with a certificate and invitation to return to LaRC for a visit during the academic year. Dr. Muhammad R. Hajj with Virginia Tech was the winner for the 2002 competition.

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

SECTION II

RECRUITMENT AND SELECTION OF FELLOWS

Returning Fellows

An invitation to apply and possibly participate in the Hampton University (HU)-NASA Langley Research Center (LaRC) Program was extended to the individuals who held 2001 fellowship appointments and were eligible to participate for a second year. Out of the individuals responding to the invitation, seven accepted offers of appointment (Table 1). Two Fellows from previous years accepted offers of appointment.

First Year Fellows

For the 2002 program, NFFP Headquarters once again provided a web site for the summer program application materials in lieu of brochures being mailed out. Many personal contacts to deans and department heads of various engineering schools in the East, South, and Midwest, were made by Dr. Douglas J. DePriest of Hampton University (HU) and Dr. Surendra N. Tiwari of Old Dominion University (ODU) requesting their assistance in bringing to the attention of their faculties the 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 minority institutions) and universities in the state of Virginia, as well as, neighboring states were contacted regarding this program (Table 2). Additional recruiting efforts included either attendance at or providing information for several of the minority and majority conferences, as well as, Video Teleconferences hosted by this staff. These efforts resulted in a total of fifty-two formal applications indicating the HU-NASA LaRC program as their first choice, and a total of fifty-four applications indicating the aforementioned as their second choice. The total number of applications received came to one-hundred-and-fourteen (Table 3).

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

The average age of the participants was 46.

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Table 1- Distribution of 2002 NFFP Fellows by Year in Program
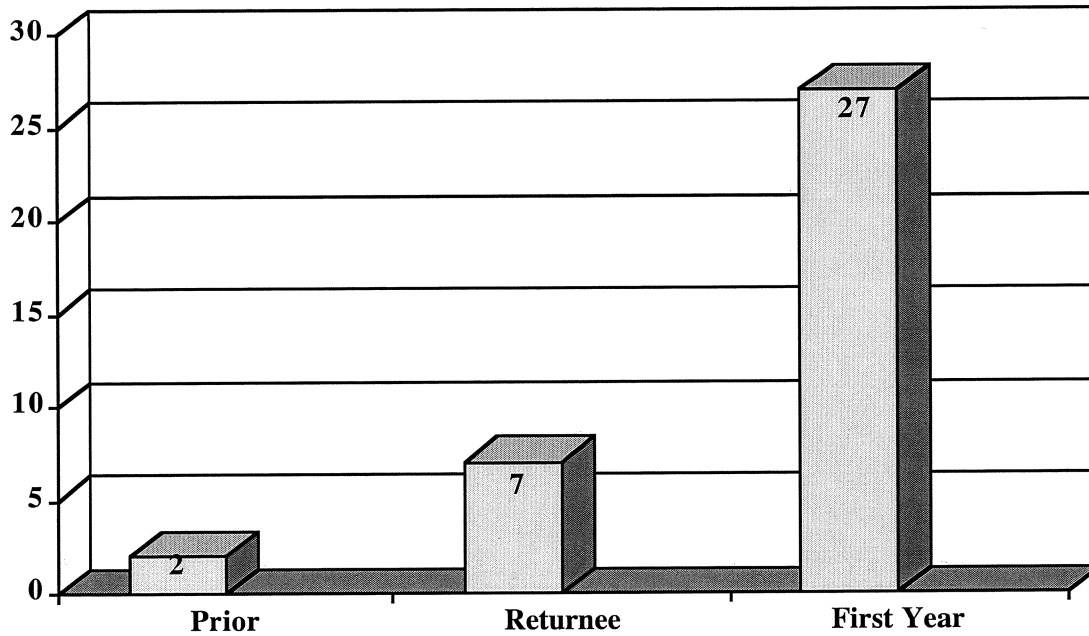
Table 2- Distribution of 2002 NFFP Fellows by University
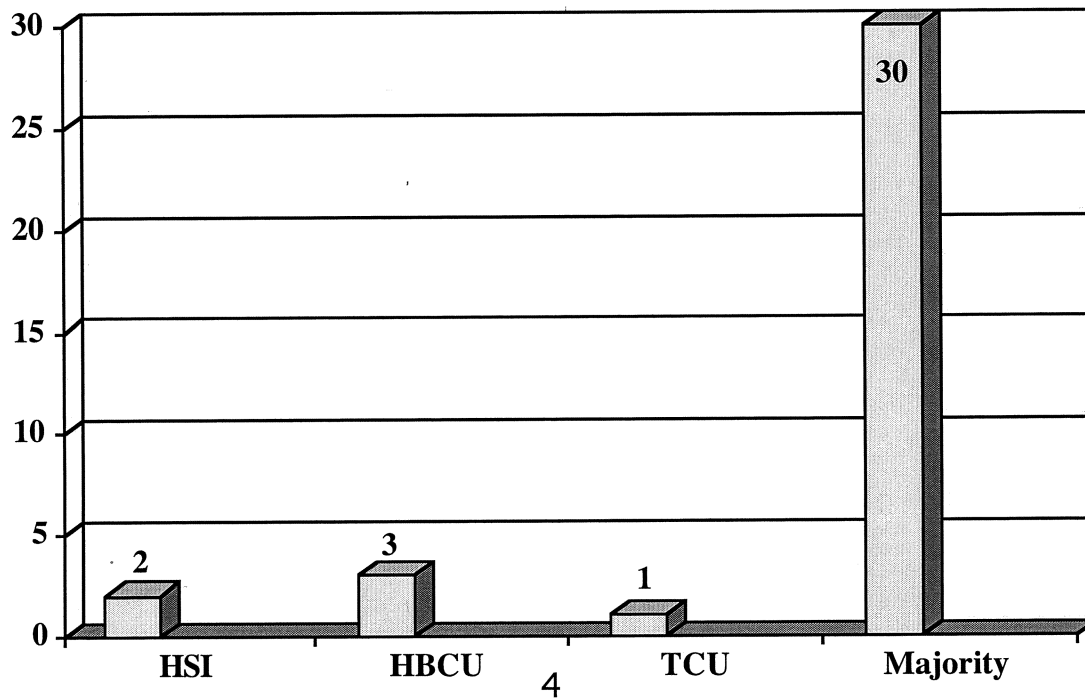
Table 3-Distribution of 2002 NFFP Fellows by Selection
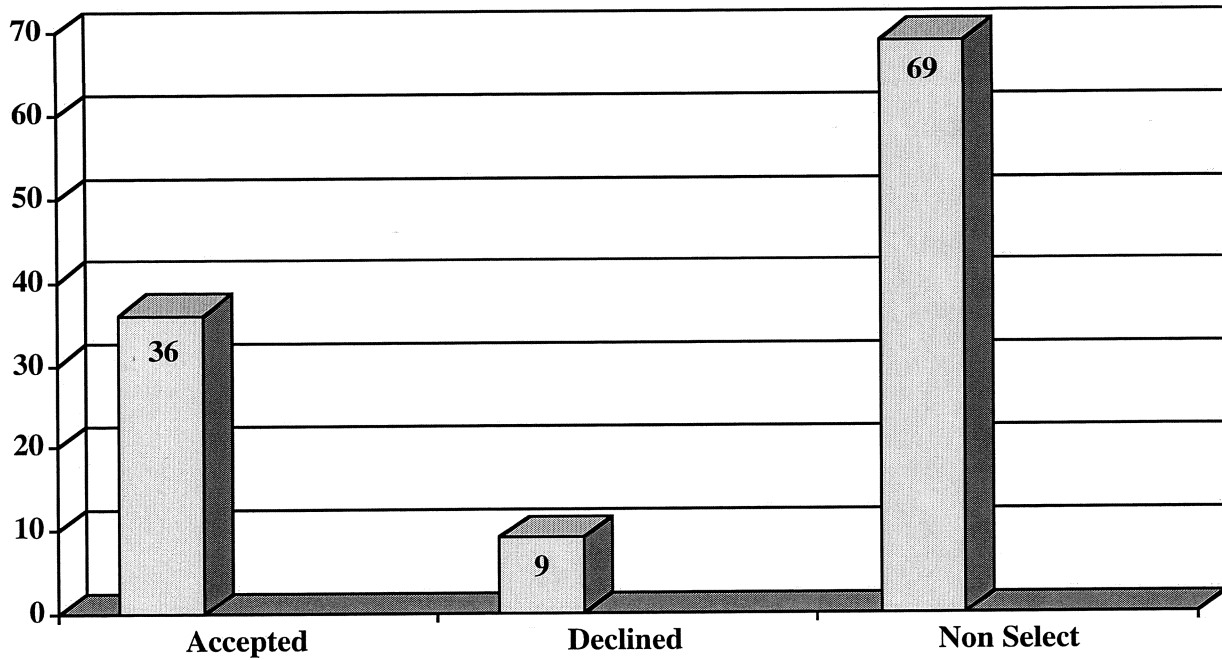
Table 4- Distribution of 2002 NFFP Fellows by Funding
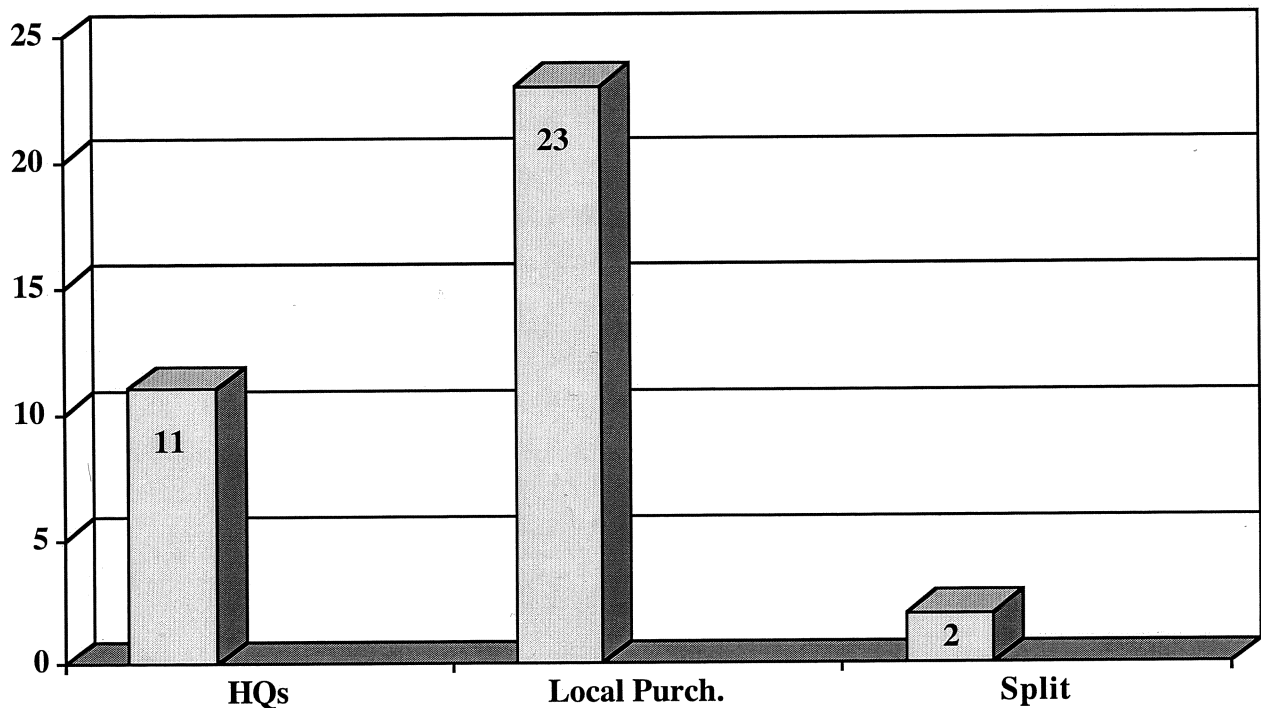
<center>**SECTION III**</center>

<center>**STIPEND AND TRAVEL**</center>

A ten-week stipend of $12,000.00 was awarded to each Fellow. Thirty-six percent of the Fellows indicated that the stipend was not the primary motivator in their participating in the NFFP program. This continues to suggest that the importance of the stipend amount is quite significant based on the fifty-five percent that indicated at least in part it was a primary motivator. Eight percent did not answer. One hundred percent of the faculty suggested an increase was in order (Survey-Section VI). This stipend continues to fall short of matching what most professors could have earned based on academic salaries or participating in other fellowships. 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 $1,500 was provided for the Fellows at a distance of 50 miles or more who were required to relocate.

<center>**SECTION IV**</center>

<center>**2002 NFFP ACTIVITIES**</center>

Lecture Series

The Lecture Series this summer was successful and well received. There were a total of six regular lectures presented, and one special presentation. The lectures were given by distinguished NASA scientists and researchers. Some of the topics included "Water, the Charters of Freedom, and Planet Mars," presented by LaRC's Dr. Joel S. Levine who is traditionally our kick-off lecturer for the summer, "The Future of Aerospace, " presented by LaRC's Dr. Dennis M. Bushnell, "Experiences and Challenges in Planetary Exploration," presented by LaRC's Dr. Robert D. Braun, and "NASA's Morphing Project," presented by LaRC's Ms. Anna R. McGowan. Mr. D. J. "Eagle Bear" Vanas, a motivational speaker, presented the special lecture.

Interaction Opportunity/Picnic

The annual Office of Education Interaction Opportunity/Picnic was held on Wednesday, June 12, 2002, for the summer program participants, their families, NASA Associates, and invited guests. This allowed for informal interaction between the Fellows, as well as, with the administrative staff. The participants also had the opportunity to purchase T-shirts bearing the 2002 NFFP design.

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Proposal Seminar

A Proposal Seminar was held for the Fellows on Tuesday, July 23, 2002. Dr. Douglas DePriest, NFFP Co-Director, Office of Education, introduced the 2002 NFFP Proposal Seminar. Mr. Roger A. Hathaway 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. Ms. Rosemary C. Froehlich discussed a few comments on grants and procurement. Dr. Rex K. Kincaid and Dr. Joseph R. Blandino, returning NFFP Fellows, shared their experiences with successfully obtaining a NASA funded grant. There was also a panel question and answer session. The panel members included Langley researcher, Dr. Emily "Mia" Siochi, who frequently reviews proposals that are submitted, and Ms. Marcia Poteat representing grants and contracting. Together with the program presenters already mentioned, they answered questions posed by the NFFP Fellows in attendance. This aspect of the proposal seminar was very well received. The Fellows received packages with information including the most current Research Grant Handbook information and web site locations.

Seminar/Banquet

On Friday, July 26, 2002, 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. NFFP end of the program information, certificates, and group pictures were presented to each Fellow at the banquet. Remarks were presented by Dr. Samuel E. Massenberg, Director, Office of Education.

NFFP Activities Committee

As in the past, an NFFP Activities Committee was formed to plan social outings for the program participants and their families. The most popular events were the weekly dinners planned for those who desired to participate. This allowed for an excellent informal networking opportunity between Fellows and staff that attended. Tours of Center facilities including a wind tunnel, simulator, and Langley Air Force Base were scheduled. This was very well received by the Fellows. (Appendix II).

In addition, the Program Manager annually hosts a Spouses Luncheon for the Fellows' spouses who are in the area for the first time. All spouses are invited and encouraged to attend. This allows an opportunity for meeting one another and planning social outings for the families of the Fellows.

RESEARCH PARTICIPATION

The HU-NASA Faculty Fellowship 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	Competency/Program Office
5	Aerodynamics, Aerothermodynamics, and Acoustics Competency
7	Airborne Systems Competency
2	Atmospheric Sciences Competency
7	Business Management
7	Structures and Materials Competency
7	Systems Engineering Competency
1	Aerospace Vehicle Systems Technology Program Office

Thirty-one (86%) of the participants were holders of the doctorate degree. Four (11%) held master's degrees and one (3%) held bachelor's degrees. The group was again highly diversified with respect to background. Following are the areas in which the last degree was earned (twenty-three different disciplines):

Number	Area of Degree
1	Biology
2	Chemistry
5	Education
18	Engineering (including 1 Biomedical; 1 Civil; 1 Computer and Electrical; and 7 Electrical; 1 Engineering Mechanics; 2 Mechanical and Aerospace; 5 Mechanical)
1	English

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1	History
1	Psychology
1	Macromolecular Science
1	Mathematics
2	Operations Research
3	Physics (including 1 applied)

Extensions

Per special written request by the LaRC Associate and the approval of the NFFP Co-Director, the following individuals were granted an extension of tenure:

Dr. Michael Baginski
Dr. John Baker
Dr. B. Terry Beck
Dr. William Edmonson
Dr. Jose Granda
Dr. Muhammad Hajj
Dr. Esther Hughes
Prof. William Nichols
Dr. Devendra Parmar
Dr. Dwight Patterson
Dr. Ronald Pollock

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 NFFP 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 Competency. 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

Dr. John R. Baker: AIAA Conference, July 10, 2002:Indianapolis, IN.

Dr. James P. Bliss: FAA/NASA Human Factors Weather Research Coordination Effort, June 10-11, 2002: Langley Research Center.

Dr. Suren N. Dwivedi: CE 2002: Computer Engineering- Research and Application, July 29-31, 2002: Cranfield University, United Kingdom.

Dr. Muhammad R. Hajj: Small Disadvantaged Business/University Opportunity Forum, June 20, 2002: Langley Research Center.

Dr. Martha J. Hall: Small Disadvantaged Business/University Opportunity Forum, June 20, 2002: Langley Research Center.

Dr. Brian Helenbrook: American Society of Mechanical Engineers Fluid Engineering Division Summer Meeting. ICASE's 30th Anniversary Symposium.

Dr. Rex K. Kincaid: International Symposium on Locational Decisions, June 12-18, 2002: New Brunswick, Canada.

Dr. Katta G. Murty: National Effective Teaching Institute, June 12-14, 2002: Montreal, Canada.

Mr. B. Kennon E. Outlaw: Small Disadvantaged Business/University Opportunity Forum, June 20, 2002: Langley Research Center.

Dr. George T. Rublein: Project Kaleidoscope Summer Institute, June 4, 2002: Williamsburg, VA.

Dr. Emma Mae Savage-Davis: Small Disadvantaged Business/University Opportunity Forum, June 20, 2002: Langley Research Center. Short Course: 4 Dimension Framing.

Dr. Mark D. Sensmeier: Small Disadvantaged Business/University Opportunity Forum, June 20, 2002: Langley Research Center.

Papers Presented or Anticipated
*Indicates Anticipated Papers

Michael E. Baginski: "A Novel Approach to Estimation of n-Layer Lossy Dielectric Constitutive Parameters from X Band Wave guide S Parameter Measurements Based on Inversion Algorithms," IEEE.

*John R. Baker: "Use of Finite Elements Methods in Quantifying Stress Concentrations in Wind Tunnel Force Balances," "Finite Elements in Analysis & Design"

*Joseph Blandino: "Model Identification of Membrane Structures with Videogrammetry and Laser Vibrometry," AIAA. "Structural Behavior of Tensioned Structural Behavior of Tensioned Membranes with Application to the Design of Gossamer Space Structures," NASA SBIR

*James P. Bliss: "Display of Aviation Weather Information," Huntsville Simulation Conference, Huntsville, AL: October 9-10, 2002. "Tactical and Strategic Plan for NASA Flight Deck Display Research-Issues and Approach." AWIN Program, NASA LaRC, Langley, VA.

*John Cain: "Multiple Simultaneous Instrument Approaches and departures in Instrument Meteorological Conditions at Airports Without Control Towers or Radar Services," NASA Airborne Flight Path Management Branch, AIAA, and Journal of Psychology. "Rare- and Non-Normal Procedures for Self-Separation Operations," NASA Airborne Flight Path Management Branch.

*Steven Chischilly: "NASA Langley Research Center and NASA Headquarters- Development of a Proposed Geospatial Technology Laboratory at the Crownpoint Institute of Technology," Crownpoint, New Mexico.

Caroline Clever: "PathFinder Project: Motivating Students to Pursue Careers in Mathematics, Science, Engineering and Technology," SWADE and NADE.

*Suren N. Dwivedi: "The Role of Testing in Reliability Study of Product Life Cycle," AIAA 2003, CARSEFOF 2003. "Probabilistic Analysis/Design Methods: The State of Art and Future Directions," AIAA 2003.

Nurgun Erdol: "Transaction on Signal Processing," IEEE. "Adaptive Bean Forming with a Wavelet Front End," NASA.

*Jose J. Granda: "Dynamics of Flexible Multi bodies, Sensors, and Actuators for Vibration Isolation and Control Using the Bond Graph Method," Society for Modeling and Simulation International, ICBGM 2003

*Muhammad R. Hajj: "Flutter Characterization of the Flexible HSCT Semi span Model," SDM02, April 2003. International Forum on Aeroelasticity and Structural Dynamics, June 2003.

*Brian Helenbrook: "P-Multigrid for the Discontinuous Galeskin Finite Element Formulation,"

*Jack Leifer: "Prediction of Wrinkle Amplitudes in thin Film Membranes Using Finite Element Modeling," AIAA SDM Conference, Norfolk, VA, April 2003. "Evaluation of Shear Compliant

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Borders for Wrinkle Reduction in Thin Film Membrane Structures," AIAA SDM Conference, Norfolk, VA, April 2003.

Richard N. Louie: "Nanomanipulation and Lithography for Carbon Nanotube Based Nondestructive Evaluation Sensor Development," Proceedings of the 2002 Society for Experimental Mechanics Annual Conference.

*Wagdy H. Mahmoud: "The Hardware Implementation of Software Algorithm," IEEE

Katta G. Murty: "Global Warming Potential of Green house Gas Emission at Various Altitudes," J. of Atmospheric Sciences, August 2002

Anticipated Research Proposal Submission

Michael E. Baginski: "A Novel Approach to Fields Induced Inside Aircraft From Direct Lightning Strikes," NASA Langley Research Center

John R. Baker: "Use of Nonlinear Finite Element Methods for Simulation of Local Performations in Fillets of Wind Tunnels," Model Systems Branch, NASA Langley Research Center

Joseph Blandino: "A Study of Wrinkle Formation and Evolution and its effect on the Thermal-Structural Behavior of Tensioned Membranes with Application to the Design of Gossamer Space Structures," NASA SBIR

James P. Bliss: "Tactical and Strategic Plan for NASA Flight Deck Display Research- Issues and Approach," AWIN Program, NASA Langley Research Center

John Cain: "Rare- and Non-Normal Procedures for Self-Separation Operations," Airborne Flight Path Management

Steven Chischilly: "Development of a Proposed Geospatical Technology Laboratory at the Crownpoint Institute of Technology," Crownpoint, NM

Caroline Clever: "Pathfinder Project," Mr. Roger Hathaway, Office of Education, NASA Langley Research Center

Suren N. Dwivedi: "Reliability Study of Products Used for Space Application,"

Nurgun Erdol: "Adaptive Bean Forming with a Wave Lit Front End," NASA Langley Research Center.

Jose J. Granda: "Study of Flexible Bodies with Bond Graph Methodology," NASA Langley Research Center

Muhammad R. Hajj: "Flutter Characterization of the Flexible HSCT Semispan Model," AFOSR

Brian Helenbrook: "Adaptive HP-Finite Element Formulation," NSF.

Jack Leifer: "Models for Computing Effectiveness of Shear Compliant Membranes," NRA or SBIR with SRS, Huntsville, AL.

Wagdy H. Mahmoud: "Evolvable Hardware," HASA/DOD/NSF

Ronald J. Pollock: "Low Energy and Versatile Synthesis of Carbon Nanotubes," C&I, "Innovative Radiation Shielding Materials," NASA Langley Research Center, "System Analysis-Failure Elimination," C&I

Mark D. Sensmeier: "CAREER: Morphing Flight Vehicle Structures: A Systems Approach," National Science Foundations

Larry E. Tise: " Papers of Wilbur and Orville Wright," NASA Langley Research Center, Office of Education, "Digitalization Wright Photographs for Educational Website," NASA Langley Research Center, Office of Education

Funded Research Proposals

John R. Baker: "Dynamics of Ultra-Light Space Structures," Co-PI, Kentucky NASA EPSCoR Enhanced Connections Program. Awarded 8/1/02.

Joseph Blandino: "Thin Film Membrane Wrinkling with Application to Gossamer Spacecraft," NASA Goddard

Steven Chischilly: "Development of a Proposed Geospatical Technology Laboratory at the Crownpoint Institute of Technology," Crownpoint, NM- Pending Approval

Jose J. Granda: "Vibration Isolation Studies," L. Martin

Brian Helenbrook: "An Unstructured Mesh Adaptation Algorithm for Ship Interaction Simulations," NOAA.

Esther Hughes: "Active Networks," Georgia Institute of Technology, NSF.

Katta G. Murty: "Graduate Assistance In Areas of National Needs," U.S. Department of Education

Ronald J. Pollock: "System Analysis- Failure Elimination," C&I

Larry E. Tise: "Papers of Wilbur and Orville Wright," NASA Langley Research Center, Office of Education

SECTION VI

SUMMARY OF PROGRAM EVALUATION

SUMMARY OF PROGRAM EVALUATION

Summary of NASA Faculty Fellows' Evaluations

At the end of the 10-week 2002 NASA Faculty Fellowship Program, Fellows were asked to evaluate the program and their associates. The results from the thirty-five out of thirty-six evaluations returned (97 %) are listed below.

On the given scale of one to five, with five being the highest rating, the NASA Faculty Fellows' evaluations of the NASA Faculty Fellowship Program revealed the following average scores:

This Program was a valuable experience	4.8
The content of the Program matched your educational objectives	4.7
The content of the Program met your career objectives	4.7
I expect to apply what I learned in this Program	4.8

On the given scale of one to five, with five being the highest rating, the NASA Faculty Fellows' evaluations of the NASA Faculty Fellowship Program Process revealed the following average scores:

The methods used to announce the program were…	4.0
The procedures used for you to apply to the Program were…	4.3
The organization of the daily activities during the Program were…	4.6

On the given scale of one to five, with five being the highest rating, the following questions asked to NASA Faculty Fellows revealed the following average scores:

Please rank the quality of the interaction between you and your colleague	4.7
Please rate the Program staff	4.9
NFFP Co-Director	4.8
Please rate the Program	4.9

What kind of recommendation would you make to someone who asks you about applying to this program   4.9

The following questions were also asked of the NASA Faculty Fellows:

Have you developed new areas of research interests as a result of the fellowship?

YES 27%   NO 73%

Are you interested in continuing your collaboration with your NASA colleague on an extended research project?

YES 100%   NO 0%

Do you anticipate involving students in future NASA related Research?

YES 91%   NO 9%

Fellow's Comments

Both NFFP and NASA Associates were asked to provide comments and recommendations relative to their participation in an effort to provide continuous improvement in the quality of the NFFP. Below are the responses received.

Please list what you think were the most valuable aspects of the Program.
* One of the most valuable aspects of the program was the lecture series and the opportunity to be exposed to many of the OED's programs, i.e. NASA Connect. As well workshops on software and different techniques for technology use in the classroom was most helpful.
* Having the experience to be at NASA, trips to NASA Headquarters, finding out about the many resources available to teachers for use in their class.
* The most valuable aspect of the program for me has to be meeting and talking with NASA researchers, especially my mentor.
* Immersion in the NASA milieu. This whole experience has been consciousness raising for me. I will use many of my experiences in my graduate classes in the future.
* I learnt a lot and the work has been intellectually challenging in spite of the fact that the remuneration was much less than my usual salary. I would like to continue my work on a NASA grant with my colleagues here, in which the remuneration may be more reasonable.
* Exposure to research topics through collaboration with colleague and through lecture series exposure to other faculty members' exposure to a multitude of educational resources.
* People
* The working environment, scientific interactions and exposure to the recent advances in aerodynamic and space areas through lectures, seminars and discussions.
* I think that Ms. Debbie Murray, the director of the NFFP program here did a wonderful job finding the right department for me. This was key to my experience at NASA. Working with Dr. Montgomery is very valuable because we learn from each other and that has benefited what we are doing. He has dedicated a lot of time to work with me and bring me up to speed on the work we need to do. At the same time he has been receptive to my proposals and suggestions for the approach to solve the task at hand.
* Chance to interact with NASA scientists and other fellows
* The program has incredible potential to give faculty members a valuable research experience. For many faculty, the resources available at LaRC eclipse any available at their home institution. Also, NASA provides access to top-notch researchers who are able to provide technical guidance. Perhaps the most beneficial aspect, from my perspective, is the possibility of getting a "leg up" into the research funding process. For me, this is crucial.
* 1. Lectures providing information on various programs NASA is involved with. 2. Establishment of networking relationships with other university personnel.
* The research program, tours and seminars had a lot of value.
* Time away from teaching for research.
* The research that is occurring at NASA Langley.
* I certainly benefited intellectually and financially from the program. In turn, I hope my colleagues at NASA benefited from my work. I think I have helped advance their understanding

of the realities, complexities, and problems associated with the application of technology in the general aviation environment.

* The aspect of the program that most impressed me was the available expertise to contact concerning all aspects of the problem.

* The most valuable aspect of the program was having an opportunity to do research full time. During the regular school year, when I teach full time, research must be squeezed into a finite amount of time.

* The program's strengths are listed as follows: 1. The ability to work with and under the supervision of some of the best scientists in the United States; in my case, very talented and encouraging mentors. 2. The ability to network with other personnel at NASA and to learn about what NASA is about. I was surprised to find out about all of the research that was conducted here at Langley; important research that will allow us to better develop aircraft and spacecraft. 3. Meeting new people, including the LARRS interns. They are up and coming scientists, engineers, GIS scientists, and they are getting the challenge and direction they desire here during their internship. 4. Working of projects and research that I can actually take back to my school and community and continue with my students, continuing the relationship with NASA personnel.

* The most valuable aspects of the program were the exchange of ideas between me and the NASA staff. This has given both of us new ideas for research directions.

* The hands on experience of using advanced tools and technologies. Bridge the gap between academia and research centers.

* A great opportunity to meet NASA researchers and plan for possible future collaborations. It is also a great way to stay abreast of current areas of heavy research interest and learn how you can contribute.

* - Opportunity to do research that really matters to my group at NASA. - Opportunity to interact with colleagues and students from a variety of other institutions (JMU, Duke, JIAFFs) as well as NASA. I envision that some of the relationships I built will extend far into the future. - Tours of NASA/Langley facilities.

* 1. The opportunity to immerse yourself in research. 2. Having access to experts in my field of study. 3. Having access to some of the best equipment available anywhere.

* The most valuable things associated with the program in my opinion relate to the hands-on and close-up interaction with state-of-the-art hardware, research facilities and personnel. You cannot get this from reading technical journals and you cannot get this from even interaction at conferences, except somewhat over a very long period of time. The opportunity to learn new measurements techniques, set up the equipment to accomplish the measurements, and use them in a hands-on manner has been invaluable.

* Collaboration with my associate was the most valuable aspect, but the interactions with other faculty, particularly those working in other areas was also very valuable. The lectures were interesting as well. Also, the welcome and involvement of family members was very helpful, and my wife's pleasant memories of the group activities and new friendships will be very helpful in our decision to participate in the program in the future.

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Fellow's Comments Continued

* Superb computing support, very friendly colleagues, excellent organization of the PSTI program.
* A nice work environment, friendly people, a challenging workload, and good financial compensation.
* Access to significant research infrastructure and the expertise of NASA/LaRC personnel.
* Exposure to work at a leading edge research organization is a very valuable experience for me. There is inherent reiteration of a need for a variety of disciplines to come together for a major project such as the building of an airplane. This is a good message to take back to University colleagues and students alike. I am going back with a proposal to restructure our curricculum to relax the boundaries between different departments.

What one specific incident or event during the Program do you remember the most?
* The lecture by Ana Rivas McGowan. That was awesome, as well as the faculty member from Old Dominion on the future classroom.
* Meeting John Houbolt, which was an opportunity provided to me by another NASA staff person, not part of my program.
* Building the fiber optic network. That was a major accomplishment for me.
* I visited the GAWS lab and saw virtual vision demonstrated. Very impressive.
* Perhaps it may be something that will occur in the next 3 weeks. When the results of the computers runs come out, it will be very exciting to compare them with what my simple model predicted. Also, when I give a talk on my work in the last week.
* Observation of a live teleconference between a NASA researcher and middle school children
* Seminars were outstanding
* I think in general the experience on the project I am working on. On another aspect, I must say that ALL the talks we have had every Tuesday have been excellent, motivational and an inspiration to go on in research to make it possible what looks impossible.
* The lecture series was the most valuable activity outside of lab, especially Dr. Levine's lecture on the Charters of Freedom.
* The technical lectures and tours were outstanding. I will definitely remember those.
* No one incident in particular.
* Several quotes from NASA personnel. One of which is "we spend a lot of time, money and effort to perform wind tunnel studies. Once performed and data taken we think the job is done. In reality, that is when the important part of the job starts"
* The people.
* Interacting with the researchers here
* Can't think of one specific incident. Just an overall memory of a great program, great people, and a sense of accomplishment.
* Morphing Seminar
* Nothing comes to mind. It has just been a wonderfully challenging summer.
* The most significant event will be probably be going to San Francisco this next week to explore the physics of the circus.

Fellow's Comments Continued

* Learning about the experiences, dreams and goals of the LARRS students that I have shared office space with; they are very talented and driven. It was refreshing to see the caliber of their expertise and realize that they will, in a few more years, be the next generation of leaders and scientists.
* The comparison of the Mars Rover expenses to the cost of making the movie Water World.
* The lecture on morphing wing technology was excellent.
* The satisfaction I felt when my membrane Finite Element model *finally* worked correctly and was verified to be correct.
* Being handed a $180,000 scanning laser vibrometer and being told to go measure something.
* It is hard to express this in one thing. Apart from the opportunity to learn and use new optical techniques and instrumentation, the things I will most remember are the scale of facilities, and the quick manner in which I was accepted into the on-going summer research activities by the personnel. They are a great bunch of individuals to work with.
* Can't pick just one!
* Discussion with a colleague in the NFFP who is interested in importing some of my work to workshop sessions in his state.
* The pig roast was delicious and fun!

Please list any aspects of the Program you would change or eliminate
* I would organize structured activities (computer workshops, etc.) in the first weeks and taper the meetings as you get to the end. Fellows need the end time with the least interruptions to complete projects. Resources need to be available prior to arrival of the fellows, computer, desks, telephone.
* Would like to have group trips, with transportation, to some of the existing experiences around the NASA site (such as at Langley: Flight Schools, Kitty Hawk, Air and Space Center, Aircraft Acoustics, CAVE, VISTA, as well as sightseeing tours.
* You are doing a great job. Why change it?
* Have more seminars
* I only would like a little more help with finding the housing. Perhaps a bit more communication or activities for the families with children would be nice, especially since some of us come from the other side of the country and do not know anyone here prior to coming here.
* The difficulties I have had are not reflective of the Program, per se. Rather, cancellation of the project(s) I have been working on was an administrative decision. Neither the NFFP program nor I could have had any input to those decisions. Therefore, I would not recommend any specific changes or eliminations. I have heard too many positive comments about the program to consider it negatively.
* Program is fine as it is.
* I can't think of any.
* More Money
* I would increase the stipend and offer a housing allowance.

Fellow's Comments Continued

* Fix air conditioning in building 1299 :-)
* Nothing to add here. All is carefully planned and has it's place.
* I would keep everything as is.
* Provide an option to extend the program to 12 or 13 weeks. The program ends just when we really start to be productive!
* This survey is way too long.
* From my experience, I do not think anything needs to be eliminated. As I mentioned above, it would be somewhat helpful to have some sort of map of the available housing and other facilities included along with the housing information that was sent prior to coming the NASA Langley Center. This would help those unfamiliar with the area.
* One thing that might be really valuable to the faculty would be to have a series of smaller, faculty-only meetings with the leadership of the competency areas. This might help identify research collaborations and matches of interest areas. The only complaint AT ALL that I have with the program is the time it has taken to get the travel reimbursement. The relocation check was available on the first pay date, but we still haven't received the travel.
* I wouldn't change a thing.
* Better initial contact and program definition with the hosts. A little more information with housing accommodations, especially for first time visitors, would be helpful.

Additional Comments/Recommendations:
* I will highly recommend this program to my colleagues and my students. As a matter of fact I will place the website address on my syllabus. I do plan to talk about my experience as a fellow to students and faculty in order to encourage them to apply.
* I have already recommended the program to five other professors (2 in Virginia, 1 in Illinois, 1 in New Jersey, 1 in North Carolina)
* This summer has been the most productive and entertaining summer I have ever had.
* I think if they want to learn about atmospheric sciences, NASA LaRC is an excellent place to be an NFFP visitor. If they want to be challenged by the complex problems in modeling the environment, this is the place.
* The NFFP at Langley Research Center is well-organized and well-run. As a second-time participant, I can say that the staff helps participants to transition from their home institution to Langley easily. They make every effort to accommodate the needs of participants while insuring that all program requirements are met.
* I would highly recommend the program to my colleagues, particularly to those who need experience in research and as also looking to improve their chances for advancement in an academic career.
* The key element is contact with the NASA mentor prior to arrival.
* It opens great opportunities and allows for realization of NASA's vision and projects.
* The summer is a relatively short time to do experimental work, but the effort is worthwhile
* Good research and good people to work with.
* Do so!

* I think that the climate for success here is very good. Everyone is working together, and everyone has been very supportive. I have felt really needed and appreciated.

* The only real concern I would have for this person that is interested in applying in making sure they look around for housing before getting here. This was my fault that I ended up in an expensive place for the 2.5 months that I am here. I could have stayed in a similar place for almost 50% less, but I didn't look around and thus that is what I would say to them, look around before you commit to any one place.

* A more formal way for meeting people working in my own discipline would be helpful. I had to work hard to meet people doing related work in different groups.

* I will say go for it. The level of experience you can achieve here cannot be attained any where else.

* It's a great experience.

* I had a wonderful time, learned and accomplished a great deal, and frankly don't want to leave to go back to my home institution!

* I can highly recommend the program. It is an excellent and rare opportunity to meet and work with other researchers in areas of common interest. It is a very valuable learning experience as well, and a chance to see state-of-the-art facilities used in on-going research.

* I plan to encourage my students to apply for this opportunity.

* I think it is a good program for University researchers to be exposed to and get a chance to learn from and participate in the cutting edge scientific and technical work going on at NASA. I liked participating in the Return on Investment workshop, where I learned that my goal for the summer experience to grow into an extended research collaboration with NASA was also encouraged by NASA. The workshop on grants and contracts was also very useful, and as I suggested to the organizers, Drs. Hathaway and DePriest, it would be more useful had it been earlier in the summer to give us more time to put our information to work.

* Thank you for giving me the opportunity.

* This program is very useful. Congress should increase funding for this program, so that more faculty may participate. This will improve engineering and Science education. This is the best use of tax payers money. I congratulate NASA and ASEE for continuing this program.

* No, I think you have done a wonderful job wit the other questions which have extracted just about everything I have experiences with NFFP.

* You asked above for me to "provide details" about whether I'd apply for this program again. This depends on whether I 1) get other funding, and 2) am able to use the results of my program here. Time will tell. On another note, the limitation for project descriptions on this form is 1500 CHARACTERS, not 1500 WORDS. Thanks.

* I learned something about myself. I can be very efficient if I set a specific time or deadline for a certain task or job.

* First class all the way - NASA standard!

* Again, thank you very much.

* The program period is 10 weeks. It took about 4 weeks to get a good computer, to have an e-mail and to have a phone. This is about half of the program period. I could have done twice as

much if these resources were in place in the first (day/Week). I wish that the program coordinators make sure about the availability of these resources (computers, software, telephones, e-mail accounts) before the program starts.

* I found this to be a very rewarding experience. It has opened doors to new potential opportunities for research collaborations in connection with Langley as well as in association with on-going research at my own university. The opportunity to learn about a broad spectrum of new optical measurement techniques, and be a part of an excellent research team, has been invaluable.

* Outstanding!

* Thank you NASA for this wonderful opportunity!

* The program administrators, especially Deborah Murray, are excellent. She has provided us with many interesting activities, both intellectual and recreational. She and her staff have been very responsive to questions and requests. In general, my opinion of the professional culture at NASA is very positive. Most people were eager to make me comfortable in a new environment and make my NASA summer experience a good one. Many researchers and managers alike have helped me locate information and resources to achieve my goals. They have treated me with respect and shared their knowledge and ideas.

Summary of Associates' Evaluations

At the end of the 10-week 2002 NASA Faculty Fellowship Program, NASA Associates were asked to evaluate the program, faculty fellows, and programmatic support. This survey revealed that one hundred percent of NASA Associates considered their collaboration with his/her NFFP Fellow a success. Fifty percent of NASA Associates responses were in favor of an extended research option.

On the given scale of one to five, with five being the highest rating, the NASA Associates' evaluations of the NFFP Fellows revealed the following average scores:

Quality of Fellow's interaction with you	4.8
Extent to which Fellow utilized available resources (data, etc.)	4.8
Quantity of research performed	4.8
Quality of research performed	4.7
Initiative to pursue the research	4.7
Current capability to contribute to the research	4.7
Assessment of Fellow's research potential	4.8

On the same scale of one to five, the NASA Associates' evaluations of the overall NASA Faculty Fellowship Program revealed the following average scores:

I would recommend the Program to prospective friends	4.9
I would recommend the Program to prospective NASA Colleagues	4.8
NASA's offering of NFFP is a good investment of taxpayer funds	4.8
The Program is a valuable experience for the Fellow	4.9
The Program was a valuable experience for me	4.6

On the same scale of one to five, the NASA Associates revealed following average scores:

How would you rate the programmatic support operations of the Office of Education?	4.0
How would you rate the program staff?	4.5

NASA Associates were asked to provide comments and recommendations relative to their participation in an effort to provide continuous improvement in the quality of the NFFP. Among the responses were the following:

"Having an NFFP fellow requires lots of time but the pay off is almost always worth it!"

"It's a great program. We both got a lot out of it. It could dramatically change [the fellow's] future research directions (for the better)"

"The NFFP program provides both the Follow and Colleague an opportunity to expand their expertise."

"As noted above, [the fellow] was able to assist me in doing m work. Two heads are better than one as the old adage goes."

"Overall, the NFFP is a worthwhile program."

"Prepare ahead of time and make sure of the short time you have"

SECTION VII

CO-DIRECTOR'S RECOMMENDATIONS

1. It is enthusiastically recommended that the recently renamed NASA Faculty Fellowship Program (NFFP) continue. It is a valuable and effective means of contributing to the research objectives of the NASA Langley Research Center; it enriches and refreshes the faculty and their home institutions, and it furthers the professional knowledge of the participating faculty. These conclusions are supported by the assessment and evaluation instruments given to the faculty Fellows and to the NASA Research Associates.

2. The informal luncheons following the lectures were well received. The luncheons provided an excellent opportunity for the faculty participants to discuss in depth the lecture topic and related topics with the guest lecturers. They also provided an opportunity for the Fellows to develop professional contacts that could aid and enhance their professional development.

3. The Return on Investment (ROI) trial initiative was conducted during July, 2002. This effort was coordinated through personnel at Stennis Space Center and NASA Headquarters (HQ). The ROI was designed to focus on accountability issues in training, human resources, and performance improvement. There was broad participation in this initiative by university Fellows and their NASA Langley Associates. This included participation in a video-teleconference scheduled by NASA HQ and completion of the ROI questionnaire.

4. It is recommended that the RADIO (research and Development Interaction Opportunities) activities be expanded and formally included in the national model of the NFFP. With RADIO, the faculty recipients would receive small awards to facilitate student presentations at professional meetings or development and distribution of curricular materials. This recommendation is offered in the spirit of the agency's interest in providing the broadest dissemination of NASA research results to the public.

APPENDIX I
2002 NASA Faculty Fellowship Program Fellows

Name and Institution	NASA Associate & Competency/Program Office
Dr. Michael E. Baginski Auburn University	Mr. Manohar D. Deshpande Airborne Systems
Dr. John R. Baker University of Kentucky	Mr. Ray D. Rhew Aerodyn., Aerothermodyn. & Acoustics
Dr. B. Terry Beck Kansas State University	Mr. Paul M. Danehy Aerodyn., Aerothermodyn. & Acoustics
Dr. John E. Bertrand Middle Tennessee State University	Mr. Kenneth H. Goodrich Airborne Systems
Dr. Joseph R. Blandino James Madison University	Mr. Richard S. Pappa Structures and Materials
Dr. James P. Bliss Old Dominion University	Mr. H. Paul Stough, III Airborne Systems
Dr. John H. Cain Florida Institute of Technology	Mr. Kenneth M. Jones Airborne Systems
Prof. Steven Chischilly Crownpoint Institute of Technology	Mr. William "Brad" Ball Systems Engineering
Ms. Caroline C. Clever (P) Dona Ana Branch Community College New Mexico State University	Mr. Roger A. Hathaway Office of Education
Dr. Suren N. Dwivedi University of Louisiana-Lafayette	Dr. Damodar R. Ambur Structures and Materials
Dr. William W. Edmonson Hampton University	Mr. John W. Stoughton Systems Engineering
Dr. Nurgun Erdol Florida Atlantic University	Mr. Robert L. Fox Systems Engineering
Prof. Scott B. Graham Embry-Riddle Aeronautical University	Ms. Gail S. Langevin Public Services Office

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2002 NASA Faculty Fellowship Program Fellows Cont.

Name and Institution	NASA Associate & Competency/Program Office
Dr. Jose J. Granda California State University-Sacramento	Dr. Raymond C. Montgomery Airborne Systems
Dr. Muhammad R. Hajj Virginia Polytechnic Institute and State Un.	Mr. Walter A. Silva Structures and Materials
Dr. Martha J. Hall Hampton University	Mr. Roger A. Hathaway Office of Education
Dr. Monson H. Hayes (R) Georgia Institute of Technology	Mr. James A. Dempsey Systems Engineering
Dr. Brian Helenbrook Clarkson University	Dr. Harold L. Atkins Aerodyn., Aerothermodyn. & Acoustics
Dr. Esther A. Hughes Virginia Commonwealth University	Dr. Qamar A. Shams Aerodyn., Aerothermodyn. & Acoustics
Dr. Rex K. Kincaid (P) College of William and Mary	Dr. Bruce R. Barkstrom Atmospheric Sciences
Dr. Jack Leifer University of Kentucky	Dr. Keith W. Belvin Structures and Materials
Dr. Richard N. Louie (R) Pacific Lutheran University	Mr. Russell A. "Buzz" Wincheski Structures and Materials
Dr. Wagdy H. Mahmoud Tennessee Technological University	Mr. Carl S. Mills, Jr. Systems Engineering
Dr. Katta G. Murty University of Michigan	Dr. William L Gross Atmospheric Sciences
Mr. B. Kennon E. Outlaw Norfolk State University	Mr. Roger M. Bailey Airborne Systems
Dr. Devendra S. Parmar Old Dominion University	Dr. Robert S. Rogowski Structures and Materials

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2002 NASA Faculty Fellowship Program Fellows Cont.

Name and Institution	NASA Associate & Competency/Program Office
Dr. Dwight J. Patterson Middle Tennessee State University	Dr. Jeffrey D. Jordan Aerodyn., Aerothermodyn. & Acoustics
Dr. Ronald J. Pollock (R) Pennsylvania State University	Mr. Warren C. Kelliher Systems Engineering
Dr. George T. Rublein College of William and Mary	Mr. Roger A. Hathaway Office of Education
Dr. Emma Mae Savage-Davis James Madison University	Mr. Robert M. Starr Office of Education
Dr. Mark D. Sensmeier Embry-Riddle Aeronautical Univ.-FL	Dr. Anna-Maria R. McGowan Aerospace Vehicle Systems Technology
Prof. Mir S. Shirvani (R) New River Community College	Mr. Robert L. Fox Systems Engineering
Dr. Charles A. Smith Our Lady of the Lake University	Dr. Robert S. Rogowski Structures and Materials
Dr. Jonathon H. Spindel James Madison University	Dr. Alan T. Pope Airborne Systems
Dr. Larry E. Tise (R) East Carolina University	Dr. Samuel E. Massenberg Office of Education
Dr. David S. Wright Tidewater Community College	Dr. Thomas E. Pinelli Office of Education

R-Designates returnees from 2001   P-Designates prior participants from earlier years

APPENDIX II

LECTURE SERIES

PRESENTATIONS BY RESEARCH FELLOWS

CALENDAR OF ACTIVITIES

2002 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 p. m. - Questions and Answer

DATE	TOPIC	SPEAKER
Tuesday, June 11	Water, the Charters of Freedom, And Planet Mars	Dr. Joel S. Levine Atmospheric Sciences Competency Langley Research Center
Tuesday, June 18	The Future of Aerospace	Mr. Dennis M. Bushnell Senior Scientist Langley Research Center
Tuesday, June 25	Experiences and Challenges in Planetary Exploration	Dr. Robert D. Braun Systems Engineering Competency Langley Research Center
Tuesday, July 2	Special Presentations by Mr. D. J. "Eagle Bear" Vanas Please see flyer.	
Tuesday, July 9	Ultra-lightweight and Inflatable Space Structures	Dr. Keith W. Belvin Structures and Materials Competency Langley Research Center
Tuesday, July 16	NASA'S Morphing Project	Ms. Anna R. McGowan Aerospace Vehicle Systems Technology Program Office Langley Research Center
Tuesday, July 30	After Maximum Likelihood, What? Some Insights on Handling Outliers in Data and Regression	Dr. David Scott Noah Harding Professor of Statistics Rice University

NASA Langley Research Center

NASA Faculty Fellowship Program
Langley Aerospace Research Summer Scholars Program
NASA Summer Scholars

Office of Education
Summer Lecture Series

June 25, 2002
11:00 a.m.

Upcoming Special Presentations

D.J. "Eagle Bear" Vanas
President, Native Discovery, Inc.

Tuesday, July 2 at 11:00 am, Reid Center
The Warrior Within:
A Path to Personal Discovery & Achievement

Tuesday, July 2 at 2:00 pm, Reid Center
Tip of the Spear: Leading Your People to Victory

OEd Program Participants will receive a
FREE COPY D.J.'s book, "THE TINY WARRIOR"

WARRIOR WITHIN: Are you ready to win? Based on concepts from D J.'s popular book, *The Tiny Warrior*, this program will enlighten and entertain you Using wisdom discovered in Native American traditional ceremonies, you'll discover the true purpose of a warrior – not what we see on TV, in movies, or in music Warriors spent their lives developing their talent and abilities to become assets to the village they served Today that "village" can be your family, company community, campus, or clients–anyone you serve You'll learn how to harness the power of your mind and spirit, embrace continual learning, and understand the impact of outstanding service to others Learn how to gain confidence by taking risk, strengthen your sense of possibility, align your actions with your goals and overcome barriers to your success in your career and life You can achieve explosive levels of performance and make ambitions of yesterday a reality today when you learn the truth about yourself –there's a warrior inside!

TIP OF THE SPEAR: This program is a dynamic blend of humor, practical examples, and powerful tools, custom-built for current and emerging leaders in any arena Even through turbulent times, an organization can survive and thrive with committed, capable leadership guiding the way. We'll use traditional Native American wisdom and leadership concepts to create leaders who are ready to embrace and endure any challenge You'll explore the 5 roles as the Tip of the Spear: Chief, Warrior, Hunter, Prophet, and Medicine Person -- understand the critical need for self-leadership, how to create a high-performance environment, plan for success and employ stress to boost your achievement You'll enhance your leadership ability by learning concepts like Relationship-Based Leadership and the "Village-Survival" model You'll learn potent communication tools and ways to build trust, commitment and motivation among your people Times are tough, but the principles D J. will share with you have been tested and proven in the toughest Prepare to learn, laugh, and lead your people to victory!
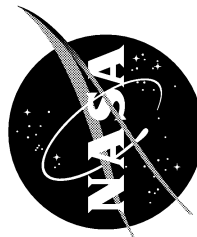
Dr. Robert D. Braun

NASA Langley Research Center

Experience and Challenges
In Planetary Exploration

NASA is in the midst of a new era of planetary exploration characterized by grand scientific goals and significant engineering challenges. In today's talk, NASA's strategy for the robotic exploration of Mars will be addressed. Science goals and engineering challenges of the successful Mars Pathfinder, Mars Global Surveyor, and Mars Odyssey missions will be presented. In addition, the exciting series of missions scheduled for flight in the coming decade will be discussed.

Dr. Robert D. Braun has been a member of the technical staff at the NASA Langley Research Center (LaRC) since 1989. He first came to LaRC as a member of the inaugural LARSS class in the summer of 1986.

His research interests focus on the development of atmospheric flight systems for robotic and human exploration. He was a member of the Mars Pathfinder design team from 1992 to 1997 and participated in landing operations for this mission. He has also made contributions to the Mars Global Surveyor, Mars Polar Lander, and Mars Microprobe spacecraft design and operations teams.

Dr. Braun received his B.S. in Aerospace Engineering from Penn State University in 1987, a M.S. in Astronautics from George Washington University in 1989, and a Ph.D. in Aeronautics and Astronautics from Stanford University in 1996.

Dr. Braun is presently working on the conceptual design of an airplane that may fly on Mars in 2007.

2002 NASA Faculty Fellowship Program (NFFP)
Final Presentations and Best Research Presentation Competition
H.J.E. Reid Conference Center
Tuesday, August 6, 2001
8:00 a.m. – 1:30 p.m.

8:00 a.m.	Welcome and Introductions	Dr. Douglas J. DePriest, NFFP Co-Director

Aerodynamics, Aerothermodynamics, and Acoustics Competency

8:10	"Development of Efficient Finite Element Modeling Procedures for Stress Analysis Of Wind Tunnel Force Balances"	Dr. John R. Baker University of Kentucky

Airborne Systems Competency

8:40	"Modeling, Simulation, and Control for Assembling the International Space Station	Dr. Jose J. Granda California State University-Sacramento
9:10	Break	

Atmospheric Sciences Competency

9:20	"Global Warming Potential of Green House (GH) Gas Releases at Different Altitudes"	Dr. Katta G. Murty University of Michigan

Systems Engineering Competency

9:50	"Atmospheric Infrasonic Signal Decomposition Using Advanced DSP Techniques"	Dr. William W. Edmonson Hampton University
10:20	Break	
10:30	"Signal Processing in Search of an Acoustic Signature of a Wake Vortex"	Dr. Nurgun Erdol Florida Atlantic University

Structures and Materials Competency

11:00	"Aeroelastic Analysis Using Higher-Order Stectral Moments"	Dr. Muhammad R. Hajj Virginia Polytechnic Institute And State University
11:30	Break	
11:40	"Fiber Optic Sensor System"	Dr. Charles A. Smith Our Lady of the Lake University
12:10	Closing Comments Photo and Lunch Instructions	Dr. Douglas J. DePriest Mrs. Debbie Murray

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2002 NFFP/LARSS/Summer Scholars Calendar of Activities

Date	Function
Monday, June 3	Office of Education Orientation Program - 9:00 a.m. H.J.E. Reid Conference Center, 14 Langley Boulevard NFFP Ice-Breaker - 5-7 p.m. - H.J.E. Reid Conference Center
Wednesday, June 5	**Office Hours:** Reid Conference Center Wythe Room 11:30 a.m. – 1:00 p.m. (Picnic forms, T-shirt orders, etc.)
Friday, June 7	Summer Scholars 7x10 Wind Tunnel Tour 11:00 Meet in front of Bldg. 1212 NFFP Spouses Luncheon - Golden Corral Restaurant 1123 W. Mercury Blvd - 11:30 a.m. **Office Hours:** Reid Conference Center Wythe Room 11:30 a.m. – 1:00 p.m.
*Tuesday, June 11	Lecture-H.J.E. Reid Conference Center - *LARSS Pay Date*
Wednesday, June 12	NFFP 7x10 Wind Tunnel Tour 11:00 Meet in lobby of Bldg. 1212 **Office Hours:** Reid Conference Center Wythe Room 11:30 a.m. – 1:00 p.m. OEd Summer Programs Picnic- H.J.E. Reid Conference Center - Picnic Grounds - 4:00 - 8:00 p.m.
Thursday, June 13	LARSS 7x10 Wind Tunnel Tour 11:00 Meet in front of Bldg. 1212
Friday, June 14	Summer Scholars ALDF Tour 10:00 Meet in front of Bldg. 1262 **Office Hours:** Reid Conference Center Wythe Room 11:30 a.m. – 1:00 p.m.
*Tuesday, June 18	Lecture-H.J.E. Reid Conference Center - *NFFP Pay Date*
Wednesday/Thursday, June 19-20	Small Disadvantaged Business/University Opportunities Forum Wed. 5:30 p.m. - Reception at HU Museum; Thurs. 8:00 a.m. Forum at H.J.E. Reid Conference Center
Thursday, June 20	LARSS ALDF Tour 10:00 Meet in front of Bldg. 1262
Friday, June 21	Summer Scholars Model Shop 10:00 Meet in front of Bldg. 1238B
*Tuesday, June 25	Lecture-H.J.E. Reid Conference Center - *LARSS Pay Date*
Wednesday, June 26	NFFP Model Shop 10:00 Meet in front of Bldg. 1238B
Thursday, June 27	LARSS Model Shop 10:00 Meet in front of Bldg. 1238B LARSS Group Photo 11:45 a.m. - Reid Conference Center picnic grounds LARSS Graduate Seminar 12:30 p.m. – LaRC Cafeteria, NACA Room
Friday, June 28	**Office Hours:** Reid Conference Center Wythe Room 12:00 noon – 1:00 p.m.

2002 NFFP/LARSS/Summer Scholars Calendar of Activities- Continued

Date	Function
*Tuesday, July 2	Special Presentation – H.J.E. Reid Conference Center – *NFFP Pay Date*
Wednesday, July 3	NFFP ALDF Tour 10:00 Meet in front of Bldg. 1262
Thursday/Friday, July 4-5	Holiday
(Program participants are given Friday as well, since many Associates and Mentors will be off too.)	
*Tuesday, July 9	Lecture-H.J.E. Reid Conference Center - *LARSS Pay*
Wednesday, July 10	**Tentative – Flight Suit Photos for LARSS and NFFP (Group Photo for NFFP)**
Friday, July 12	**Office Hours:**Reid Conference Center Wythe Room 12:00 noon – 1:00 p.m.
Tuesday, July 16	Lecture-H.J.E. Reid Conference Center - *NFFP Pay Date*
*Tuesday, July 23	Lecture-H.J.E. Reid Conference Center - *LARSS Pay Date*
Thursday, July 25	NFFP R&T Competency Presenter Recommendations Due from Associates to Administrative Officers
Friday, July 26 1:00 p.m.	**Office Hours:**Reid Conference Center – Wythe Room 12:00 noon – NFFP/LARSS/Summer Scholars Banquet-LAFB O'Club - 6 - 9:00 p.m.
Mon-Fri, July 29-Aug. 2	EDCATS on-line evaluations must be completed during this week
Tuesday, July 30	Lecture-H.J.E. Reid Conference Center - *NFFP Pay Date*
Friday, August 2	Last Day of NASA Summer Scholars Program (SPACE, WISE, IMAGE) **Office Hours:**Reid Conference Center Wythe Room 12:00 noon – 1:00 p.m.
Tuesday, August 6	NFFP Final Presentations and Best Research Presentation Competition H.J.E. Reid Conference Center
Friday, August 9	Last Day of Program - *Final NFFP/LARSS Pay Date* - Process Out 2 - 4 p.m. - H.J.E. Reid Conference Center - Hampton Room

*Lectures will be at 11:00 a.m.--Arrive early for paydays indicated. **Activities Committees will plan other social functions.

APPENDIX III - GROUP PICTURE OF NFFP FELLOWS

2002 NASA Faculty Fellows in order from left to right:

Front Row: Dr. Martha J. Hall, Dr. Wagdy H. Mahmoud, Dr. James P. Bliss, Dr. Charles A. Smith, Dr. Esther A. Hughes, Dr. Nurgun Erdol, Dr. Suren N. Dwivedi, Dr. Jose J. Granda, Dr. Katta G. Murty, Prof. Scott B. Graham, Dr. Emma Mae Savage-Davis, Dr. Dwight J. Patterson, Ms. Sylvia Sessoms, Dr. Muhammad R. Hajj

Back Row: Mrs. Debbie Murray-NFFP Program Manager, Dr. Douglas J. DePriest-NFFP Co-Director, Dr. Joseph R. Blandino, Mr. B. Kennon E. Outlaw, Dr. Jonathan H. Spindel, Dr. Jack Leifer, Dr. William W. Edmonson, Dr. Brian Helenbrook, Dr. Richard N. Louie, Dr. Michael E. Baginski, Dr. Larry E. Tise, Dr. Mark D. Sensmeier, Dr. B. Terry Beck, Prof. Steven Chischilly, Dr. John H. Cain, Dr. David S. Wright, Prof. Caroline C. Clever

APPENDIX IV

DISTRIBUTION OF FELLOWS BY UNIVERSITY RANK
and
DISTRIBUTION OF FELLOWS BY COMPETENCY/PROGRAM OFFICE

Distribution of 2002 NFFP Fellows by University Rank
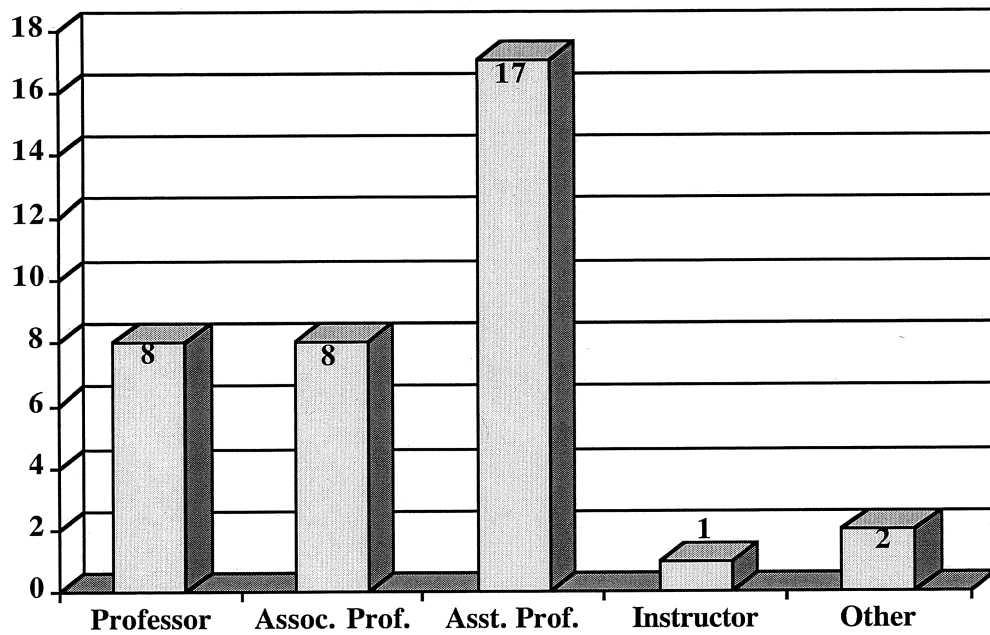
Distribution of 2002 NFFP Fellows by Competency/Program Office
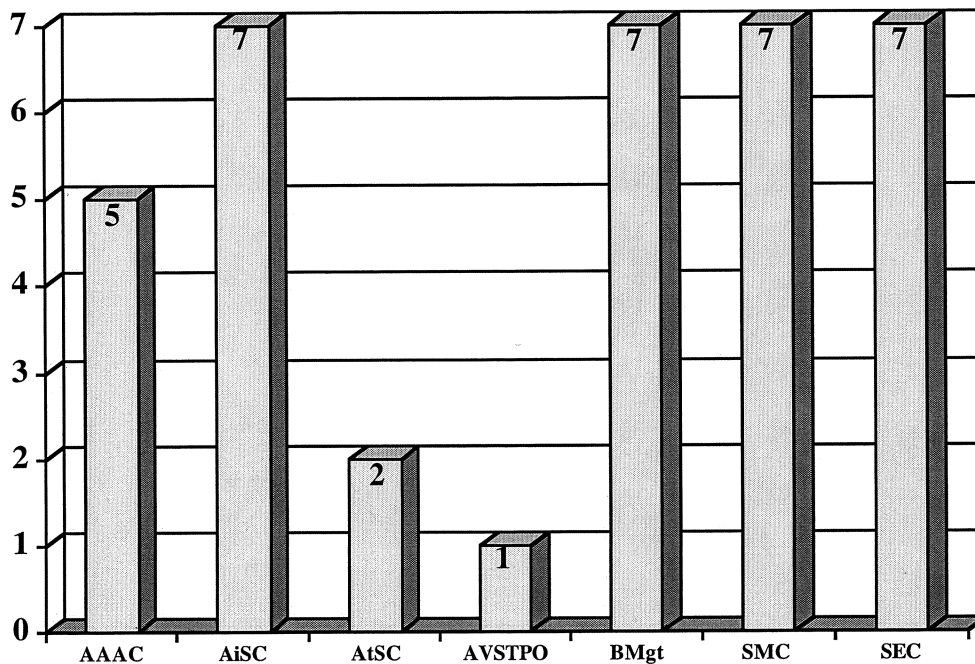
APPENDIX V

DISTRIBUTION OF FELLOWS BY ETHNICITY/FEMALE
and
DISTRIBUTION OF FELLOWS BY ETHNICITY/MALE

Distribution of 2002 NFFP Female Fellows by Ethnicity

5 Female Participants
(Represent 14% of all participants)
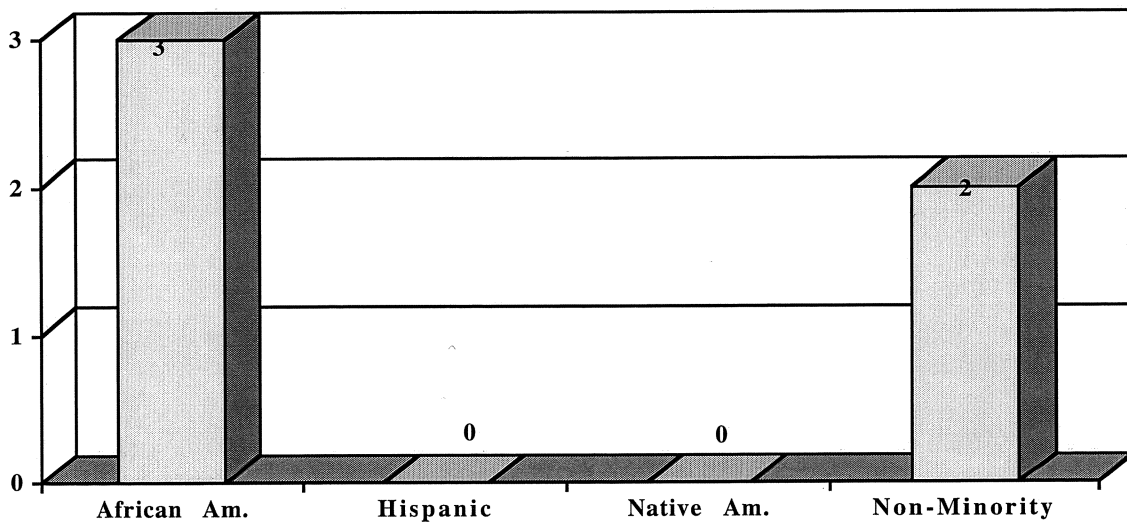
Distribution of 2002 NFFP Male Fellows by Ethnicity

31 Male Participants
(Represent 86% of all participants)
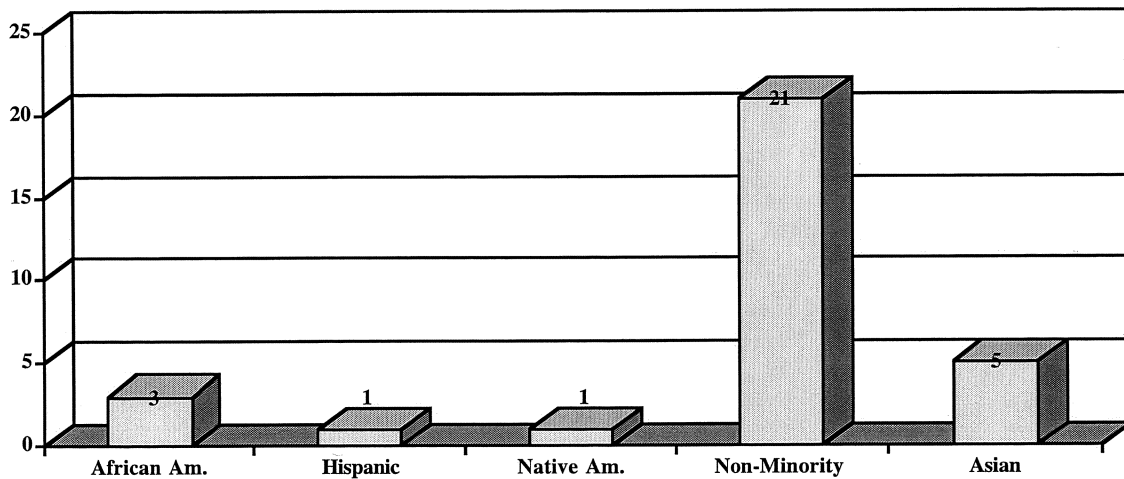
APPENDIX VI

2002 NASA FACULTY FELLOWSHIP PROGRAM
DISTRIBUTION OF FELLOWS BY UNIVERSITY PARTICIPATION

2002 NFFP SUMMER FACULTY FELLOWSHIP PROGRAM
DISTRIBUTION OF FELLOWS BY UNIVERSITY PARTICIPATION

UNIVERSITY/COLLEGE	NO. OF FELLOWS
Auburn University	1
California State	1
Clarkson University	1
College of William and Mary	2
^Crownpoint Institute of Technology	1
~Dona Ana Branch Community	1
East Carolina University	1
Embry-Riddle Aeronautical University	2
Florida Atlantic University	1
Florida Institute of Technology	1
Georgia Institute of Technology	1
*Hampton University	2
James Madison University	3
Kansas State University	1
Middle Tennessee State University	2
New River Community College	1
*Norfolk State University	1
Old Dominion University	2
~Our Lady of the Lake University	1
Pacific Lutheran University	1
Pennsylvania State University	1
Tennessee Technological University	1
Tidewater Community College	1
University of Kentucky	2
University of Louisiana-Lafayette	1
University of Michigan	1
Virginia Commonwealth University	1
Virginia Polytechnic Institute and State University	1

Total Number of Fellows   **36**

Total Number of Institutions Represented   **28**

*Indicates a Historically Black College or University (HBCU).
^Indicates a Tribal College or University (TCU).
~Indicates a Hispanic Serving Institution (HSI).

APPENDIX VII

ABSTRACTS – RESEARCH FELLOWS

A Novel Approach to Estimation of n-Layer Lossy Dielectric Constitutive Parameters from X Band Waveguide S Parameter Measurements based on Inversion Algorithms

Michael E. Baginski, Ph.D.
Department of Engineering
Auburn University,
Auburn,, AL. 36849
E-mail: mikeb@eng.auburn.edu

The constitutive parameters for two and three layer planer dielectric materials are obtained from X-band measurements using a novel numerical inversion routine. Initially, X band S parameters measurements are obtained for each sample using an HP-8510 spectral analyzer and standard algorithms. The resulting data sets then serve as a basis for numerical optimization that obtains all constitutive parameters via minimization of error between numerically predicted values and measurements.

The numerical code used in the optimization initially assumes the sample's layers have a nonmagnetic a relative permittivity of 2. A Method of Moments (MoM) code is then used to predict the resulting output transmission and reflection parameters. This input/output relationship is linked to a parametric optimization routine that minimizes the least-squared error difference between measurements and MoM predictions. All samples are tested over the entire X-band frequency range (8.2 GHz < f < 12.4 GHz) and the resulting best fit lossy permittivities catalogued.

Numerical codes were written in MATLAB primarily for platform portability. The Method of Moments code used was an adaptation of an earlier FORTRAN code specifically designed for explicit solutions to the problem. Several optimization routines were investigated and in all cases the global search region confined to physically realizable systems. The methods were investigated for compatibility with the inversion routine, fastest rate of convergence, and overall accuracy. For all samples considered the complexity was generally low enough to preclude the need for a genetic algorithm even though this appears to be the preferred method for large-scale highly unpredictable problems and the Gauss-Newton method was selected

The Gauss-Newton method was implemented with an average analysis time of less than 10 minutes per sample. The linear least squares problem exacerbation of the conditioning of the equations is avoided by using the QR decomposition. This is in contrast to inverting the explicit matrix, which can cause unnecessary errors to occur.

Robustness measures are included in the method. These measures consist of changing the algorithm to the Levenberg-Marquardt method when either the step length goes below a threshold value (in this implementation 1.e-15) or when the condition number is below 1e-10. The condition number is a ratio of the largest singular value to the smallest.

Six different samples were investigated with cross-sectional dimensions of 2.4 cm x 1.029 cm with layer thickness varying from .17 cm to .22 cm. Data sets contain complete scattering matrices allowing a significant increase in accuracy. Manufacture supplied material data for the electrical properties of the samples were compared to algorithm estimations. The results of the investigation show excellent agreement with manufacture's information. Possible sources of discrepancies between estimations and manufacture's data are likely due to sample construction and placement errors.

Development of Efficient Finite Element
Modeling Procedures for Stress Analysis
of Wind Tunnel Force Balances

John R. Baker, Ph.D.
Department of Mechanical Engineering
University of Kentucky - Extended Campus Program
Paducah, KY 42002
E-mail: jbaker@engr.uky.edu

Wind tunnel force balances are transducers on which wind tunnel test models are mounted. The balances are instrumented with strain gages. They are used to measure the forces and moments acting on a test model during a wind tunnel test. Failure of a force balance during testing could cause significant damage to the wind tunnel and/or test model, resulting in high repair or replacement costs. Therefore, it is important that reasonably accurate testing limits are defined for each force balance to reduce the likelihood of failure. To determine testing limits, predictions of stresses in the balances for assumed loads are needed. The standard method for predicting stresses in structures is finite element analysis. Commercial finite element software is widely used to model structures and predict deflections and stresses due to assumed loads. However, the force balances have relatively complex geometries, and previous finite element analysis has indicated that high stresses may be localized in small features, such as fillets. To accurately predict stresses in these small features, a highly detailed finite element model is required. Producing a highly detailed finite element model of a force balance requires significant up-front modeling effort. Also, even though there have been great increases in readily available computing power over recent years, obtaining a solution for a typical force balance with a highly detailed full finite element model, using a sufficiently fine finite element mesh, pushes the limits on today's high-end pc's.

This summer fellowship involved research aimed at developing a better understanding of the detail required on force balance finite element models, and at reducing the up-front modeling effort and the computational effort required in analyzing wind tunnel force balances. The work is based on the finite element software package, ANSYS. Macros were written to automate some of the modeling effort for standard geometries. Also, some initial studies, using the "cut boundary displacement method" were undertaken. This method involves analyzing detailed "submodels" of portions of the structure, using boundary conditions deduced from a solution based on a less-detailed full model of the entire structure. Also, some mesh convergence studies were performed using submodels representative of some small features in force balances. The results of the convergence studies may be helpful as a guide in future analyses in determining the level of detailed required in modeling force balances.

Planar Laser Induced Fluorescence (PLIF) Imaging System Development for Aerothermodynamics Applications

B. Terry Beck, Professor
Department of Mechanical and Nuclear Engineering
Kansas State University
Manhattan, KS 66506
Email: tbeck@ksu.edu

Wind tunnel testing in high-speed flows is an extremely valuable component of modern aerothermodynamics research. It is not only important as an investigative tool to further the understanding of complex flow processes in general, but is especially useful for investigating those flow processes associated with high speed combustion phenomena. Traditional non-contact techniques such as Laser Doppler Velocimetry (LDV) and Particle Image Velocimetry (PIV) have long played an important role in flow diagnostics; however, these techniques require particle seeding of the flows, which severely limits their application in rapidly accelerating flows and in high-speed flows involving combustion. Furthermore, in chemically reacting and combustion flows, there is a need for additional diagnostics capable of assessing not only velocity fields, but species concentration, temperature, and pressure as well.

The objective of this project was to develop a Planar Laser Induced Fluorescence (PLIF) imaging system for non-intrusive fluid flow measurements. In contrast to techniques such as LDV, PLIF is a non-coherent laser-based technique, which does not require particle seeding of the flow. This type of system is capable of measuring several flow variables including species concentration, temperature, and pressure. It can provide both visualization as well as quantitative measurements, and is particularly applicable to a wide range of aerothermodynamics measurements in high-speed compressible flows associated with combustion. Initially the system will be demonstrated on a simple flame jet flow utilizing OH fluorescence. A portable system of this type is also under development, and will soon use fluorescence of NO to support on going high-speed wind tunnel flow research investigations.

A Theoretical Review of Flight Training: An Examination of How Pilots Might be More Effectively Transitioned into the SATS Era

John E. Bertrand, Ph.D.
Department of Aerospace
Middle Tennessee State University
Murfreesboro, Tennessee 37132
jbertran@mtsu.edu

General aviation posts greater numbers of aircraft and flights each year. There are about five times as many GA aircraft as airliners, which post about 1.5 times the flight hours per year. The return of single engine production in 1997 and the rise of fractional ownership of mainly turbine aircraft have both led to the increases in number of units and the number of flight hours.

However, while numbers are increasing, flying these aircraft has not changed much qualitatively. For the most part, these aircraft fly in the national airspace system that we have had since the 1950's, using much the same equipment with the exception of GPS, and utilizing pretty much the same procedures. This has led in turn to some enviable outcomes. Turbine GA operations have accident rates that are comparable to the airlines; that is, a safety record that is better than any other form of transport in history. Piston operations do not post safety rates that are as good as turbine operations, but they are improving and are very good nonetheless.

But times are changing. It seems clear that new initiatives and new technologies will overtake us in the near term future, particularly the extended use of GPS, synthetic vision, other cockpit displays, and on-board real time information, particularly traffic and weather information. Technologies are now being tested which will pretty much obviate many if not most of the basic assumptions of today's flying. IFR on-route, precision versus non-precision approaches, airways, on-route control, weather reporting, flight service stations, Flightwatch, HIWAS, and non-towered IFR operations are all examples of elements of the present system which will be eliminated or altered beyond recognition as a result of technologies now being tested and marketed. It is unclear how the scope and sequence of events will unfold, but it is clear that things will change markedly whether government, training institutions, and other stakeholders are ready or not.

Experience with GPS should provide government, training institutions, regulatory bodies, the industry, and aircraft owners with a cautionary tale. With new technologies just over the horizon, we cannot afford another chaotic set of events. GPS was redundant to existing navigational systems. If it was utilized badly, there was always other information readily available in the cockpit. The same cannot be said of synthetic vision, for example. It seems unlikely that planes will be built which display SVS and "steam gauges" side by side. What, after all, would be the point. Failure to train appropriately in the use of new systems will inevitably lead to chaotic events in the air transport system, not just momentary confusion on individual flight decks.

However, how should that training be managed, and what should it contain? Simply jury-rigging existent training has been the answer in the past, but that will certainly be insufficient for systems now in the pipeline. The basic experience requirement for a private license is still 40 hours for most Part 61 students, for example. However, since the 1960s, the knowledge and skills necessary to fly within the national airspace system have increased by many multiples. The likelihood of starting from scratch and passing a practical test with 40 hours logged today is very small. Experience would indicate the average is more like 55. What students are expected to be able to know and do has accreted similar to the formation of stalactites in caves, one drip at a time, but will this incremental approach to training be sufficient in the event of an order of magnitude change in equipment, such as with SATS technology?

Pretending a new technology does not exist and letting pilots get their training from manufacturers and each other may have worked somehow for GPS, since it was redundant to other systems, but it seems unlikely to be sufficient for the future. In order to avoid undesirable events, it is in the interests of stakeholders to be very intentional about how new technologies are introduced into the national airspace system and how they will interact with each other. Several initiatives in this regard are in progress, most notably the SATS program now in progress at NASA Langley. As researchers, particularly SATS personnel, discover how best to combine new hardware and use the cockpit of tomorrow, it is obvious that training must be addressed. One aspect of that examination of training is the purpose of this paper.

When a system is faced with the prospect of imminent, radical change, it is obvious that the system will profit most if change can also be managed to the greatest extent possible and concurrent dislocations minimized to the greatest extent possible. This is a powerful argument against the notion of "business as usual"; that is, against the notion of incremental systemic reaction of "tinkering'. If our ability to react to imminent technologies now being tested is based therefore on our present training system, it is likely that the outcomes will be extremely undesirable.

New ideas about methodologies are needed, but what form shall they take? If the old system is obsolete, so may be the assumptions on which it rests. Obviously, it would be profitable to examine these assumptions and see if they can continue to serve or if a new set of guiding principles should inform the curriculum development and scope and sequence of training for the future.

The most basic question concerning all instruction is this. What is the most informed set of principles applicable to the purpose at hand on how people learn best? Or to put it another way...do people learn to fly and use the national airspace system because of what trainers do or in spite of it? Can training be constructed that takes advantage of current learning theory?

A related question is what is the most critical element that training is designed to develop; that is, what is the most central issue contained in training? The answer form most authorities appears to be that the central issue is the development of those mental processes which lead to situational awareness and good decisions which reflect good judgement (cites needed here). A third lens through which to view this problem is that of good practitioners. A third question is whether the best instructors have any "received wisdom" that might inform training in a new era.

Each of these is only a way to view an aspect of the problem. The first two are more or less academic and lend themselves to literature reviews. The last is rooted in the real world and lends itself to an interview study. This is an attempt to meld theory and practice. This is, to what extent do academic conceptions of these issues find congruence with real world experience among the most informed practitioners?

This study reviewed the scholarly and more commonly available literature to answer the first two questions and conducted an interview study with very experienced flight instructors. The outcomes of these analyses resulted in a number of recommendations intended to address the general research questions.

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Modal Identification of Membrane Structures with Videogrammetry and Laser Vibrometry

Joseph R. Blandino, Ph.D.
Department of Integrated Science and Technology
James Madison University
Harrisonburg, VA 22807
E-Mail: blandijr@jmu.edu

Dynamic testing of Gossamer structures is inherently difficult. Because they are low-mass, flexible structures non-contact measurement techniques must be employed. Techniques must be developed employing both mature and emerging technologies for both ground and on-orbit testing of large Gossamer structures. Two techniques that are suitable for dynamic testing of large, low mass, flexible structures are laser vibrometry and videogrammetry. The goal of this research was to compare laser vibrometry and videogrammetry for measuring flexible membrane structures. The test article for this study was one quadrant of a four quadrant, 2 m solar sail model. The two objectives were to 1) compare videogrammetry and laser vibrometry data obtained using a membrane structure subjected to a sinusoidal input and 2) determine if accurate mode shapes could be determined from displacement data obtained using videogrammetry.

Laser vibrometry is considered the "Gold Standard" for structural vibration testing, while videogrammetry is a relatively new non-contact measurement technology. A laser vibrometer measures the component of surface velocity in the direction of the laser beam. Laser vibrometry is a costly technology. Single point units start at $20,000, while scanning units cost between $150,000-$200,000. Because of the cost involved in acquiring a vibrometer it is desirable to find less expensive, acceptable alternatives. It is also often desirable to measure more than one degree of freedom at each point and measure all points simultaneously. Videogrammetry offers these advantages at a lower cost. Videogrammetry is based on photogrammetry. Photogrammetry is the science of constructing a 3-D model from a set of 2-D images. Videogrammetry uses a sequence of images to obtain the static shape of a structure at discrete times, which allows the characterization of the dynamic behavior. Each image set, or epoch, is used to create a 3-D model. The models are sequenced to produce a time history of the displacement of the imaged surface. Using either fixed or projected targets, videogrammetry allows rapid data collection over an entire surface.

Using two scientific cameras with 1008 x 1018 pixel resolution sampling at 15 frames per second, 384 frames were acquired of a vibrating membrane. Five modal frequencies between 1.65 and 4.75 Hz were identified. The mode shapes at the five frequencies, 1.66, 2.68, 3.47, 3.62 and 4.51 Hz, were compared with those obtained using a scanning laser vibrometer. Only the first mode had a Modal Assurance Criteria (MAC) number greater than 0.9 indicating the mode shape was the same as that obtained with the vibrometer. Modes at 2.68 and 3.47 Hz had MAC numbers of 0.76 and 0.78 respectively. Above 3.47 Hz there was poor agreement between the two measurement techniques. The differences between the mode shapes may have been due to the limited number of frames acquired. The outcome of this study indicates that videogrammetry has the potential to be a useful tool for modal identification of membrane structures, but further development of the technology is necessary.

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Display of Aviation Weather Information

James P. Bliss, Ph.D.
Department of Psychology
Old Dominion University
Norfolk, VA 23529
Email: jbliss@odu.edu

Presentation of weather information is critically important to pilots, because inclement weather may reduce visibility, interfere with air-to-ground communications, interference with onboard display functions, and degrade aircraft aerodynamics. Therefore, it is important to display up-to-date weather information frequently and intuitively. The current research focuses on two aspects of weather display: the combination of onboard and NEXRAD weather information, and the display of weather related turbulence information.

Traditional on-board weather systems offer pilots the opportunity to obtain only tactical weather state information that is not updated frequently. NEXRAD weather systems promise access to more frequent and detailed weather information, enabling strategic decision making. In the first experiment, we assess whether flight crews might benefit from the combination of NEXRAD and onboard weather displays. Ten pilot/copilot flight crews will fly a simulated flight path encountering severe weather along the way. Half of the flight crews will view combined weather information; the other half will have only on-board radar available. All flight crews will experience weather information update rates at various frequencies. Dependent measures will include speed and accuracy of flight rerouting decisions, flight path analyses, content analyses of flight crew-ATC communications, estimates of pilot situation awareness and cognitive workload, and pilot acceptance of the displays. We expect that flight crews will show a subjective preference for NEXRAD information, but may suffer increased workload with such information. In addition, we expect to quantify significant workload and flight performance benefits from more frequent weather information updates.

In the second experiment, we plan to investigate the feasibility of displaying weather related turbulence information in the cockpit. Although clear air and wake turbulence are difficult to predict, storm related turbulence might be inferred from weather elements such as convective patterns or rain intensity. Industrial partners, in cooperation with NASA, have created a prototype turbulence display. This display allows pilots to visualize approaching weather cells and associated turbulence. When a turbulence encounter is imminent, display information may be accompanied by an auditory and visual alarm signal. In the current research, twelve pilot/copilot flight crews will fly a predetermined route in a high-fidelity B-757 simulator. While doing so, they will encounter simulated turbulence, shown on the display. Pilots will be presented either standard weather information with no auditory and visual alarm signal, or weather information accompanied by a visual and auditory alarm. The speed and accuracy of subsequent pilot reactions will be examined. Also, measures of mental workload, situation awareness and alarm trust will be gathered.

Multiple, Simultaneous Instrument Approaches and Departures in Instrument Meteorological Conditions at Airports Without Control Towers or Radar Service

John H. Cain, Ph.D.
School of Aeronautics
Florida Institute of Technology
Melbourne, FL 32901
E-mail: jcain@fit.edu

The primary research objective was to develop new operational concepts in which pilots could apply NASA-developed technologies to maintain safe separation distances from other aircraft during multiple, simultaneous instrument approaches and departures in instrument meteorological conditions (IMC) at airports without control towers or radar service. These concepts were developed in support of the Small Aircraft Transportation System (SATS) program.

Today, air traffic control (ATC) insures aircraft remain separated in IMC. ATC primarily uses radar to achieve separation. If aircraft are below or beyond radar coverage, then restrictive procedural separation is applied. Procedural separation allows only one aircraft at a time to operate in the airspace around an airport. This restriction is referred to as the one-in-one-out paradigm. While this current paradigm results in safe operations, it results in low volume operations at non-towered, non-radar airports.

A SATS program operating capability to be demonstrated is high volume operations (HVO) by general aviation aircraft in near all-weather conditions at over 5,000 small, non-towered, non-radar ,public-use airports in the U.S. HVO requires pilots to self separate. Self separate means the pilot, not ATC, is responsible for separating his/her own aircraft from nearby aircraft even in weather conditions that prevent the pilot from seeing other aircraft, i.e., IMC. NASA has developed technologies that enable pilots to self separate in IMC, e.g., a Cockpit Display of Traffic Information (CDTI) with conflict detection and alerting tools and a ground-based airport traffic sequencer.

Detailed operational concepts and pilot procedures were developed to enable pilots to employ NASA's self-separation technologies. Self separation criteria were derived from radar separation precedents. Rules of the air were developed by examining and modifying appropriate existing rules. Technology-enabled new rules were also developed. Three new operational concepts based on Terminal Arrival Area (TAA) Design Criteria (DOT/FAA Order 8260.45A) were developed and examined in detail. Specific pilot operating procedures were developed for each concept. CDTI, airport traffic sequencer, and simulation capabilities were identified. The concepts and operating procedures were scenario-tested for feasibility. The research suggested all three concepts were feasible but at varying pilot workloads and for varying aircraft numbers. Research questions and a test matrix were proposed for additional research in batch and pilot-in-the-loop simulation experiments.

Use of Geographic Information Systems
To Assist in the Development in an On-line Mission Plan for
NASA's White Sands Test Facility

Steven Chischilly, Professor
Department of Natural Resources
Environmental Science & Natural Resources Program
Crownpoint Institute of Technology
Crownpoint, New Mexico
Navajo Nation
E-mail: stevechischilly@yahoo.com

The development of a mission plan for a facility requires direct insight and planning from facility management. Accurate communication must occur between the person(s) developing the mission plan and the facility for which it is being developed. The facility in question for the work conducted during the summer of 2002 was the White Sands Test Facility (WSTF) located in southern New Mexico. This NASA facility must develop an on-line mission plan that will direct and assist personnel regarding the WSTF mission and goals. The mission plan states the mission, goals and purpose of the facility.

The mission plan included other areas of concern that are near the site and these areas were the Holloman Air Force Base, Sevilleta Wildlife Refuge, and the White Sands National Park. Raw data was obtained from these facilities and they were incorporated into the dots, polygons, and lines that make up the maps for the general area. The purpose of the on-line mission plan was to develop an on-line website for personnel working within the facility so that they may easily reference current facility issues.

Software utilized for this work is as follows: ArcMap, ArcCatalog, ArcIMS and other ESRI software. Different software is currently utilized by the GIS industry, and this software was available from the NASA GIS laboratory. This on-line website will allow personnel of the WSTF to become intimately acquainted with their facility geospatially, making this document a living document that will contiually be upgraded and the maps generated will also serve to show locations of important attributes found at these facilities.

PathFinder Project: Motivating Students to Pursue Careers in Mathematics, Science, Engineering and Technology

Caroline Clever, Assistant Professor
General Studies Division
Doña Ana Branch Community College – New Mexico State University
Las Cruces, New Mexico
e-mail: cclever@nmsu.edu

In support of NASA's vision to inspire the next generation of explorers, the *PathFinder Project* created a course designed to encourage and motivate minority students, particularly Native American students, to pursue degrees beyond the community college level in the fields of mathematics, science, engineering and technology. The course curriculum makes significant use of NASA distance learning resources, as well as other related NASA education resources.

Minority students, particularly Native American students, often enroll in the community college with the belief that all that they want to gain from their educational experiences are the knowledge and skills necessary to pass the required coursework for a certificate or associate degree which will allow them to obtain employment. Often, they have not been given the opportunity to see themselves as intelligent, desirable learners with great potential to succeed in academic settings beyond the community college level in pursuit of scientific and technical careers.

PathFinder presents students with an interesting and motivational look at how the mathematics, science, and technology that they will be learning in their coursework connect with the mathematics, science and technology used at NASA Centers every day. Students have the opportunity to interact with real NASA scientists, engineers, and technicians using NASA's distance education video-conferencing capabilities. Additional NASA internet resources are used to motivate students to explore their academic and career interests and potential and to set into motion the actions necessary to achieve their goals.

The valuable success skills of risk-taking, visualization and affirmation, proactive living, mission statement writing, goal setting, personal and time management, goal attainment, synergy, valuing diversity, and mental, physical, emotional and spiritual renewal are introduced through guided discussion based on the book, The Seven Habits of Highly Effective People by Dr. Stephen Covey. Discovery worksheets and journal responses to topics based on the reading of Native American traditional stories presented in the textbook: The Tiny Warrior: A Path to Personal Discovery and Achievement by Native American author and motivational speaker, D. J. Vanas, allow students to reflect on how the discussion topics can be immediately applied in their lives to enhance their personal growth and achievement.

In order for the scope of the *PathFinder Project* to extend beyond the home institution of the course creator, project extensions are expected which include presentations at professional conferences with complete course master packets distributed to interested institutions. Packets include disks with a sample of each document necessary to advertise, teach and assess the course, as well as complete instructor notes which give a step-by-step lesson plan for each class session. NASA video tapes, technology instructions and a course textbook are also included.

Application of Probabilistic Analysis/Design Methods:
The state of Art and Future Directions

Suren N. Dwivedi
Endowed chair professor in Manufacturing
Department of Mechanical Engineering,
University of Louisiana,
Lafayette, LA- 70504.
Email: dwivedi@louisiana.edu

Definition of a design problem often involves uncertainties in various issues, leading to uncertainties in space vehicle structure design, which in turn leads to safety. Involving a safety factor or taking into account the reliability of design often addresses the safety issue in design. Reliability is measured by a probabilistic approach, which involves quantification of all input data, plant model, and output in a statistical manner. Statistical procedures are required to take the plant model and the input data to produce a probabilistic output. Probabilistic approach has been given great importance by the aerospace community, which developed an extensive database that helps in determination of launch vehicle control and dynamic responses and loads. This kind of approach is best utilized as a design tool that identifies sensitivities of the problem parameters.

This study deals with various probabilistic approaches used to solve different problems under uncertainty. Ryan and Townsend's proposal to combine the probabilistic approach and safety factor approach to solve the problem of design uncertainty in aeronautical and space applications, Arbocz proposal for a more complete probabilistic criterion for design of shells that are widely used as structural elements in space applications and Hilton's development an analytical method for designing structures having a known probability of failure so that the overall weight is least under combined loads have been prominently discussed in the article. Kirby's Technology Identification, Evaluation and Selection (TIES) method, which accounts for technological uncertainty by including a forecasting environment in the design method, and Eric, Pratt and Whitney's "Box-Behnken Matrix method" which helps in integrating a probabilistic design within an organization's design system have also been discussed in comparison with a few other methods. Further, various recommendations involving different strategies, studies and training are suggested for future development and application of these approaches. The study even discusses about a proposal to create a new algorithm that will be adapted specifically for the robust design task. The algorithm will approximate the Hessian matrices of the objective and constraints using the Broyden-Fletcher-Goldfard-Shanno (BFGS) update formula, as the algorithm moves towards the nominal optimum. The second derivative information will then be used to perform robustness calculations at no additional cost in terms of functional calls. The results of this method are compared with another robust optimal design procedure in terms of efficiency and accuracy.

Atmospheric Infrasonic Signal Decomposition Using Advanced DSP Techniques

William Edmonson, Ph.D.
Department of Electrical Engineering
Hampton University
Hampton, VA 23668
Email: wedmonson@ieee.org

Acoustical studies of atmospheric events such as convective storms, shear-induced and clear air turbulence, acoustic gravity waves and microburst are strong emitters of infrasound. Atmospheric infrasound represents sound waves in the .5 – 20 Hz range. Other sources of infrasonic signals, considered noise, that can obscure the above atmospheric events can be created by the ramping up of jet engines, wind blowing over very large structures (buildings, bridges and mountains) and space shuttle launchings. The project consist of developing advanced digital signal processing methods to locate and identify sources of infrasonic acoustic activity. The infrasonic source can be characterized as being turbulent and therefore has a unique spectral and statistical characterization for which we plan to exploit.

The location of infrasonic acoustic activity is accomplished by array signal processing methods. Array signal processing utilizes an array of sensors to do spatial-temporal filtering on incoming signals. Presently, time delay estimation is used to determine the signal source elevation and azimuth. This method is best for a single signal that is highly correlated. To overcome this limitation two methods were investigated: blind source separation (BSS) and direction of arrival (DOA). Blind source separation represents a process for separating out spatially different signals given that only mixed signals at the sensors are available. After separating the different signals and noise using BSS, then time delay estimation is performed on each signal to determine location. Independent component analysis is the BSS method chosen and is based on using higher order statistics for identifying the mixing parameter. An additional of result of BSS is an approximation of the number of separate signals that exist. The DOA methods determine the source location based on decomposing the statistical expectation of the data from the array of sensors. The methods are based on spectral or parametric procedures and both can locate multiple sources that are spatially very close.

This work is in support of the C and I research "Infrasonic Detection of Severe Storm and Clear Air Turbulence (Climate)."

Signal Processing in Search of an Acoustic Signature of a Wake Vortex

Nurgun Erdol, Ph. D.
Department of Electrical Engineering
Florida Atlantic University
Boca Raton, FL 33431
August 5, 2002
erdol@fau.edu

Signal processing is applied to a set of acoustic data recorded by a directional microphone array placed on the landing path of airplanes, in an exploratory effort to detect ground based wake vortices. The successful detection and tracking such chaotic air phenomenon could help improve safety and increase capacity during bad weather operations at airports with closely spaced runways. Air traffic controllers currently separate aircraft as much as 6 miles to allow wake turbulence to dissipate, based on a worst-case scenario.

A wake vortex is a turbulent air phenomenon generated by aircraft in flight. Its detection, classification, localization and tracking can be extended to various natural meteorological and man-made atmospheric anomalies that pose hazards to commercial and general aviation. These aviation hazards include clear air turbulence, severe wind gusting along mountainous airstrip approaches, downdrafts producing windshears and microbursts, tornadoes, and mountain wind rotor, all of which are naturally occurring meteorological phenomena.

This work is based on the hypothesis that turbulence created in the wake a flying aircraft creates a sound that has a statistically consistent signature. There are theoretical reasons and experimental evidence to show that the acoustic signature would be subsonic, however some reports suggest frequency concentrations around 200 Hz. There is speculation, as well, that there may not be a reliably detectable acoustic signature corresponding to this non-linear air phenomenon.

The purpose of this work is to perform a variety of signal processing techniques and report the findings for verification. Data provided was recorded by equidistant five rows of 2 microphones. Cross covariance and beam forming methods are used to remove uncorrelated recordings and time-align the data from the 10 channels and produce one time series. The data sequence is initially analyzed in windows corresponding to 0.4 seconds (10000 samples at 25 KHz.). The reason for the choice is to make the window wide enough to contain two cycles of a 5 Hz. wave in case the vortex frequency concentration were that low. The Fourier transform of each window shows much harmonically related spectral resonance lines which are assumed to be interference. The data are also put through a maximally decimated bank of orthogonal wavelet filters, denoised using statistically chosen thresholds, reconstructed and Fourier analyzed. The purpose for using the filter banks is their ability to divide the spectral band into octave spaced filters so that there is more detailing at the low frequency range than in high frequencies. It is well known that energy normalized wavelet filter banks act as a whitener for 1/f type signals. We show that the data in each channel can be reliably modeled as 1/f type. This implies that the detection of a hypothesized signature signal can be done optimally without requiring computationally expensive eigen-analysis methods. It also suggests that wavelet front end can be used in an adaptive filter for such purposes.

Writing for the Office of External Affairs

Scott Graham, M.A.
Department of Humanities and Social Science
Embry-Riddle Aeronautical University
Daytona Beach, FL 32114
E-mail: sgrah01@yahoo.com

I feel that my NFFP fellowship in conjunction with LaRC and the Office of External Affairs has been both pleasurable and educational, and I thank those individuals who have made my employment here possible. I extend my sincerest gratitude to Debbie Murray, Doug DePriest, Ed Prior, Roger Hathaway, and Karen Credeur, all of whom made my fellowship not only a reality, but a memorable endeavor. As a result of working with Gail Langevin on the 2002 *Stakeholders Report* and *Winds of Change: Langley Research Center's 75 Years of Accomplishment*, I have learned much about Langley's history and goals, current research projects, and its significant contributions to Earth sciences and aerospace technology.

During my ten weeks here at NASA, I copy-edited an expanded edition of *Winds of Change*, which our staff later re-titled *Crafting Flight*. As yet, a final title for this document has not been chosen. The 185 page body of the text drew my close attention to its grammar and syntax dynamics, and to a lesser extent, its stylistic issues, all of which I addressed with my trusty red pen. At the time that I received the *Stakeholders Report*, not only did its text need revisions, its layout needed reconfiguration, so Gail and I chose new photographs, rearranged their organization among the text, gathered and compiled fresh numbers indicative of LaRC's 2002 output, and began to reformat the entire aesthetic look of the publication. I can't wait to see the final product! Later I helped Sandra West with her speaker's bureau slide presentations. For these I chose new photographs and added snippets of text that serve as speaking prompts. For layman lectures, I wrote brief explanations addressing the significant details and facts of NASA projects as seen in the photographs on the slides. Outside of these efforts, I have edited other public relations materials for Donna Lawson, who prepared flyers and posters for the Osh Kosh air show.

As a member of the activities committee, I helped to plan weekly dinner outings, and for some of these I provided written directions. Like other NFFP fellows, I attended lectures and toured LaRC's wind tunnels. I particularly liked "the cave" and the Fluid Dynamics Computational Facility. Overall, I feel that NASA provides a wonderful service to all NFFP fellows and the associates whom they help. We all have tremendous workloads at times, and having another person's help in any matter can be refreshing. I look forward to working for NASA in the future, should the opportunity arise. I thank all of you for your energy and time.

Modeling, Simulation and Control
for Assembling the International Space Station

José J. Granda, Ph.D.
Airborne Systems Competency
NASA Langley Research Center
Professor
Department of Mechanical Engineering
California State University, Sacramento
Email: grandajj@ecs.csus.edu

NASA Associate: Dr. Raymond Montgomery

ABSTRACT

Modelling and integrating aerodynamic, biological, electrical, hydraulic, mechanical, and thermal dynamic subsystems (e.g. Mechatronics) plays a central role in the design of any complex system. The International Space Station (ISS) is a good example. A major challenge is to obtain integrated models in a state variable form, i.e. in the form of first order differential equations. This presentation introduces a new methodology (Bond Graph Modelling), originated by Prof. Henry Paynter of MIT, which solves this problem in a unified manner, across engineering disciplines. Based on this methodology tools are being developed throughout the world in industry, government, and universities. These are expected to play a premier role in modelling, simulation, and the design of future systems.

The fundamental theory of Bond Graph Modelling is explained, and applied to example physical systems. The program CAMP-G (Computer Aided Modelling Program) implements Bond Graph Modelling and automatically generates Matlab/Simulink models for systems. The examples herein have been developed using CAMP-G.

This NFFP project is to combine the Bond Graph Modelling methods with methods currently in practice to model and simulate the dynamics and control of the International Space Station (ISS) Assembly Flight 12A. This requires knowledge of several, distinct engineering disciplines. The task at hand is the study of the dynamic response of the structure subject to the manoeuvres planned for the mission to identify structure/control interactions. Jets are used to change the orientation of the ISS and electric motors to modify its configuration. Operations can excite the modes of vibration of the structure differently in the different configurations that are planned. And for each new configuration, a new model has to be generated. This new technology obtains such models quickly and efficiently.

ANALYSIS OF NONLINEAR AEROELASTICITY PHENOMENA USING HIGHER-ORDER SPECTRAL MOMENTS

Muhammad R. Hajj[1], NFFP 2002

and

Walter A. Silva[2], NASA Associate

Structures and Materials Competency, NASA LARC

ABSTRACT

Aircraft flying into or through the transonic regime may develop flutter instabilities. These instabilities are violent enough to cause significant motions, damage or even the loss of aircraft. Prediction, modeling, testing and/or analysis of aircraft flutter are extremely difficult. This is due to the many complexities involved in the aerodynamics and structural aspects of the flutter phenomenon. Flutter is due to the coupling between unsteady aerodynamic loads and structural oscillations of the aircraft. This coupling allows for energy lost through structural and aerodynamic damping to be regained through the work done by the aerodynamic forces and can take place over different regions of the flight envelope with different aspects or characteristics.

This work aims at characterizing high dynamic response observed in wind tunnel studies of an HSCT (High Speed Civil Transport) Flexible Semispan Model. These studies were conducted in the Langley Transonic Dynamics Tunnel (TDT). The 1/12 model has a planform that is based on the reference H configuration. Of particular interest is a "chimney" region which occurred over a large range of dynamic pressures around a Mach number of 0.98. At the top of this region is a "hard" flutter point that resulted in the loss of the model. Data analyzed in this work includes wing tip accelerations, bending and torsional strains, and pressure coefficients at different locations on the surface of the wing. Nonlinearly coupled frequency components are detected using the bispectrum.

The results show that, ahead of the flutter boundary, the frequency of wing bending mode decreases continuously. Over a small increase in the Mach number, this frequency increases significantly and high amplitude response is encountered. Examination of the pressure coefficients shows that this variation in the wing bending frequency is due to a change in the flow characteristics and the resulting aerodynamic forces. Particularly, around a Mach number of 0.96, a strong shock takes place on both surfaces of the wing near the trailing edge. Associated with this shock is an aerodynamic loading whereby the low frequencies of the unsteady pressure at different points are nonlinearly coupled. These results provide important insights into the flutter phenomenon. They show that, in order to predict a flutter phenomenon such as the one encountered in these experiments, a predictive tool must have the capability of capturing the nonlinear aerodynamic forces and the nonlinear interaction between the shock and structural motions.

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[1]Associate Professor, ESM Department, Virginia Tech, Blacksburg, VA 24060.

[2]Senior Research Scientist, NASA Langley Research Center, Hampton, VA 23681. AIAA Senior Member.

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Descriptive Analysis of
The Graduate Student Researchers Program and
The Faculty Fellowship Program

Martha Jallim Hall, Ed.D.
Department of Education
Hampton University
Hampton, VA 23668
E-Mail: HEALDMMJ@aol.com

The purpose of this study was to provide a descriptive analysis of data collected from two of the university level programs offered by the Office of Education and administered by University Affairs; the Graduate Student Researchers Program (GSRP) and the NASA Faculty Fellowship Program (NFFP). This was conducted by using the secondary analysis method. To accomplish the purpose of this study, nine research questions address the Graduate Student Researchers Program and six questions address the Faculty Fellowship Program. Data were collected from annual reports and rosters of participants for the GSRP from 1991-2002, and the NFFP from 1997-2000. The GSRP population was 244 students over a twelve-year period and the NFFP was 167 faculty members over a four-year period. This study will provide the Office of Education results that can be taken into consideration for assessment and the development of recruitment strategies for these programs.

This study found (a) the programs are not equitably distributed between gender and ethnicity, (b) there is a need to develop strategies to increase the population of women, (c) there is a need to develop recruitment strategies that include current faculty and students, and (d) a national study of disciplines should be conducted to recruit replacements for highly specialized fields. Four key strategies to address the findings have been identified:

Develop strategies to increase the representation of minorities at the LaRC. Although this is a national issue, it should not be dealt with in a vacuum, but as an interrelated complementary component of the larger landscape of strengthening NASA's diversity.

The development of strategies to increase the population of women in the GSRP and NFFP should be identified in measurable objective terms, over a period of time. Specifically, a long range or strategic plan should be undertaken to provide the leadership and guidance in designing this strategy.

Volunteers from the current faculty fellows and interns should be solicited to serve as ambassadors for these programs. These individuals will be able to share personal experiences to prospective candidates, as well identify the appropriate faculty and students that will benefit the most from this experience.

Conduct a national study of highly specialized science and engineering disciplines to compare to the data collected by headquarters in order to develop strategies for replacement of personnel.

Calibration of the GIFTS Super-Channel Data

Monson H. Hayes
Georgia Institute of Technology
School of Electrical and Computer Engineering
Atlanta, GA 30332

A Geostationary Imaging Fourier Transform Spectrometer (GIFTS) is being developed to enable the gathering of high spatial and high spectral resolution Earth infrared radiance spectra for enhanced meteorological observations and forecasting. The GIFTS measurement system consists of a pair of focal plane detector arrays in a Fourier transform spectrometer (FTS) that is to be mounted on a geostationary satellite.

The interferograms recorded by each detector produce a spectrum, when Fourier transformed, that must be calibrated. Radiometric calibration is the process of assigning absolute values in physical units (usually radiance) to the spectral intensity axis with a specified accuracy. In order to perform radiometric calibration, deep space and internal blackbody measurements are used as standard reference spectral radiances. The calibration equation is a frequency-dependent operator that removes phase dispersion, and produces a calibrated spectrum. However, one of the GIFTS missions is to generate *superchannel data*, which is the integral of the calibrated data over one or more spectral bands. To calibrate the spectrum over a band consisting of N frequency bins, it is necessary to store approximately $3N$ spectral samples for the blackbody and deep space scans. Since the superchannel data is a single number for each band, it would be much more efficient to calibrate the integrated spectrum, referred to as the *superchannel algorithm*, thereby eliminating the requirement to store $3N$ spectral samples, and eliminating the computations necessary to calibrate each spectral sample. However, since calibrating the superchannel data introduces an error in the calibration, it is necessary to see how large this error might be. Therefore, we ran simulations of the superchannel algorithm to quantify this error, and found that the errors are less than a half of a percent. Of greater concern are the errors in the calibration that are introduced if there are relative phase offsets between the scene data and the calibration data.

Investigations of "p"-Multigrid for the Solution of Continuous and Discontinuous Finite Element Discretizations

Brian Helenbrook, Ph.D.,
Deparment of Mechanical and Aeronautical Engineering
Clarkson University
Potsdam, NY 13699-5725
E-mail: helenbrk@clarkson.edu

"hp"- finite element methods have become increasingly popular for simulating fluid flow. With these methods, it is possible to obtain high levels of accuracy much more efficiently than with typical finite-volume methods, and in addition, the methods retain their accuracy on highly distorted grids making them ideal for complex geometries. The difficulty with "hp"-formulations is that the discretized equations are perceived to be much more difficult to solve than finite-volume methods.

This summer, the effectiveness of "p"-multigrid was investigated for solving "hp"-finite element method formulations. ("p" denotes the polynomial degree of the discretization and "h" is the element mesh size.) The basic concept of "p" multigrid was introduced by Ronquist and Patera in 1987, but has not received much attention since. The idea is very similar to multigrid for finite volume equations: eliminate the high-frequency error on a fine mesh and the transfer the hard-to-eliminate long wavelength error modes to a coarser approximation where they are easier to eliminate. In "p"-multigrid, the fine mesh is a given mesh with a finite element discretization of degree p. The next coarser approximation level is the same mesh with degree p/2. This sequence is continued until p = 1 is reached. Beyond this level, standard multi-grid techniques are used with geometric grid coarsening.

The above technique was tested for several canonical problems. The first was the Poisson equation discretized with a C^0 continuous basis. A difficulty with "p"-multigrid is creating a good high-frequency smoother. In this case, an approximate mass matrix inversion technique developed in my previous work was used. The performance was optimal; the number of iterations required to reach convergence was independent of p. This demonstrates that "hp"-discretizations are not inherently more difficult to solve. The second test problem was the first order wave equation. In this case, both C^0 and discontinous formulations were tested (discontinuous Galerkin). It was found that for all levels of p including linear, the convergence rates were dependent on the mesh resolution. The slowest converging error mode was long wavelength in the direction of wave propagation and short wavelength normal to the direction of wave propagation. Further work is necessary to find ways to eliminate this error mode. Nonetheless, p-multigrid still provided a large improvement over the single-grid relaxation scheme. To conclude, it was demonstrated that p-multigrid provides an optimal way for overcoming stiffness associated with diffusive operators and also can improve efficiency when applied to convective operators.

Design of Networking for Field-Deployable
Intelligent Acoustic Measurement Systems

Esther A. Hughes, Ph.D.
Electrical Engineering Department
Virginia Commonwealth University
Richmond, VA 23284
E-mail: eahughes@vcu.edu

Researchers at the NASA Langley Research Center (LaRC) have been interested in understanding and reducing noise generated by aerospace vehicles for more than two decades. Research in this area could lead to the reduction of domestic aircraft noise, thus improving the quality of life for citizens living in close proximity to our nation's airports. Two field-deployable systems, designed and built at NASA LaRC, are used for measuring acoustic noise levels from rotorcraft and tiltrotor aircraft. Langley's two systems, the Digital Acoustic Measurement System (DAMS) and the Remote Acquisition and Storage System (RASS), are functionally equivalent with one fundamental difference: the microphones of the DAMS system are physically wired to the base station while the microphones comprising the RASS share a wireless connection to the base station via radio frequency (RF) communications. For both systems, each microphone must be accompanied by a digitizer and battery pack weighing well over 40 pounds making the systems cumbersome and unwieldy in terms of maneuverability in the field.

We are in the process of designing a streamlined, functionally equivalent, modular, embedded Intelligent Acoustic Measurement System (IAMS) with Ethernet capabilities. One node of the IAMS is to be composed of multiple boards: a Rabbit RCM 3000 module (which includes a 10base-T Ethernet port); a Miniature Embedded Reconfigurable Computer and Logic (MERCAL) board containing a DIMM PC, an FPGA, and a digitizer; a programmable filter and programmable amplifier board; a global positioning system (GPS) board; and a storage device. Interfaces will be designed for these individual boards and they will be integrated onto a printed circuit board (PCB), mounted on an Electrofuel battery and subsequently housed in a ruggedized encasement. The estimated weight for one IAMS node is 10 pounds. Several IAMS nodes will be networked together for data collection. Each IAMS node will be assigned an IP or Internet address. As a result, each node will be accessible via TCP/IP applications such as FTP (used for file transfer) and HTTP (used for web page hosting). The intelligent system will facilitate remote operations including self-diagnostic testing.

Initially, the intelligent acoustic measurement network will be constructed by connecting up to four IAMS nodes into an Ethernet hub forming a cluster. The modules comprising the cluster will be dispersed up to one mile apart from each other and five miles away from the base station. Up to eight clusters will then feed into an 8-port Fast Ethernet switch. The switch will then connect to the base station. We anticipate that the IAMS network will be capable of supporting 100 nodes. In addition, connection to the base station will be converted from wired Ethernet to wireless. Unfortunately, network and data security issues abound with the current encryption algorithm used with the IEEE standard for wireless communications (802.11). It is anticipated that these issues will be resolved and that security in a wireless environment will not be a concern.

Models for Data Production Scheduling at the Atmospheric Sciences Data Center

Rex K. Kincaid, Ph.D.
Department of Mathematics
College of Wiliam and Mary
Williamsburg, VA 23187-8795
rrkinc@math.wm.edu

Data production scheduling at the Atmospheric Sciences Data Center (ASDC) is similar to production scheduling problems in the manufacturing sector. Techniques to address the manner in which schedules are built and maintained have a long history in mathematics and industrial engineering. The nomenclature for the academic scheduling literature is well developed and we make use of it here. The *raw materials* for ASDC are the data collected from satellite-borne instruments. The mission of the ASDC is to take these raw materials and produce a variety of data products for the scientific community. These data products are the *jobs* in the scheduling system. Typically a series of *operations* must be performed to complete the job. Each of these operations has a *processing time* that is a function of the size of the data files needed (raw materials) and the speed of the CPU on which the operation is completed. Finally, the *machines* that produce these data products are the CPUs.

There four generic stages in the data production system. We begin with Level 0 (L0) which is the raw data from the satellite instruments. We assume that (L0) data is arriving from more than one source and that it arrives in time-ordered packets. Moreover, the time-ordered packets for these (L0) data sources are not necessarily in the same time units (e.g. days versus hours). The first operation on these (L0) raw materials is to calibrate and geolocate (latitude and longitude) the data. The outputs from this stage are Level 1 (L1) data. (L1) data is an intermediate data product (work-in-process inventory). Next, these (L1) data sources are processed (operation 2 of our job) by a set of scientific algorithms to produce Level 2 (L2) data. (L2) data products are geophysical fields which retain the same temporal and spatial resolution as the (L1) data. Finally, the (L2) data are processed on the machines to produce Level 3 (L3) data products. The (L3) data products are the final outputs of our data production system. These (L3) products are time and space average fields and are at much larger spatial and temporal resolutions than the (L2) data.

The above simplified data production model is termed a *recirculant flow shop with compound machines*. That is, there are a collection of CPUs (compound machines) each capable of executing any of the three operations (1–calibrate and geolocate, 2–produce instantaneous fields and 3–average over time and space). The operations of the jobs compete for the same machine resources (recirculate). Future efforts will test a variety of scheduling regimens on simulation models of data production. We expect that metaheuristics such as tabu search will be needed to generate robust reactive schedules. Once the simulation models have been validated, uncertainty due to contaminated raw materials and machine breakdowns may be included.

Characterization of Thin Film Membrane Structures Incorporating Integrated Shear-Compliant Border Supports

Jack Leifer, Ph.D., P.E.
Department of Mechanical Engineering
University of Kentucky
Paducah, KY 42002

The effects of wrinkle formation on the surface of large, very thin space structures under tension (e.g., solar sails, solar shields) are well documented, and can lead to problems such as non-concurrent centers of pressure and mass, reduced reflectivity, and non-uniform surface heating. One approach to maintaining the flatness of such structures is to fabricate an integrated, shear-compliant area along its perimeter. This region prevents shear forces generated by the supports from propagating, and maintains the central portion of the film (surrounded by the shear-compliant area) in a flat, unwrinkled configuration.

A film incorporating integrated shear-compliant border supports has recently been demonstrated by SRS Technologies of Huntsville, AL, and its effectiveness in reducing wrinkles has been qualitatively demonstrated. However, the border design required for successful wrinkle attenuation is highly dependent on the specific geometric and material attributes of the membrane for which it is being designed; hence a general design approach for membranes incorporating shear-compliant borders must be developed.

One approach enabling the design of shear-compliant borders incorporates robust numerical models capable of estimating the wavelength and amplitude of the wrinkles, as well as the membrane's stress state. Such models were developed using the ANSYS finite element code, and use shell elements to simulate the response of the membrane. In addition to a ramped shear displacement, the input to the membrane model includes small, random out-of-surface forces that are used to numerically initiate a buckling response. These force inputs are removed from the model once buckling has commenced. This approach is among the first that permits the calculation of wrinkle amplitude and wavelength, and (unlike similar approaches) does not require the permanent alteration of the finite element mesh. It was validated by entering membrane material parameters and geometries of previously published membrane systems into the finite element model, and computing membrane response. The numerical results predicted by each finite element model were then compared to the previously published experimental data for the actual membranes.

Wrinkle profiles were predicted using the new finite element models for membranes incorporating shear compliant borders, and were then compared to actual membrane response data obtained through the use of photogrammetry, a non-contact measurement technique that calculates three-dimensional surface deformation using still photographic images taken at a number of different camera locations. A fixture was designed that allows a known displacement to be applied to the top edge of a square membrane incorporating shear compliant borders, and was used to obtain membrane surface profile data. Good correspondence between the experimental data and the new finite element models was obtained.

Edge Discrimination in the NASA Rotating Probe System

Richard Nam Louie, Ph.D.
Department of Physics
Pacific Lutheran University
Tacoma, WA 98447-0003
E-mail: louiern@plu.edu

In the nondestructive evaluation (NDE) branch at NASA Langley Research Center, an electromagnetic Rotating Probe System (RPS) containing a giant magnetoresistance sensor element has been incorporated into a product. This probe can detect deeply buried flaws underneath installed fasteners (i.e., rivets) in aerospace structures. However, the instrument is more susceptible to error when checking rivets that are near edges, because boundaries strongly distort the paths of eddy currents that are generated by the magnetic drive coils. The resulting spurious spikes can overwhelm any signals due to currents that are diverted by actual flaws in the material. Rivets are used near metallic edges (e.g., lap joints in an airplane fuselage), so this problem must be addressed.

In this study, a discriminator scheme is presented that improves the performance of the RPS near boundaries, and does not significantly impact the number of false alarms. Several software-based filtering algorithms with adjustable parameters were implemented in Labview 6.1. One of the simpler ones is described next. This scheme establishes an angular window within which the undesired edge signal is expected to occur - based on the orientation of the probe with respect to the edge. It rotates the data (if necessary) to center the spurious signal within the window, and then replaces the data within the angular window by the average of the data outside. This scheme proves to be quite robust. It has enabled rivet checking in locations where previously the edge signal had overwhelmed the desired signal, and greatly speeds up the process of initial alignment.

As part of another project, external device control programs were written (using Borland's Delphi 5) for the Magnetic Properties Measurement System (MPMS), manufactured by Quantum Design. These software drivers act as conduits to other instruments, and enable current-voltage curves and resistance measurements to be taken vs. sample temperature. The data gathered complement the DC moment vs. magnetic field measurements that are the MPMS's primary function. Furthermore, the capability for a substrate-biased measurement was implemented. This will prove useful, because one of the current goals of the NDE group is to fabricate a carbon nanotube (CNT) tunnel junction between magnetic electrodes. By applying voltage to the silicon substrate (i.e., a back-gate), the CNT can be switched from an insulating to a conducting state. Substrate-biased measurements will not only yield fundamental information about materials' band structures, but will optimize the operations of these three-terminal switching devices.

These new capabilities were tested by making resistance vs. temperature analyses on some "smart materials": nickel-titanium shape memory alloys (SMA). The results of these studies determined the transition temperatures of each SMA sample between its martensite, austenite, and R phases. These temperatures were confirmed with another method, differential scanning calorimetry, also performed at NASA LaRC.

FPGA Implementations of Software algorithms

Wagdy H. Mahmoud
Electrical and Computer Engineering Department
Tennessee Technological University
Cookeville, TN 38505
E-mail wmahmoud@tntech.edu

Recently, The Field-Programmable Gate Array (FPGA) has become the medium of choice for the hardware implementations of computationally extensive algorithms like those found in DSP applications. FPGA implementations have proven that they outperform their respective software implementations by many folds. The FPGA are used to implement a system on a chip. However, they are not very efficient in implementing some mathematical operations, especially those that are used rarely in the code.

The programmable logic industry has recently realized the obvious; there are some mathematical operations that better be implemented in software. For example, the reconfigurable logic implementations of floating-point multiplication and division operations require an unreasonably large number of logic cells. Moreover, due to their reconfigurable paths, these algorithms perform poorly compared to their VLSI or software implementations. To improve performance, recently introduced FPGAs contain a large number of non-reconfigurable multipliers. The latest version of the Vertix Pro[TM] FPGAs contains RISC cores to allow software implementations of mathematical and logical operations. The addition of division and floating-point cores in the FPGA are expected in the very near future. This will allow the users the best of both software and hardware tools on the same chip.

To aid the development of systems on a chip, software tools like Microblaze and System Generator have been introduced. The Microblaze software allows the user to implement software algorithms written in the C language using a RISC core and user-defined peripherals in Harvard-style architecture. The implemented software algorithm(s) can be a part of a bigger application that is implemented using reconfigurable logic. The System Generator software combines the software capabilities of MATLAB[TM] SimuLINK and the hardware capabilities of Xilinx tools. The System Generator accepts MATLAB files as inputs and translates them into VHDL codes. The resulted code can be functionally simulated and synthesized. The System Generator allows the hardware designers to concentrate on the functionalities of the design instead of its implementation mechanisms.

In the past few weeks, an extensive study on the capabilities of the Microblaze and System Generator, and how to effectively use them for the implementation of the ADAPT system algorithms, was conducted. The ADAPT system design is an ongoing project in NASA Langley Research Center to produce the first reconfigurable board that is suitable for many of NASA Space applications. Some of the algorithms were designed and tested using Microblaze and System Generator tools. The two tools are new and both still under development and their features are constantly changing with new versions and patches that are announced every so often. The study concluded that, in spite of these difficulties, these tools are of tremendous values and will be widely acceptable in the near future.

Global Warming Potential of Green House (GH) Gas Release at Different Altitudes

Katta G. Murty (katta_murty@umich.edu)
NFFP, Atmospheric Sciences Competency
NASA Associate: Dr. William L. Grose
NASA Langley Research Center, Hampton, VA; and
Department of Industrial and Operations Engineering
University of Michigan, Ann Arbor, MI-48109-2117.

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Abstract

Many human activities involve fossil fuel combustion that releases GH gases. Emissions from ground transportation occur at earth's surface. Tall chimney's of power plants and smaller private planes release at higher altitudes. Subsonic jet aircraft release in the **UT-LS** (Upper Troposphere, Lower Stratosphere, altitudes of about 13 km). We investigate the short and long term effects on global warming of additional GH gases release at various altitudes.

Short term analysis ignoring atmospheric circulations indicates that the transient effect of a single release of GH gases on global warming, grows with the altitude of release.

Because of rapid mix up in the lower troposphere caused by circulations, there are only two altitudes to compare for longer term effects, the UT-LS, and anywhere in the lower troposphere. Jet aircraft flying is the only activity releasing directly in the UT-LS. Our limited computer runs took only H_2O releases into account, and did not consider the formation of condensation trails and cirrus clouds. They indicate that the present releases in the UT-LS cause a slightly larger reduction in the amount of terrestrial radiation escaping to space, than if they were to occur in the lower troposphere; suggesting that the northern mid-latitudes where majority of jet aircraft releases occur today is a sensitive region for such releases.

This suggests an important topic for further study. Polar ice melt at the north pole is faster than at the south pole. Whether the large volumes of jet aircraft releases in northern mid-latitudes are at least partly responsible for the faster ice melt at the north pole deserves investigation.

A Feasibility Study of Data Communications Options for Using Real-time Video to Remotely Pilot a General Transport Aircraft Model

B. Kennon E. Outlaw, Instructor
Department of Electronics Engineering
Norfolk State University
Norfolk, VA 23504
E-mail: **bkoutlaw@nsu.edu**

Loss of control from adverse conditions such as lightning, electromagnetic fields, critical system failures, etc. is believed to be the most common cause of transport aircraft accidents. Aircraft systems must be made robust enough to be immune from such effects, and if a failure happens to occur, must be able to automatically recover. One means of evaluating control algorithms and their effectiveness for recovery from adverse conditions is to conduct tests in a scaled down model of the actual aircraft. For safety and cost reasons, sub-scale aircraft models are frequently flown to collect data and to perform flight maneuvers that would be too risky for the full-scale aircraft. These models are normally scaled in size to produce dynamic characteristics that are as close as possible to the full-size aircraft.

A Remote Pilot Station has been proposed for NASA Langley's Systems and Airframe Failure Emulation and Testing Laboratory (SAFETI Lab) as part of the General Transport Model (GTM) project. A pilot on the ground in the SAFETI Lab at Langley will fly a 5.5% subscale model of NASA's 757 research aircraft 120 miles away at Wallops. The pilot will use simulated displays driven by real-time data from the Wallops ground station, and real-time monochrome video from a portable tracking station. Control data from the pilot's joystick will be sent to the model. My tasks within this project were as follows:

1. Evaluate methods for transmitting real-time video data from Wallops, and from other future remote test sites, to Langley.
2. Perform analysis of capability of existing land communications link for handling two-way model control data and video information.
3. Determine the feasibility of using wireless communications between a remote test site and Langley.

Known land communications options and wireless communications techniques were examined. Data transport delay considerations were also estimated and compared. A critical factor is the latency of the video data transmitted from the optical tracker to the Langley SAFETI Lab. To minimize this latency, video teleconferencing using satellite technology appears to be the best choice. Satellite communications has reasonable costs and low delays for the operating distances and remote test site locations anticipated.

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Experimental Determination of In-Fiber Bragg Grating Temperature Response Function

Devendra S. Parmar, NFFP 2002
Structures and Materials Competency, NASA Langley Research Center
Department of Mechanical Engineering
Old Dominion University,
Norfolk, VA 23529
E-mail: **D.S.Parmar@larc.nasa.gov**

NASA Associate: Dr. Robert S. Rogowski

Optical fiber Bragg gratings are excellent transducer elements because of their being integral to the light guiding fiber core. Reflection spectra of Bragg grating elements is of extremely narrow bandwidth. For this reason, Bragg gratings are particularly sensitive to temperature and mechanical strain. The temperature sensitivity is thought to arise largely from modulation of the refractive index of the fiber. The experimental fiber grating is written in the doped silica core.

In the reported experiments, temperature sensitivity of Bragg grating on a silica fiber without the plastic jackets is measured in a wider temperature range (10 − 350K). The experimental results are being analysed and explained in the frame work of the thermodynamic model in conjunction with thermal characteristics of the materials of fiber core and the cladding.

Study of Leuco Dye Systems for Use in Pressure Sensitive Paints and NMR Characterization of Poly (trifluoroethyl methacrylate-co-isobutyl methacrylate) Copolymer Base Resin

Dwight Juan Patterson, Ph.D.
Department of Chemistry
Middle Tennessee State University
Murfreesboro, TN 37132
E-mail: dpatters@mtsu.edu

Aerodynamicists are interested in developing inexpensive methods for the determination of surface pressures on aerodynamic objects for wind tunnel testing. Static pressure over the surface of airfoil bodies are currently determined by using pressure taps, which are drilled into the airfoil surface and connected via tubing to multiplexed electronic pressure scanners external to the wind-tunnel test section. Several methods are in development that provides a less expensive and convenient means for the determination of static pressure on airfoil surfaces. One such method proposed by Peterson and Fitzgerald in 1980, used oxygen quenching of fluorescent dyes (an optical pressure measurement technique) for flow visualization in wind tunnels. Optical pressure flow visualization is an active research area that relies on the development of a dye and resin package as the response luminescent package for used in the development and design of airfoils. Certain compounds (organic dyes, transition metal complexes and metalloporphyrins) emit light when excited by a suitable light source (photo-luminescence). The intensity of the emitted light is inversely related to the partial pressure of oxygen (oxygen quenched). The brighter an area appears the lower its pressure. An oxygen quenchable photo-luminescent compound is mixed with an oxygen permeable polymer to form a pressure sensitive paint, PSP. Organic dyes interact with polymer molecules and thus optical sensing properties strongly depend on the properties of polymer matrices. Polymer matrices that are oxygen permeable and low diffusion barrier for oxygen and high stability to photo-oxidation are desirable. Fluoro-polymers are one class of polymers suitable for use as binder resin.

Four batches of the poly (trifluoroethyl methacrylate-co-isobutyl methacrylate) copolymer was analyzed by ^{1}H and ^{13}C NMR. All samples were made via free radical polymerization techniques. Proton NMR showed the mole ratio of the trifluoroethyl ranged from 48 to 51-mole %, this close to the 50-mole % in the reaction mixture. The ^{13}C NMR resonances of the carbonyl peaks (177–174 ppm), quaternary backbone carbon (44-46 ppm) and the CH_3 (19-16 ppm, two different groups of methyl's) groups attached to the quaternary carbon show sensitivity to configurational and compositional sequences.

Dye system consisted of a Leuco dye (crystal violet lactone), an aromatic proton donor (bisphenol A, benzotrizole or 4-hydrocumarin) and a solvent (1-hexadecanol, 1-octadecanol or meth heneicosanoate). Formulations were developed that showed the ability the change from a colored state to a colorless state in the temperature range of 24 ^{0}C to 53 ^{0}C. The color of the dye mixtures ranged form a light blue to a deep violet. The most intense violet color developed with mixture containing crystal violet lactone (dye), bisphenol A (developer) and aliphatic alcohols (C-16 and C-18). Samples batches containing high solvent levels, developed a step color change behavior, going from violet to blue to clear.

Dr. Ronald J. Pollock, Ph.D.
Assistant Professor of Chemistry
Pennsylvania State University
Sharon PA 16146
(724) 983-2962
rjp4@psu.edu

Proposal for 2002 NFFP

<u>SAFE</u>   System Analysis-Failure Elimination

Continuous on line monitoring of fluids at real time is a proactive method of responding to a mechanical system before failure occurs. This is vastly different from an active response to a failed system. Proactive response is of obvious importance to safety in the transportation system. Presently, mechanical fluids are extracted, analyzed, tested, and then approved before each mission for military aircraft or after a failure occurs in other mechanical systems. A proactive system not only prevents failure but also is effective for monitoring performance, determining maintenance, and increasing the expected life of the mechanical systems. Fluids normally are changed according to need instead of a schedule. With SAFE fluids are changed when needed preventing excessive waste and disposal, which is critical when considering the vast economy of the automotive industry.

The purpose of SAFE is to analyze the mechanical system and its performance. Determining the properties of mechanical fluid is secondary but necessary for a critical interpretation of the operating mechanical system. An external real time multi-sensing system using x-ray fluorescence, infrared spectroscopy, and giant magnetoresistance (GMR) will determine fluid degradation, impurities, temperature, and fluid usefulness. The use of x-ray fluorescence is an innovational application for this system of measurement and is the primary work during NFFP 2002. The response time of x-ray fluorescence is in seconds enabling real time monitoring and it responds to metals present in the fluids. Through continuous monitoring and interpretation of data major system failure is prevented, location of failure is identified and engine history and wear is recorded.

The experimental work consists of developing a miniaturized safe detection system that is continuously operational in real time and external to the mechanical fluids. Present internal systems have a limited accurate response time or lifetime and need frequent cleaning or replacing. A window and port need developing for transmitting and receiving the informational signals. Particular aspects are an instrument that is safe, durable, vibration, and temperature resistant, and a non-radioactive x-ray source for x-ray fluorescence and a non-toxic durable window. After the system is in operation a knowledge-based trouble-shooting software is needed. The savings for SAFE are in catastrophic accident-prevention, increased reliability, excessive wear prevention, and selectivity in repair. It can be used as a Black-Box for the history of mechanical performance. If a wide market is achieved, it will have an impact on oil consumption, and the environment. An additional application for the development of x-ray fluorescence is elemental analysis of soils in future space exploration. This application was successful in the two Explorer Missions to Mars in 1976, and the new technological advancements make it promising for future exploration.

Some Aspects of Graphic imbedding into Mathematical Text

George Rublein
Department of Mathematics
College of William and Mary

Two related projects were undertaken during the term of the author's 10 week NFFP appointment.

1. Four weeks were occupied with the NASA-Norfolk State University Pre-service Teacher Institute (PSTI). Two two-week sessions, one beginning in May and one beginning in late July enrolled approximately 24 students each. The author's work with these students dealt mainly with navigation issues, including the fundamental geometric and arithmetic ideas required to address the the problem of finding locations with geometric data.

Use of the Microsoft Flight Simulator (FS) brought many of these ideas into a very practical realm. In a final exercise, students were required to employ standard flight navigation instruments together with standard FAA low-level Instrument Flight charts to locate themselves in unknown FS situations that had been prepared by the author.

2. Navigation is a central part of the author's text prepared for non-science students seeking to fulfill a mathematics requirement for graduation. As this text had been written largely at NASA-Langley some four years previous, the fellowship period was a timely opportunity for revision into completely electronic form.

Most time-consuming was the issue of conversion of manifold sources of graphics into a form suitable for imbedding into LaTex documents. With sometimes arcane methods, most, but not all of these documents could be converted, but some, (Hewlett-Packard Graphics Language) resisted. Work on the book will be completed before an October deadline.

Research to Support the Development of NASA/Code U-Related Resource Materials for Teaching High School General Biology

Emma M. Savage-Davis, Ed.D.
Middle Education Program
James Madison University
Harrisonburg, VA 22807
E-mail savageem@jmu.edu

NASA Headquarter Administrator Sean O'Keefe, through a speech given on April 12, 2002, stated his vision for educating student and teachers in the areas of mathematics, science and technology, which includes a statement that directs NASA to "inspire the next generation of explorers." This statement as well as the sentiments conveyed about education in his speech seemed to highlight NASA's renewed focus and support of education. As part of a joint venture of the NASA-Langley's Office of Education and NASA-Headquarters' Office of Biological and Physical Research, a study was conducted to ascertain the curriculum resource needs of high school general biology teachers in preparation for future resource materials that would integrate a traditional high school general biology curriculum and space exploration. The goal was to design a web-based survey that would allow general biology teachers to examine their knowledge, skills, and needs regarding resources that will enhance, remediate and/or support their existing science curricula relative to space exploration. The information was obtained through a survey, which was the preliminary stage for assessing the instructional and/or resource needs of Biology teachers. The research design was based on the ADDIE's model of (analysis, design, development, implementation, and evaluation), systematic design of instruction. This study was limited to high school general biology teachers and those associated with high school general biology curriculum. The web-based survey consisted of 21 questions including topics about: 1) familiarity with NASA-related educational materials, resources, and programs, 2) use of NASA-related educational materials, resources, and programs, 3) confidence level of integrating instructional materials within the classroom, 4) perceived need for classroom instructional resources to support or provide a more effective delivery of instruction, 5) ability to use technology applications, 6) priority of resource material delivery methods to suit individual classroom/curriculum needs, and 7) priority of Biology content resource materials to support or enhance current biology curricula. 465 e-mails were sent out to Biology teachers requesting their participation in a "very important venture" which outlined how their submission would be greatly beneficial to the results of this survey and provide teachers with the opportunity to be heard as NASA formulates a plan for developing a high school general biology resource. 150 were completed and returned via the web-based survey. This represented a 32% survey return rate. With the 32% survey return rate and the broad range of results it was determined that the sampling was valid and representative of the total biology teacher population. Survey submissions were received over a 3-week period from 42 states plus the District of Columbia. The student population represented from these submission were 72% Caucasian, 14% African American, 8% Hispanic/Latino, 5% Asian/Pacific Islander, and 1% American Indian/Alaskan Native, which is similar to the government statistics which shows that in 2000, 64% Caucasian, 16% Hispanic/Latino, 15% African American, 4% Asian/Pacific Islander, and 1% American Indian/Alaska Native. Some of the findings lead to implication that there first has to be a change in the mind set of general high school biology teachers from the more traditional or manually manipulated methodology to a more technologically enhanced paradigm to allow for innovative curricula growth. This can be done through training and support mechanisms for any technological resource that is developed, as well as providing a fundamental guide and/or website to support the resource. NASA should develop and maintain relationships with general educational organizations and present in their venues as well as remember to not design/create programs or materials in isolation from the target population because their knowledge, skill and experience are valuable.

Adaptive Structures Technology: What in the World is Going On?
A Survey of the State-of-the-Art Outside the United States

Mark D. Sensmeier, Ph.D., P.E.
Aerospace Engineering Department
Embry-Riddle Aeronautical University
Prescott, AZ 86301
E-mail: mark.sensmeier@erau.edu

NASA has taken a leading role in developing technology and concepts for 21st century aircraft, and a major thrust toward this is the Morphing Aircraft Program. Here, morphing is defined as "efficient, multipoint adaptability" and includes such approaches as micro-aero adaptive control, biologically inspired flight systems, and adaptive structural morphing which was the focus of this project. Langley Research Center has long been a leader in research and development of aircraft structures and materials. In recent years, NASA researchers have made substantial contributions to the field of adaptive structures and have helped shape the direction of activity within the U.S. However, there is evidence that great strides have been made by researchers in Europe and Asia, and that the U.S. might be losing its edge in the race to make morphing aircraft a reality. In response to this perception, this project was launched with the goal to review international (i.e. outside the U.S.) progress in adaptive structures, discover who the key players are and what innovative concepts are proceeding forward, and make recommendations to NASA (and its U.S. colleagues) regarding directions for future research and development.

Though this project was basically a literature study, the extremely broad scope required a substantially different approach than a classic literature review. Instead of "mining" deep into a particular problem, the aim here was merely to "skim the surface" of activity (though a very large surface indeed!). To this end, a number of sources were used: open literature, including conferences, journals, and books; patent office databases, including those in the United States, Europe, Japan, and International; government technical report and translating storehouses; and the Internet. Effort was made to include results from the academic world, government laboratories, and industry. This "dragnet" resulted in a database of 1700+ technical paper references, a number of relevant patent and patent application summaries, and an extensive list of organizations involved in the field and their primary areas of interest.

Extensive research activities were identified in Japan, Germany, the United Kingdom, France, Korea, Canada, Australia, Italy, Taiwan, Singapore, and lesser activities in nearly 40 other countries. The vast majority of the activity was focused on development of adaptive devices (e.g. piezoelectric sensors and actuators, shape memory alloys, optical fibers as sensors) and on active vibration control of structures. This was not too surprising, as development of efficient, powerful devices is prerequisite for their wide-scale application into vehicle structures. Very little activity was found in the area of systems-level design of flight vehicles incorporating adaptive structures. While this has probably been appropriate while devices have not reached maturity, it appears that the time may have arrived when the focus should begin to shift toward application studies. A number of commercially available devices are now on the market, many of which have power requirements which are low enough to begin to make them practical on a larger scale. And further effort on device development would be best accomplished with an improved understanding of what the requirements would be for a given family of applications.

Wireless High Voltage Sine Wave Generator

Mir S. Shirvani
Department of Electronics Technology
New River Community College
Dublin, Virginia 24084
E-Mail: NRSHIRM@nr.vccs.edu

A research for the development and design of a small lightweight wireless high voltage sine wave generator. This generator was intended to drive a unimorph ferroelectric actuator. The unimorph ferroelectric actuator was invented by a group of NASA's scientists at Langley Research Center. This actuator responds to a narrow band of very low frequencies with relatively high voltage amplitude.

After researching and examining all the possible options, the wireless system was designed and prototyped. The designed wireless system comprises of a transmitting boards and a receiving board. The transmitter board consists of a highly stable, low distortion, linear monolithic integrated circuit. This IC is connected as a variable voltage and frequency sine wave oscillator with a bandwidth identical to the bandwidth of the actuator. The output waveform of this oscillator acts as a control modulating signal and is applied to a miniature off-the-shelf FM UHF radio matching transmit module. The receiver board is comprised of a matching UHF receive module, a pair of high voltage operational amplifiers, and a pair of ultra miniature dc-to-dc converters. The receive module reproduces the control signal. In order to elevate the amplitude of the reproduced control signal to a sufficient level, a cascade configuration of high voltage operational amplifiers are used. The required high supply dc voltages for these amplifiers are provided by a pair of step-up dc-to-dc converters. The wireless sine wave generator tested, the required data acquired, and the results were promising.

Fiber Optic Sensing System

Charles A. Smith, Ph.D.
Chemistry Department
Our Lady of the Lake University
San Antonio, TX 78207
E-mail: smitc@lake.ollusa.edu

Dr. Robert Rogowski's research group in the Nondestructive Evaluation Sciences Branch has successfully developed a fiber optic strain sensing system (FOSS) that monitors strain at a multitude of sensing locations along a fiber optic cable. Due to the extreme sensitivity of the system, only a minute fraction of the light source intensity is consumed by the strain sensing measurements. Since a large portion of the light source intensity remains at the end of the fiber, a chemical sensing mechanism may be incorporated into the FOSS system. Chemical sensing may be used to monitor environmental degradation, aging, or presence/absence of specific chemical compounds.

There are several approaches to achieve this objective. Evanescent coupling may be the most direct and promising approach. Evanescent coupling occurs in a fiber optic when light in the cladding of a fiber couples with a specific chemical species located near the sensing region. Fiber networks that incorporate a long period grating (LPG) or taper are methods that may be applied to observe evanescent coupling. A second approach is the incorporation of a multi-path length sample cell or white cell into the fiber network. Research may be done on developing a network that utilizes both absorption and dispersion measurements that may further enhance the sensitivity of the sensing system. A third approach is fluorometric sensing. A drawback with fluorometric sensing is that light in the ultraviolet or visible region of the electromagnetic spectrum would have to be utilized which is not the frequency region currently being used in the FOSS system. The outcome of a dual-sensor (FOSS/chemical sensor) could potentially increase safety to the aircraft and pilot, enhance aircraft operation, and reduce inspection time.

Balance Function in Virtual Environments

Jonathan H. Spindel, PhD
Departments of Integrated Science and Technology
And Communication Sciences and Disorders
James Madison University, Harrisonburg, Virginia 22807
spindejh@jmu.edu

Virtual reality (VR) environments coupled to robotic systems can provide a means to allow humans to explore places that would otherwise be too dangerous, too costly or impossible to achieve in a direct manned mission. Using "tele-presence," humans can travel through microscopic and hazardous environments from the safety of a research laboratory. As with the deployment of aerospace and undersea technologies, however, these "tele-presence" systems present unique challenges to the human sensory system as it interprets and compensates for incoming information that can differ significantly from known experiences.

A key component to this sensory process involves the response of the balance system. Balance system function, in general, involves integration of signal from the inner ear (vestibular), visual and peripheral (somatosensory) nervous systems. Integration of these varied inputs within the central nervous system coupled to motor responses used for postural and visual system provides us with a sense of orientation, a stable visual field and functional balance. When visual, vestibular and somatosensory cues do not agree, as can be the case in virtual environments, the result can be disorientation and/or disequilibrium.

The goal of this research project is to gain a more complete understanding of the impact of VR environments on human balance system function. While in a controlled variable visual VR environment, objective non-invasive balance system measurements provide information on an individual's balance system performance. Results from this research will provide insight to the effect of VR environments on human balance system function, help to define the impact of these effects on immersed human operational performance, and aid in designing better immersive software and hardware for future VR applications.

A computerized platform posturography system (Balance Quest, Micromedical Technologies, Chatham, Illinois) is employed to obtain clinical data on human balance function and balance system performance within a CAVE virtual environment. The subject is immersed in a "virtual world" generated and projected by the CAVE hardware. For this study, a virtual sphere made up of cubes surrounds the subject's head. During testing, data is collected using sphere rotation in yaw, pitch, and roll axes. A variable pattern of rotations is also performed randomized in rotation direction and duration. Data collected using the platform posturography system provides information regarding subject postural sway and stability under standard baseline and CAVE generated test stimulus conditions.

Thirty subjects were tested for baseline balance system function and CAVE VR effects on balance function. All test subjects responded to the immersive effects of the CAVE virtual environment. Initial indications support the utility of this testing paradigm for the purpose of evaluating the effects of VR environments on human balance function. Continued study of these effects can lead to a better understanding of visual-vestibular-somatosensory system interaction within virtual environments and enable us to develop immersive applications that can better simulate real-world systems and furthering our understanding of how these sensory responses can be used to enhance "operator presence sense" within tele-present environments.

IDENTIFICATION, TRANSCRIPTION, AND EDITING
OF THE PRIVATE PAPERS OF WILBUR AND ORVILLE WRIGHT

Larry E. Tise, Ph.D., M.Div.
Wilbur and Orville Wright Visiting Distinguished Professor
Department of History
East Carolina University
Greenville, NC 27858-4353
e-mail: ltise@attglobal.net
Permanent address: PO Box 15782, Philadelphia, PA 19103
Phone 215.765.2418; Fax 215.765.2721

As we approach the first centennial of flight—that is, the anniversary of "the first manned, powered, controlled, and sustained flight of a heavier-than-air aircraft" by the brothers Wilbur and Orville Wright in 1903—there is a growing and renewed interest in telling the story of the Wright brothers; and in recalling it accurately, authoritatively, and with human interest. A review of the literature on the Wright brothers in 2000 indicated that there is a growing and abundant literature on the Wrights and their achievements.

However, as a result of an examination of the manuscript and photo collections of the Wright brothers at the Library of Congress, Wright State University, the North Carolina State Archives, the National Park Service Center at Manteo, NC, the Museum of the Albemarle, and the Outer Banks History Center at Manteo, NC, it became clear that a majority of the original sources concerning the activities of the Wright brothers in the period from 1900-1912 have never been published.

The thrust of the 2002 summer project has been to identify, photocopy, catalogue, transcribe, and document parallel collections to the writings of the Wrights—particularly unpublished materials in the Octave Chanute and George Spratt Collections at the Library of Congress; materials recently reorganized and recatalogued in the Wright Papers at the Library of Congress; photographic and map materials at the Outer Banks History Center; photographic materials at the Museum of the Albemarle in Elizabeth City; and other materials at Wright State University in Dayton, OH.

The documents thus identified and transcribed for publication depict a different set of Wright brothers than those known from prior publications over the last century. They are happy, gleeful, determined, miserly, sometimes separate and perhaps mean-spirited, and then totally embattled to protect what they think is their unique solution of what they called "the problem of flight."

This research activity is part of a larger goal to publish a definitive set of documents on the Wright experiences at Kitty Hawk in North Carolina, to publish a definitive edition of the private papers of the Wrights from the 1890s to the 1920s, and to enhance activities leading to the commemoration of the centennial of flight in 2003 in North Carolina and around the world.

The NASA Sci Files Television Series:
The Case of the Powerful Pulley and
The Case of the Shakey Quake

David S. Wright, Ph.D.
Physics Department
Tidewater Community College
Virginia Beach, VA 23453
E-mail:tcwrigd@tcc.vccs.edu

Helping children to understand and get excited about science is a challenge. Science seems very difficult to some, and boring to others. Elementary School teachers have training in some science fields, but lack a complete background. Many elementary schools are also lacking equipment and money for field trips. The information that students receive is often given in an encyclopedic manner, without practical application.

The NASA Sci Files is a television series designed for 3rd to 5th grade students. It is a one-hour show, produced by NASA Langley Research Center and broadcast nation-wide on PBS. Its problem based learning style helps students to see the application of science principles. The show is produced in a manner to make it fun, as a group of Tree House Detectives seek to solve mysteries using scientific principles. The show demonstrates how to use the scientific method in solving problems. The Tree House Detectives use a logical approach to get to the bottom of their mysteries. Experimentation, discussion with experts, field trips and a variety of activities make this show a very face paced, and informative presentation of science. There is a workbook and a website that accompany the show. These give a way for teachers to amplify and further investigate principles introduced in the show.

My task has been to research the principles of science that will be addressed. I have also been finding ways to present the material in an enjoyable and understandable way. I have also been involved as a member of a very talented team, who have lined up researchers, written script, and acted. The most difficult task of the project, for me, was to present the material very briefly, but in a comprehensible and scientifically correct way. We worked on two shows. We have almost completed the filming of one show, and have the second show completely written.

The first show, The Case of the Powerful Pulleys, involves an investigation of simple machines. We went to the Circus Center and Legoland, in addition to talking to NASA researchers. The problem of getting one of the kids up into their tree house was solved by combining pulleys, a wheel and axle and gears. In the process the kids reviewed principles of energy conservation and mechanical advantage. They also learned about safety and NASA's use of pulleys in two locations.

The second show, The Case of the Shakey Quake, looks at earthquakes, and other means of causing earth vibrations. The kids discover that their first hypothesis, that they discounted early on, is actually the solution. A trip to Dinosaur National Monument, a visit to an earthquake room in a museum in California, and conversations with JPL personnel and the USGS help them to solve the mystery. It doesn't end up being an earthquake.

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APPENDIX VIII

2002 NFFP ORIENTATION EVALUATION REPORT

2002 NFFP ORIENTATION EVALUATION REPORT

(Twenty-seven Orientation evaluations were returned - 75%.)

1. **Was the Orientation notification e-mail received in a timely manner?**
    1 - Poor - 0%   4 - Good - 5 (19%)
    2 - Fair - 0%   5 - Excellent - 20 (74%)
    3 - Average - 1 (4%)   No Answer - 1 (4%)

2. **Were the meeting facilities adequate?**
    1 - Poor - 0%   4 - Good - 6 (22%)
    2 - Fair - 0%   5 - Excellent - 21 (78%)
    3 - Average - 0%

3. **Was the Welcome Package beneficial?**
    1 - Poor - 0%   4 - Good - 8 (30%)
    2 - Fair - 0%   5 - Excellent - 19 (70%)
    3 - Average - 0%

4. **How do you rate the Program Breakout Session?**
    1 - Poor - 0%   4 - Good - 7 (26%)
    2 - Fair - 0%   5 - Excellent -20 (74%)
    3 - Average - 0%

5. **Was the information and knowledge gained at the Orientation helpful?**
    1 - Poor - 0%   4 - Good - 9 (33%)
    2 - Fair - 0%   5 - Excellent - 17 (63%)
    3 - Average - 1 (4%)

6. **In general, how do you rate this Orientation?**
    1 - Poor - 0%   4 - Good - 8 (30%)
    2 - Fair - 0%   5 - Excellent - 19 (70%)
    3 - Average - 0%

7. **Comments:**
    -Very good work to Debbie and her crew. –More breaks. Attention span is approximately 45 minutes. –Maybe combine the security and safety lecturer. –Thanks for the refreshments. –E-mail received in plenty of time. –Very nice facilities. –Very good overview of program. –Possibly put materials more in order of presentation. –The map was not that good. A more detailed area map would be helpful.

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DePriest, Hampton University; Murray, Old Dominion University; Berg, LARSS Intern through Hampton University

14. ABSTRACT

Since 1964, 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 and science faculty members spend 10 weeks working with professional peers on research. NASA HQs and the American Society for Engineering Education supervise the program. Objectives: (1) To further the professional knowledge of qualified engineering and science faculty members; (2) To stimulate an exchange of ideas between participants and NASA; (3) To enrich and refresh the research and teaching activities of the 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 consisting of lectures and seminars relevant to the Fellows' research.

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