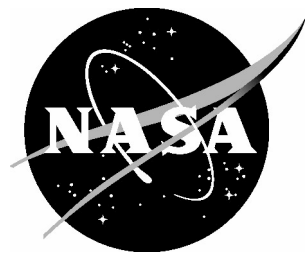NASA/CR-2005-213776

2004 ODU-HU NASA Faculty Fellowship Program

Compiled by:

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July 2005

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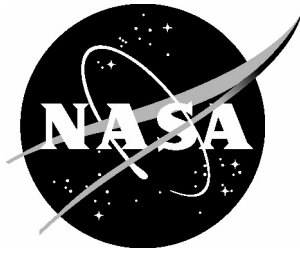
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SECTION 1

ORGANIZATION AND MANAGEMENT

The 2004 Old Dominion University (ODU)-Hampton University (HU)-NASA Langley Research Center (LaRC) NASA Faculty Fellowship Program, the fortieth 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.   Individuals were given ten days to respond in writing to the appointment. Once the letters of acceptance were received, a roster was sent to each 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 contacted by his or her Research Associate or representative of the branch.

Each Fellow and Research Colleague received a 2004 NFFP Guidance Manual that clarified many commonly asked questions up front regarding the roles, responsibilities, policies, and procedures of both parties. This manual was very beneficial and will be updated annually to be used in the years to come.

At the Orientation meeting, Mr. Edwin J. Prior, Deputy Director, Office of Education, provided a welcome on behalf of Dr. Samuel E. Massenberg, Director, Office of Education, and presented an overview of NASA Langley Research Center. Introductions of the Administrative Staff and a program overview were presented by Mr. Roger A. Hathaway, University Affairs Officer. The LaRC Security Office provided a Export Control and security briefing. Ms. Patricia G. Cowin provided a Safety Briefing. Mrs. Christina L. Fay, the Multimedia Education Center Coordinator, then briefly discussed LaRC's Multimedia facilities. Following a short break, an Information Technology Security Briefing was given by Mr. Geoffrey M. Tennille, Information Technology Security Manager for LaRC. 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 Program Manager) to meet with the 2004 Fellows to discuss administrative procedures and answer questions. Following the breakout session, the Fellows were greeted by their LaRC

Colleagues, who then escorted them to their respective work sites. An evaluation of the orientation meeting was completed (Appendix VIII).

Throughout the program, the NFFP Co-Directors 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 the Program Manager's representative in his absence. Site visits were conducted with selected Fellows and their NASA Colleagues 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. Six excellent papers were presented to the Fellows, Research Associates, and invited guests. For the eleventh 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 Officers' 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. Gregory Tait of Virginia Commonwealth University was the winner for the 2004 competition.

Each Fellow and Research Colleagues was asked to complete an online 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 2003 fellowship appointments and were eligible to participate for a second year. Out of the individuals responding to the invitation, eleven accepted offers of appointment (Table 1). Five Fellows from previous years accepted offers of appointment.

First Year Fellows

For the 2004 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 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 one hundred and eighty-three formal applications indicating the HU-NASA LaRC program as their first choice, and a total of seventy-three applications indicating the aforementioned as their second choice. The total number of applications received came to one hundred and fifty-six (Table 3).

Twenty-nine applicants formally accepted the invitation to participate in the program. Eleven applicants declined the invitation. Some years, Fellows delay 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. Fourteen positions were budgeted by NASA Headquarters (one slot was used to split fund two positions). Fourteen positions were funded by the LaRC Competencies, and two positions' funding was split between NASA Headquarters and the LaRC Competencies. (Table 4).

The average age of the participants was 45.6.

Table 1- Distribution of 2004 NFFP Fellows by Year in Program

Bar chart showing distribution of 2004 NFFP Fellows by Year in Program. Returnee: 11, Prior: 5, First Year: 13.

Table 2- Distribution of 2004 NFFP Fellows by University

Bar chart showing distribution of 2004 NFFP Fellows by University. HSI: 1, HBCU: 3, Majority: 23.
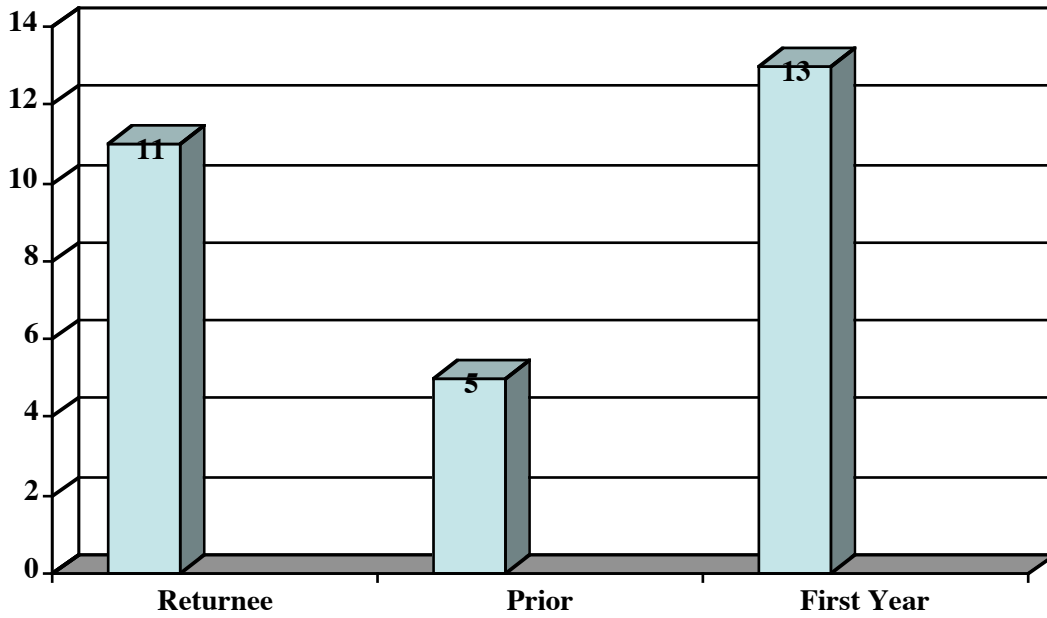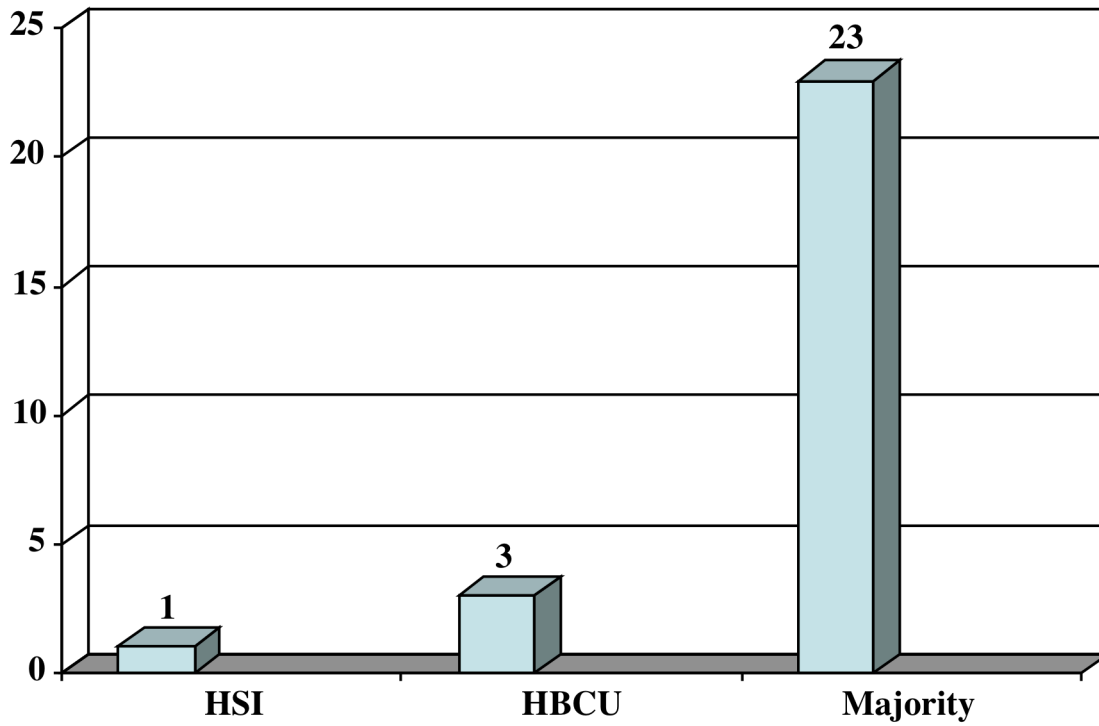
Table 3-Distribution of 2004 NFFP Fellows by Selection

	Accepted	Declined	Non Select
Value	29	11	116
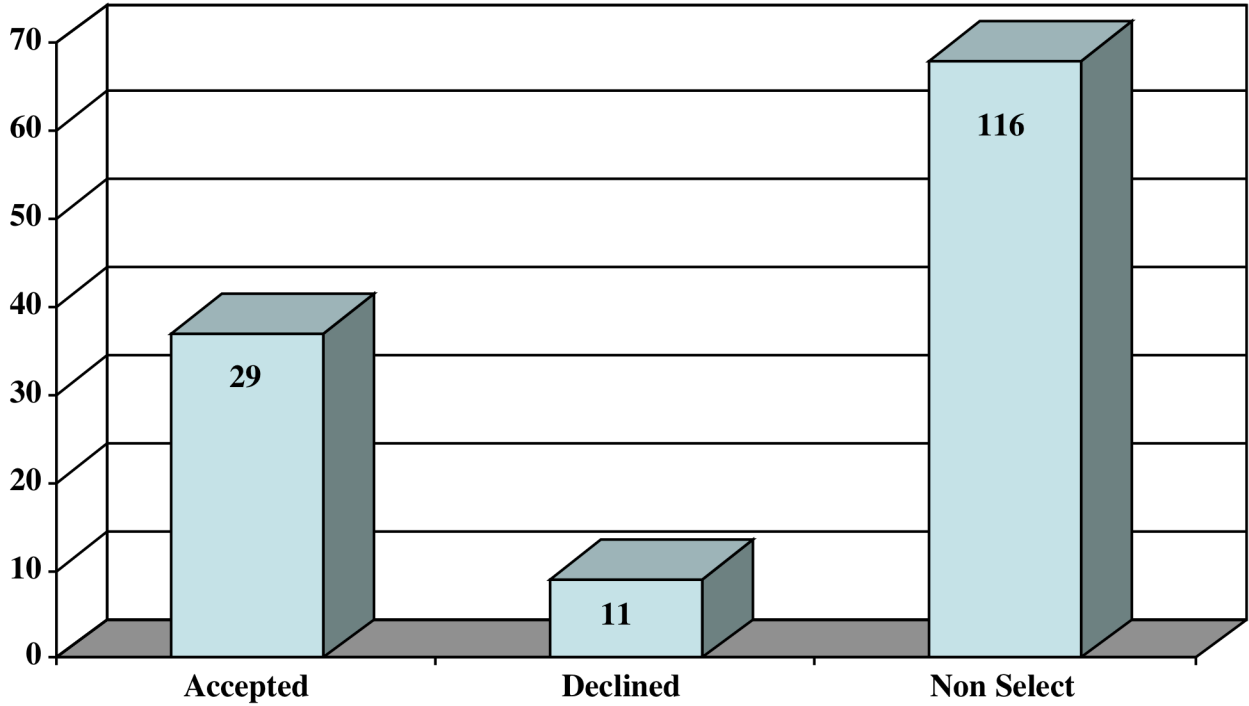
Table 4- Distribution of 2004 NFFP Fellows by Funding

	HQs	Local Purch.	Split
Value	13	14	2
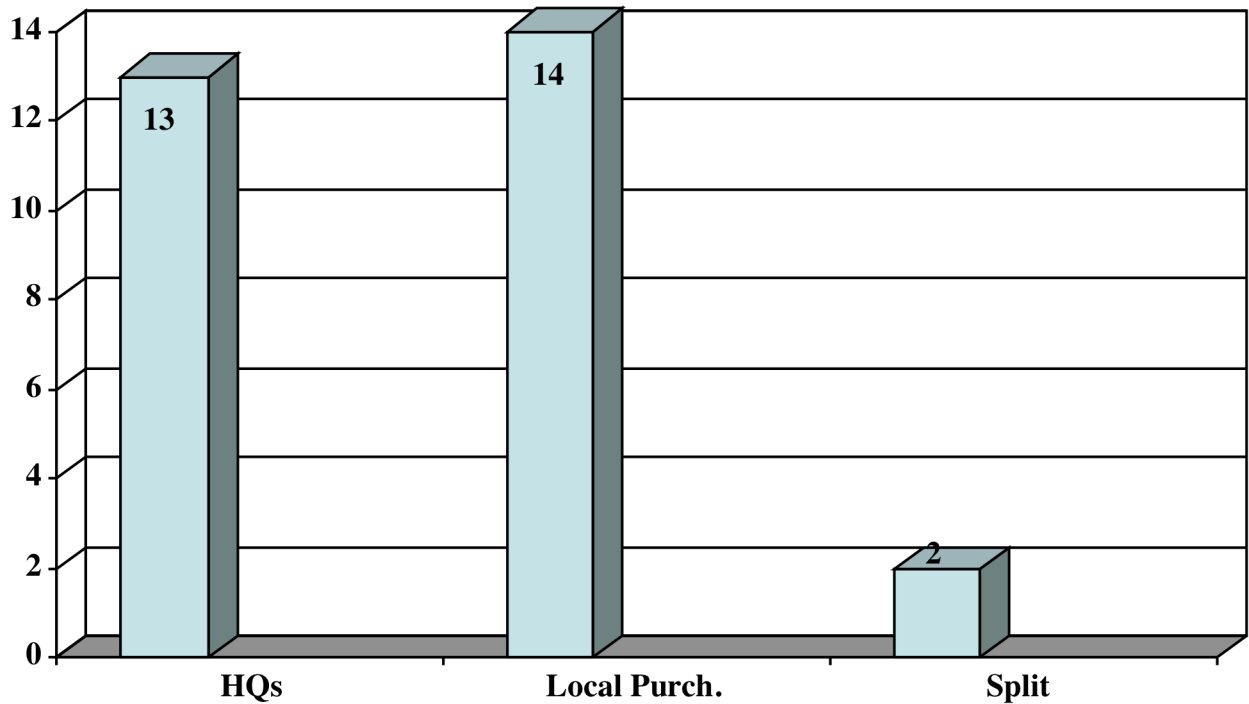
SECTION III

STIPEND AND TRAVEL

A ten-week stipend of $12,000.00 was awarded to each Fellow. Seventy-nine percent of the Fellows indicated that the stipend was sufficient to encourage them to participate in the NFFP program again, which continues to suggest that the importance of the stipend amount is quite significant. 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 HU 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.

SECTION IV

2004 NFFP ACTIVITIES

Lecture Series

The Lecture Series this summer was successful and well received. There were a total of six lectures presented. The lectures were given by distinguished NASA scientists and researchers. The topics included "The Search for Our Cosmic Roots: Earth, Mars, and Titan," presented by LaRC's Dr. Joel S. Levine, "Mars Exploration in the Coming Decades, " presented by LaRC's Mr. Prasun N. Desai, "Technology 'Future(s) (A 'Wave-Top' Tour through Emerging Technologies and Their Potential Applications and Implications)," presented by LaRC Senior Scientist Mr. Dennis M. Bushnell, "The Hyper X-43A…World Record Flight," presented by Mr. Vincent L. Rausch, "The President's New Vision" by Mr. Mark Saunders, Director of Space Access and Exploration Program Office, and a "NASA Engineering and Safety Center Overview," by Ms. Dawn M. Schaible.

Interaction Opportunity/Picnic

The annual Office of Education Interaction Opportunity/Picnic was held on Wednesday, June 16, 2004, for the summer program participants, their families, NASA Colleagues, 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 2004 NFFP design.

Proposal Seminar

A Proposal Seminar was held for the Fellows on Tuesday, July 6, 2004. Dr. Douglas DePriest, NFFP Co-Director, Hampton University, introduced the 2004 NFFP Proposal Seminar. Mr. Roger A. Hathaway, University Affairs Officer, Office of Education, gave a short presentation, "Grantsmanship 101" on the proposal process. The program covered both the NASA and the university perspectives. Ms. Karen Dempster, Old Dominion University Research Foundation, gave a few comments on the "Proposal Process from the University Perspective." Mr. Waldo Rodriquez, LaRC researcher and prior faculty member, shared his perspective from both views. In addition, he shared a copy of a successful proposal with very hands on helpful hints regarding the preparation process. Dr. Rex K. Kincaid and Dr. Eduardo Socolovsky, 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 Ms. Audree Hughes, Old Dominion University, Dr. Qamar Shams, LaRC, and Mr. Roger A. Hathaway, UniversityAffairs Officer.

Poster Session

For the first time, the Faculty Fellows were invited to participate in a Poster Session highlighting their research being conducted at NASA LaRC. The session was held in the cafeteria to achieve maximum exposure to Center employees. This activity was well received by all who attended.

Seminar/Banquet

On Thursday, August 6, 2004, a seminar/banquet was held for the Fellows and their spouses. The banquet took place at the beautiful Langley Air Force Base Officers' Club. NFFP end of the program information, certificates, and group pictures were presented to each Fellow at the banquet.

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.

SECTION V

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 Colleagues 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
3	Aerospace Systems Concepts & Analysis Competency
3	Airborne Systems Competency
2	Atmospheric Sciences Competency
1	Business Management
9	Structures and Materials Competency
3	Systems Engineering Competency
2	Earth & Space Sciences Program Office
1	AVST Program Office

Twenty-seven (93%) of the participants were holders of the doctorate degree and two (7%) held master's degrees. The group was again highly diversified with respect to background. Following are the areas in which the last degree was earned (thirteen different disciplines):

Number	Area of Degree
3	Aeronautics and Aerospace
2	Chemistry
1	Computers and Computer Science
1	Educational Technology
16	Engineering (including 1 Chemical, 3 Electrical; 1 Industrial, 5 Mechanical)
2	Mathematics
1	Operations Research
3	Physics

Extensions

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

Dr. Tarek M. Abdel-Fattah
Dr. Michael E. Baginski
Dr. Hari Bidasaria
Dr. Anthony Dean
Dr. José Granda
Dr. Rex K. Kincaid
Dr. Bretta King
Dr. Norman W. Loney
Dr. Patricia Mead

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 Colleague and the University Co-Director.

Short Courses, Seminars, and Conferences Attended

Dr. Michael E. Baginski: Presented Short Course, "Electromagnetics for Structural Engineers," SDB: June 24, 2004.

Dr. B. Terry Beck: 11th International Symposium on Flow Visualization, University of Notre Dame: August 8 – 11, 2004.

Dr. W. Elliott Hutchcraft: 2004 APS-URSI Symposium, Monterey, CA: June, 2004.

Dr. Dimitris Lagoudas: Morphing Wing Program Review, NASA Langley Research Center: July 15, 2004.

Dr. Mark D. Sensmeier: Morphing Wing Program Review, NASA Langley Research Center: July 15, 2004.

Dr. Eduardo A. Socolovsky: "2004 Applied Mathematics Summer Workshop, Delaware State University: July 9 – 11, 2004.

Mr. Thomas C. Spencer: VTEA Summer Conference, Richmond, VA: August 2 – 5, 2004.

Dr. Alfred Striz: 2004 NASA Vehicle Systems Program Annual Meeting, Atlanta, GA: May 11 – 13, 2004. 2004 ASEE Annual Meeting, Salt Lake City, UT: June 21 – 23, 2004. "Conceptual Design," Bernd Chudoba, NIA Fellow, University of Oklahoma.

Dr. Deonna F. Woolard: Thermosense XXVI, Orlando, FL: April 12 – 16. 2004.

Anticipated Research Papers, Proposal Submissions & Grants

Dr. Amos Lynn Abbott: "Image Processing for Autonomous Navigation and Control of Personal Air Vehicles" (NIA)

Dr. Michael E. Baginski: "Effects of Structural Deformations of the Performance of a Phase Alloy Radiometer," (IEEE, Journal of Remote Sensing) "Pattern Optimization for Large Phased – Array Antennas under structural Loading" (IEEE, Journal of AP) "An Analysis of Large Space-based Antennae Arrays under Structural Loading" (NASA) "Evaluation of Critical Performance Issues for StAR- Antennae Array Systems during Structural Deformation (DARPA)

Dr. B. Terry Beck: "A Resonant Pulse Detonation Actuator for High Speed Boundary Layer Separation Control,"

Dr. Hari Bidasaria: "Atmospheric Ionization and Human Exposure," (Advances in Space Research, COSPAR; Paris, France: July 18 – 23, 2004)

Dr. Vikram Cariapa: "Wear" (January, 2005) Patent Pending for Kimberly-Clark Corp.

Dr. Anthony Dean: "High Level Lunar Trade Space Definition and Analysis," (TBA)

Dr. Demetris Geddis: "Tunable Optical Brass Grating Filter Using Macro Fiber Composite Actuators," (Optical Fiber Communication Conference, September 14, 2004)

Dr. Winn Elliott Hutchcraft: "Investigation of Cost Effective Production of Polymeric Composites with Desired EM Characteristics," (NASA)

Dr. Rex K. Kincaid: "Scale-Free Networks: A Discrete Event Simulation Approach," (TBA)

Dr. Bretta King: "Using HALOE Data to Study Atmospheric Trends in HCl and HF," (TBA)

Dr. Dimitris Lagoudas: "MURI" (AFOSR) "MEANS II" (AFOSR)

Dr. Jack Leifer: "A Simplified Computational Model for Shear-Complaint Borders in Solar Sails," (AIAA SDM/GSF, April 2005) "Effect of Gravity on Ripple Amplitude Measurement in Sub-scale, Single-curved Parabolic Membrane," (AIAA-SDM/GSF, April 2005)

Dr. Norman W. Loney: "Surface Chemistry on Tin/Oxide Catalyst Sites," (NSF)

Dr. Roger Marshall: "Speech Interface for Reducing Pilot Manual-visual Interactions with In-flight Weather Information Systems," (Cognitive Linguistics Conference- Pending)

Dr. Mark D. Sensmeier: "Automatics Aircraft Structural Topology Generation for Multidisciplinary Optimization and Weight Estimation," (AIAA SDM, August 1, 2004)

Dr. Eduardo A. Socolovsky: "A Siddimilarilty Measure for High and Infinite Dimensional Data that Satisfies the Triangle Inequality," (IEEE) "Heirarchical Algorithms to Cluster Heterogeneously Distributed Data of Any Dimension," (IEEE) "Clustering Distributed and Other Large Scale Data Sets Containing Data of Arbitrary Dimensions," (NASA-FAR, NSF-CISE, ARO)

Mr. Thomas C. Spencer: "Geospatial Technologies," (Technology Student Association."

Dr. Alfred G. Striz: "Noise and Emissions Module Integrated Into PrADO," (AVSTO), "Intelligent Assistant for MDO in Conceptual Design," (AVSTO), "A PrADO Prototype for CDS" (AVSTO) "Cubesat Development," (Oklahoma NASA Space Grant), "Acquisition of an Itanium Cluster for Grid Computing," (NSF-MRI) "CDF and CSD Coupled Dynamic Parallel Sub-Domain Analysis Capabilities for Space Vehicles," (NASA Ames)

Dr. Harovel G. Wheat: "Piezoelectric Sensors for Corrosion Detection," (NSF) "Corrosive Effects of Alternative Fuels," (Texas Department of Transportation) "Composite Wrapping of Reinforced Concrete," (Texas Department of Transportation)

Dr. Mohamed Younis: "Accurate Achor-free Node Localization in Wireless Sensor Networks," (Globecom Wireless Ad-Hoc and Sensor Networks, Dallas TX: November 2004), "Efficient Aggregation of Delay-Constrained Data in Wireless Sensor Networks," (Workshop on Internet Computible QoS Networks, Cairo, Egypt) "Sensor Web for Lunar and Planetary Exploration," (NASA) "SPACEWIRE Based Fault Tolerant Architecture," (NASA) "Port Multiprocess optimization for Real-time Processes" (NASA)

SECTION VI

SUMMARY OF PROGRAM EVALUATIONS

Summary of Fellows' Evaluations, Comments, and Recommendations

At the end of the 10-week 2004 NASA Faculty Fellowship Program, Fellows were asked to evaluate their summer program experience.

The results 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	4.9
This Program was inspiring	4.9
Please rate the Program Overall	4.9
What kind of recommendation would you make to someone who asks you about applying to this program?	4.9
The methods used to announce the program were:	4.6
The procedures used for you to apply to the Program were…	4.7

Please rate the content and organization of the following program activities:

Research	4.6
Time allotted for Research	4.4
Technical (e.g., presentations, seminars, conferences, short courses, etc.)	4.6
Social (e.g., picnics, weekly lunches, dinners, etc.)	4.5
Administrative (e.g., orientation, on-site support, communications, etc.)	4.8
Center Specific (e.g., center overview presentation, tours, security briefings, etc.)	4.5

Please rate the interaction with your NASA Colleague:

Please rate the quality of the interaction between you and your Colleague	4.7
How likely is it that you will have a continuing research relationship with your Colleague	4.4

Research Outcomes – The following questions were also asked of the Fellows:
Have you developed new areas of research interests as a result of the fellowship?

YES <u>27%</u>   NO <u>73%</u>

Do you anticipate involving students in future NASA related Research?

YES <u>71%</u>

Note: Out of seven responding second or third year Fellows, a combined total of 164 students (134 undergraduate and 30 graduate) have already been involved in their NASA research.

Fellows' Comments

NFFP Fellows were also 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 to various questions. All responses from one faculty member are grouped together under one asterisk.

How could any of the activities be improved?
* The submission of proposals. There is not clear way in which to continue the relationship once we go back to our schools unless NASA would request a specific project or program under which we could continue with the graduate students once we are back.

* Technical presentations were generally at the General Public level, they could benefit with a little additional advanced technical detail.

* All of the activities were very organized. The only problem I had was entering the building (1230A) before 7:00 a.m. or after 5:00 p.m. We should have access to these buildings during the 6:00 a.m. to 6:00 p.m. time frame.

* As just a minor comment, it is my feeling that the orientation is overly focused on issues of safety. There are videos explaining how to walk on stairways, for example, but there was no mention of several things important to newcomers. Some examples: Where is the cafeteria? Where should I park my car? Can I access the library? Is there a gymnasium on the center? Do I have access to the Air Force base next door?

* Because we have only ten weeks in the program, it becomes challenging to schedule the ideal number of seminars to complement every faculty research project. Therefore a preliminary survey listing the very general topics that might be covered in the weekly seminars may help to streamline the presentations by NASA personnel to the Faculty Fellows and students during the ten weeks.

* I am very satisfied with the level of support and activities provided.

* I feel that the program should be 12 weeks, so that we could accomplish more in the area of research.

* I felt good about my entire experience at NASA. I thought there were too many things to do. They were optional though, so that was no big deal. It was unfortunate that there weren't more vegan activities since my colleague is a vegetarian.

* I found it difficult to confine my workday to not go outside of the 12-hour window from 6 a.m.-6 p.m. Specifically, I would have preferred not having to leave my office when I was in the middle of something, as well as not being able to come in prior to 6 a.m. This is a minor point, and I am not advocating a workday that would last more than 12 hours, nor am I advocating a workweek that exceeds 40 hours. However, sometimes research requires flexibility. The

program is already pretty short, so having the flexibility to keep going when things are working well would really help.

* I wish the time could be longer than 10 weeks.

* It is my understanding that the opportunities for follow-up grants in the form of unsolicited proposals are not good. This seems to be a real drawback, because my NASA counterpart and myself are very interested in following up on this work with additional research. The difficult preliminary work has been done this summer by me, and the project is now ripe for further investigation. Unfortunately, there does not appear to be a good way, from an administrative point of view, to pursue the work further. In addition, I understand that there is a strong chance that the NFFP program will be canceled, and additional NFFP opportunities will not be available. This is very frustrating to both my NASA counterpart and me, as all we want to do is continue the research and collaboration. Policies seem to be thwarting our continuance, and that is a shame.

* More formal information about submission of research proposals. More opportunities for discussions on NASA colleague's current research, recent publications, and presentations.

* NASA did an excellent job of providing information regarding proposal writing, and made a large resource pool available to all summer faculty members. All of my research colleagues were extremely helpful in providing guidance and providing the necessary equipment, laboratory resources, and advice whenever requested. The facility tours gave everyone a greater understanding of the entire mission of NASA and the immense scope of NASA's undertakings.

* Perhaps it would be useful to have different "tracks" for 1st, 2nd, and 3rd year faculty--at least in certain areas this might be useful.

* Possible continuation of funding the current projects is essential to help their success.

* The program activities were well balanced and thought out. No improvement is necessary.

* The program is fine. Nothing needs to be changed or added.

* The research and technical aspects of the program are top-notch. The social aspect is excellent, though only a minority of the faculty attended our weekly dinners...their loss! The only thing I can think to improve would be the initial (first-day) orientation. For one thing, those who are in the program for the second (or more) time could perhaps be exempt from some of the routine (safety, etc.) briefings. Also, the quality of some of those presentations could be better (particularly IT Security). The breakout session just for NFFP was very well run and informative.

* Too many non-technical activities (tours, pr seminars) resulting in about 6-7 days (out of 10 weeks) of unproductive work.

* While we received a seminar on proposal techniques, the lack of a mechanism to submit proposals directly to our NASA colleague's Branch or Competency is discouraging. 'Unsolicited'

proposals should still be allowed, and other means (contracts, MOA, consortiums) to continue research collaboration between our home institution and NASA LaRC need to be established and implemented.

What other activities would you like to see included?
* I would suggest that the program would have a component to fund at least one graduate student for one semester or for one year to continue the relation and turn a work product. The way it is there is not an easy way to keep continuity.

* Brief summary or tours (optional) of other participants' research would be interesting and might improve establishment of contacts.

* I honestly cannot think of any thing else that needs to be included.

* I understand that most of the presentations and technical subjects are naturally related to the host center. I feel that it would be useful to get some exposure to what other NASA centers are doing, even at a high level.

* If possible, it would be nice to use the recreational facilities available to the NASA employees.

* Mid-program seminar on research activities of other NFFP participants

* None. Any more activities would impinge on research time, and break the present good balance.

* PLEASE have people from each competency come and talk to everyone as a way to let people know what is going on in all the areas.

Please comment on any of the previous statements:
* I think this program is well served by the Staff that runs it. Ms. Debbie Murray does a fantastic job. It is clear to the participants that the staff acts as a team. Mr. Roger Hathaway, Dr. Douglas Depriest, Jennifer and others communicate well and make the program run.

* All documentations provided were very helpful and informative. The staff did their very best to provide us with every information.

* All of the information about the project itself, the housing opportunities available and what NASA expected me to undertake this summer were very clear and correct. To put it simply – "NASA was the perfect host".

* During the application process the staff was very helpful and could answer all of my questions.

* Getting assistance from NFFP Program Staff to help identify an appropriate NASA colleague contact prior to application is highly recommended.

* I was not happy with the person that I stayed with, but that was really no reflection on the program staff. I would suggest that in the future, if any faculty decides to go the route of living with a family, that they check with the family concerning what the family likes for inside temperature, cooking, etc. The lady I was living with kept the temperature at 78 and would not get her AC fixed until the program manager's husband came out to fix it.

* Since we are usually communicating over the air or via mail there is always a chance that information is not transmitted perfectly. However, based on my unofficial research, more than enough is transmitted between the faculty and his/her Colleague prior to arriving on site.

* The Program staff was extremely helpful, especially when my letter requesting confirmation did not arrive and they informed me they did not receive confirmation and provided a copy by email.

* The program staff did an excellent job in assisting with the application process. The information supplied was also very helpful and relevant.

* The whole process ran very smoothly.

* No one knows who is doing what or which program or person to ask. I understand to some extent this is the price of research but someone should have an idea on what each area is working on.

Please list any aspects of the Program you would change or eliminate.
* On the final presentation competition, I wish they would give awards to the first three presentations instead of one person taking all the awards.

* Comments on mechanisms for continuing research collaborations and for proposal submission are outlined above. This aspect of the Program needs to be strengthened.

* Eliminate the limit of 3 summers, in particular for minority and other mostly teaching schools from which it is difficult to obtain research funding. Research productivity rather than time should be used to determine repeated participation.

* I feel that the program should last a little longer- perhaps 12 weeks. So, that we may get more accomplished- research wise.

* I felt that there were too many activities that took away from the research and ability to network with the NASA colleagues, but each activity was well planned and executed and the experience would not have been quite as rewarding with out them.

* I recommend that nothing change. The program is fine currently.

* In my opinion, the program works very well as is. It has been optimized over many years, and has reached a state of maturity that makes it successful.

* More information from the some Competencies themselves.

* None!

* Some of the requested information applies in the future after we have had an opportunity to apply what we have learned during the summer. A follow-up would probably be necessary for this to really provide any useful information. A ranking (rather than picking only one benefit from a number of program benefits) would perhaps be more useful. I believe that all of the benefits listed would apply in my case, and it was very difficult to pick only one from the list.

* Too much bureaucracy involved in getting the needed equipment, software, etc.

This program was inspiring.
* The fact that NASA was receptive to the new modeling and simulation methods existent at our university that NASA does not have, made me feel appreciated. This will be the second year that I have held a class for any engineer and scientist interested in the Automatization of the modeling process. The class I taught last year was attended by about 20 engineers and scientists at Langley. The title of the course was: "Automating Modeling and Simulation of Dynamic and Control Systems Using the Bond Graph Method". I wish I would have the opportunity to teach this class for a week perhaps during the school breaks so that the technology will continue to develop and expand for the benefit of the NASA community.

* As a new faculty member just out of graduate school, this has been a great experience. It has allowed me to make new contacts with folks at NASA as well as other faculty members from various universities. I have been exposed to facilities relevant to my research. And, I hope to continue the research that I have been involved in this summer.

* During the academic year, my time is divided between teaching, advising, administration, and research. The NFFP provides an atmosphere for full-time research that I would be unable to experience at my home institution.

* I feel that the NFFP program is particularly important to both NASA and academia. In fact, with the "New NASA" working more with universities and contractors, I think this program will become more invaluable. It allowed me to know things that are important to NASA and what problems NASA is trying to solve.

* I feel that this program has really provided opportunities for me to delve into this research much more than would be possible just working part time. It was a complete immersion this summer and I thoroughly enjoyed it.

* I have been a Professor at Minority Serving Institutions (MSI´s) for the last 13 years. These schools have a heavy academic load: four courses per semester, committee assignments, and ´grantsmanship´. As a result there is little time or opportunity for research and even the faculty, like myself, with substantial prior research experience become non-competitive and outdated. This program provided the conditions and opportunity to conduct meaningful research and put me to work with very supportive NASA colleagues that actually introduced me to my present

research area. Furthermore, they provided the additional support for a full year sabbatical research leave. I owe to this program and the NASA colleagues I worked with, my reacquaintance with research.

* I really gained a great deal from this program. The workshops and seminars were very interesting and informative. Moreover, I was able to branch off into a new area of research. Not only did I gain a lot of valuable contacts here at NASA, but I learned a lot about atmospheric chemistry that can be used to strengthen a new course, that I developed, at my home institution. Also, I am inspired to develop 3 other courses based on the information that I learned this summer. I am sure that my research will result in a publication. At my home institution, it is very rare to have the time/opportunities to do the work required to publish. Also, our resources/instrumentation are lacking. The only opportunities that many of us have to publish are in the summer.

* I represent an undergraduate-only campus, and have found it difficult to "knock down the doors" in the traditional research funding world (i.e. NSF). Not only has this program allowed me to pursue my research interests during the summer, which of itself has been a great help towards the scholarly activity required for tenure, but it has enhanced my relationship with the research community as well as the stature of my university as not just an excellent teaching place but a place where top-notch research can be conducted. My first NASA Associate didn't even know that our campus existed. However, our research during that summer not only made her aware, but she has helped to spread the word and to increase our visibility and folks' impressions regarding the quality of research that our faculty and students are capable of performing.

* In the past three summers I have greatly increased my experience and background in optical measurements, in particular with the application of spectroscopic measurements. I have had the opportunity to work in a very much hands on setting to assemble with my colleague from the ground up a complete Planar Laser Induced Fluorescence flow visualization system, and to become experienced with all aspects of the measurement process associated with this technique as well as with other on-going research in which my NASA colleague is currently involved. It has without a doubt been (and continues to be) a very rewarding experience. We are currently discussing future collaborative research activities in conjunction with on-going research at my home university, and my NASA colleague is planning a visit there this fall. We have an application, which appears to be very promising in an entirely different area, and this came about as a direct result of my involvement here at NASA Langley and with the NFFP program.

* Interaction with NASA researchers, exposure to the different areas of SOA research at Langley Research Center, initiation into a new field of interest (noise and emissions) new ideas and materials to be used in the classroom ideas for proposals to NASA and other entities

* My participation in this program has provided me with a core research area in which I am now actively participating in all year. I've received funding to continue in this area from state agencies (Kentucky Space Grant), and have encouraged undergraduate participation through the NASA Reduced Gravity Flight program, in which I had students perform measurements that I learned here at Langley in Zero-g, aboard NASA's KC-135 in Houston's Ellington Field.

* My research interests and capabilities have been truly expanded, and I look forward to contributing further in exciting NASA projects.

* My teaching is done at a Private Liberal Arts Institution where my 80% of my time during the semester is devoted to teaching. Working at NASA has resparked my passion for research.

* Participation in the NFFP program proved to be a very valuable experience. The interactions with the NASA colleagues and the exposure to current on-going projects have given my research a new spin. While I have been conducting research on sensor networks, I have never entertained the possibility of employing such emerging technology in space exploration. During the summer I have gained significant insight and broad appreciation for the role sensor networks can play in space missions and the potential design requirements. I shall be taking my experience back to my graduate students and hopefully direct their interest in tackling the unique challenges. In addition, the NFFP program has given me the opportunity for establishing new collaboration forums that can further enrich my research productivity.

* Since my summer tasks at NASA were clearly delineated, there was little opportunity to experiment; I had hoped to expand on some of my own research plans that would have been mutually beneficial.

* The NFFP program allowed me to learn more about practical applications for lasers and fiber-optic components. I will transfer this experience to my students and it will influence my research objectives. Most important however, the fundamental application that this NASA branch pursues is in the area of environmental science. I consider the work to be of critical importance to achieving a sustainable society, and I know that this topic is inspirational for students as well.

* The overall experience this summer greatly enhanced my understanding of the complex issues that engineers and scientists must understand to properly design a deployable radiometer in space. Prior to my involvement with NASA, I have never considered the complexity of determining antenna performance for systems that were undergoing structural changes. The insight I have gained from this program is truly priceless.

* This program has helped me advance in the area of nano technology research. With the support of NASA equipment I was able to produce good and promising results through this project.

* This program reinforces the nexus between theory and its practical applications. This experience may generate some new ideas about how to make classroom material more relevant to students

* This program was valuable and inspiring in the sense that it provided me with an opportunity to have an "up close and personal" experience at a NASA facility. Normally, such experiences are ones you only get to read about or see on television.

* This program was very important, as it will lead to furthering the opportunities I will encounter as a person relatively new to academia. Current research has been with the DoD, the DoE, and VDMME and their various contractors. This has opened up contacts that I am quite sure not only

fit with my current research agenda, but will lead to future research across many differing government agencies.

* You have an amazing pool of talented people. I wish that you would go out and give lectures to young students in school and college.

* Things that I took for granted as being solved, are not the huge areas of research, and are mind-boggling. The things I want to do now are overwhelming. It will change the way I look at everything. It will change the way I talk to students and hopefully inspire them.

Please share additional thoughts or suggestions related to the administration and organization.
* During the Banquet when the certificates are issued, I think it is better to let the audience applaud as the candidates come along and not to request that the public hold their applause to the end. It makes the ceremony a bit cold and restricts the emotions of colleagues and in some cases families who come to accompany and see the participants receive recognition. This is not a major issue but will make everyone feel better.

* A great program, please, don't get rid of it. How else can faculty interact with top level researchers in a cutting edge environment, and then take that experience back to their home institutions and multiply the experience by passing it on to all the students they encounter during the next years. This type of program is vital to academia, both with respect to research and teaching.

* First of all I would like to commend the NFFP, the Office of Education at LaRC, and the ASCAC-SSB for their support and professionalism during my fellowship. Especially Debbie Murray, William Cirillo, and Douglas DePriest. During the fellowship period, my long-time companion passed away. Without their support, kindness and assistance I would have had to leave the program. I am eternally grateful for the outpouring of support that the NASA-LaRC gave me during that time period. Additionally, it has come to my attention that the NFFP is in serious jeopardy of not continuing. I URGE careful reconsideration of the cancellation of this program. The NFFP has given an opportunity for academia (especially young professors) to become involved in NASA programs/projects where otherwise they would not. The colleague who recommended that I apply to the program is an alumni of the NFFP. The impact it has made on his career is phenomenal - record promotions to Associate and Full Professor, excellent teaching evaluations due to the ability to translate his research to the class room, numerous awards and research grants and most recently the distinction of being honored with a Fulbright - the first in the engineering college's history. Opportunities like the NFFP are becoming very rare in academia, causing many of my peers (young PhD's just starting out) to seriously consider leaving college teaching. With out programs like the NFFP, NASA will never sustain a viable space program, because there will be a loss of the ability to generate the type of excitement that only a participant in programs such as this can take to the classroom.

* Forgive me if I am not informed about existing opportunities, but I hope that NASA will expand NFFP by also considering opportunities for one-semester internships. A primary

limitation is the short duration of the summer experience. A semester opportunity would help to alleviate this.

* I am disappointed to hear that NASA is no longer enthusiastic about funding unsolicited proposals from individual researchers at smaller institutions. I was looking forward to pursuing this research and submitting a proposal to continue the work at my home institution. I will still submit a proposal, but I am informed that NASA´s new funding policies make the chances of success rather slim. In any case, I will continue the research on my own, funded or not. It would, of course, advance the research at a more rapid pace if there were a grant involved. If NASA wants to support research at educational institutions, then it seems to me that a convenient policy needs to be in place. My NASA colleagues and I want to continue this research, but its very frustrating in identifying a means to do so.

* I do hope that this program is allowed to continue. It has been one of the most beneficial and rewarding educational programs that I have had the pleasure of being involved with. It has opened new doors of research capability and new possibilities of collaborative research. The level of cooperation at the NASA Langley Research Center, from my colleague, from the support staff, from the technicians, and from many other NASA researchers and personnel that I have come in contact with during my past three summers with the NFFP program has been nothing less than exceptional.

* I have had a very good experience, overall but there are a few things I wish had been different. For one, since IT has been given to a contractor, I had major problems with computer access. I had a computer my first day at the job, but I didn't have Microsoft Office installed for over a month. This is also true for my email account. It was a very big pain that I was not an administrator of my computer because for every little program that I wanted to install, I had to wait several days to get it done. The only other negative comment is that since I needed information from different people, sometimes I had to wait nearly a week before my question was answered and I could progress to the next step.

* I have heard rumors that the NFFP is "on the chopping block" for NASA cuts. I believe that this would be a grave mistake. This program is an excellent means for fostering the creative exchange between academia and the government that works for the benefit of both. NASA gains fairly inexpensive access to high-quality researchers, and the faculty gain the opportunity to interact with NASA's top researchers and explore often new avenues of research they might not otherwise have considered. In addition, the program is particularly beneficial for faculty who are early in their academic careers. Especially for those of us in smaller institutions where it's not possible to find an established researcher to "latch onto" existing funding, the NFFP give us the opportunity to get in the door and establish the kinds of relationships that can lead to new research directions and opportunities for continuing that research later. Even though I hope to continue my research through grants now rather than just summer NFFP experiences, I know several young faculty at my school and others who would benefit greatly by participating in this program. Please keep it going!!

* It will be useful to compile a NASA-wide NFFP-related abstracts and share them with the NFFP participants. It will be useful to know what other fellows did and baseline the experience of each individual faculty.

* Make it longer if possible. Try to find a little bit cheaper housing. More tours, I found out there are 16 wind tunnels here I would love to see more than one and maybe tour the structures labs or if any of the fellows are working in a lab have a tour of that. I loved this and hope I can come back if I can find where I fit.

* The NFFP program provides a valuable service to faculty at institutions lacking a strong research environment. At my institution there are only a few people interested in optimization applications. My time at NASA-Langley affords me the opportunity to speak with many researchers interested in optimization and its applications to a wide variety of key research questions.

* The program is a great opportunity to focus on research during the summer. The resources made available were excellent and I found that my colleagues here treated me with great respect.

* The program should not only be maintained, but expanded to maintain and promote year round collaboration. It should also be expanded to allow the participation of many more faculty. Research faculty are needed to produce competitive students trained in the most recent advances and technologies. Research faculty have a deeper understanding of their field and either develop or is familiar with real world applications. Funding at minority and other mostly teaching schools generally is in the form of 'Human Development' Grants and rarely is applied to fund faculty research.

Summary of Research Colleagues' Evaluations, Comments, and Recommendations

At the end of the 10-week 2004 NASA Faculty Fellowship Program, NASA Colleagues were asked to evaluate the program and faculty Fellows. Seventeen (63%) of the Colleagues responded to the evaluation request. This survey revealed that one hundred percent of the NASA Colleagues responding considered the program as a means of stimulating an exchange of ideas between faculty and NASA. In addition, ninety-four percent considered their collaboration with his/her NFFP Fellow a success.

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

Current capability to contribute to the research	4.6
Assessment of the Fellow's ability to contribute to future research	4.8
Quantity of research performed	4.5
Quality of research performed	4.6
Initiative to pursue the research	4.8
Ability to work independently	4.6
Ability to work in teams	4.6
Overall evaluation of the Fellow	4.6

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

I would recommend the Program to prospective Fellows	4.9
I would recommend the Program to prospective NASA Colleagues	4.8
Offering the program to educators is a good use of NASA resources (i.e. facilities, equipment, data, engineers, scientists, etc.)	4.75
The Program is a valuable experience for the Fellow	4.9
The Program was a valuable experience for me	4.7

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

How likely is it that the Center will use the results from the Fellow's research project?	4.5
How likely is it that a student accompanying the Fellow would be of value to the research project?	4.0

NASA Colleagues were asked to provide comments and recommendations relative to their participation in an effort to provide continuous improvement in the quality of the NFFP. The majority of the Colleagues cited specific successful research contributions with strong emphasis on continuation of the NFFP. Among the additional responses were the following:

"The especially useful part is the physical presence of both collaborators at the same location…allowing an exchange of ideas in real time!"

"The NFFP is an effective means of educating the University Personnel in the leading edge type of practical research that NASA is involved and provides the opportunities to form a cooperative relationship with the Universities for future research efforts."

"The influx of new ideas to the project has been invaluable."

"This interaction is one of the most effective ways to bring new ideas to the Center."

"The program is fantastic! I don't wish there to be any changes."

"By all means possible, please continue the NFFP program as it is useful for training NASA Colleagues/Fellows from fresh-outs to 40 year professionals."

"The NFFP should be expanded to allow participation of Fellows in a third year of research. The first year is generally developing the ability to do fruitful research or put together the required equipment. The third year would allow the Fellow to begin to enjoy and get meaningful results from the previous efforts."

SECTION VII

CO-DIRECTOR'S RECOMMENDATIONS

1. For forty years the NASA Faculty Fellowship Program (NFFP) has been a valuable and effective means of contributing to the research objectives of the NASA Langley Research Center. The effectiveness and utility of this summer's program are supported by the assessment and evaluation instruments completed by the faculty and their NASA research Colleagues, and are included in this report.

2. The Poster Session, a new required activity, was well received by managers, engineers, technicians, contractors, and faculty Fellows. This activity provided an opportunity for the faculty to show some of their research results to center employees. The session was held in the cafeteria during lunchtime to achieve maximum exposure and communication.

3. The informal luncheons following the lectures on Tuesdays were well attended. These luncheons provided the faculty participants the opportunity to discuss in depth the lecture topic and related topics with the guest lecturers. The Fellows were also encouraged to establish professional contacts that could aid and enhance their professional development.

4. With the Research and Development Interaction Opportunities (RADIO) awards, four faculty were able to attend and make presentations at professional meetings and to return to NASA Langley to continue the interaction with their Colleagues. This supported the dissemination of NASA research results to the public and the professional community.

5. Due to substantial program budget reductions by NASA Headquarters, the number of faculty Fellows will be drastically reduced next year. In addition, the university Co-Directors will not be used to support the reduced program in the near future. When these changes became known, the Center Director as well as many past and current fellows wrote letters of support for the NFFP to NASA Headquarters.

APPENDIX I
2004 NASA Faculty Fellowship Program Fellows

Name and Institution	NASA Associate & Competency/Program Office
Dr. Amos Lynn Abbott Virginia Tech	Mr. Gary A. Fleming Aerodyn., Aerothermodyn.., and Acoustics
Dr. Tarek M. Abdel-Fattah (P) Christopher Newport University	Dr. Qamar A. Shams Aerodyn., Aerothermodyn.., and Acoustics
Dr. Michael E. Baginski (P) Auburn University	Dr. Garnett C. Horner Structures and Materials
Dr. B. Terry Beck (R) Kansas State University	Mr. Paul M. Danehy Aerodyn., Aerothermodyn.., and Acoustics
Dr. Hari Bidasaria (R) Central Michigan University	Dr. John W. Wilson Structures and Materials
Dr. Vikram Cariapa (R) Marquette University	Mr. Warren C. Kelliher Systems Engineering
Dr. Anthony Dean Old Dominion University	Mr. William M. Cirillo Aerospace Systems Concepts and Analysis
Dr. Demetris Geddis Norfolk State University	Dr. Robert S. Rogowski Structures and Materials
Dr. José J. Granda (R) California State University-Sacramento	Dr. Lucas G. Horta Structures and Materials
Dr. Winn Hutchcraft University of Mississippi	Dr. Manohar D. Deshpande Airborne Systems
Dr. Rex K. Kincaid (R) College of William and Mary	Dr. Natalia Alexandrov Aerospace Systems Concepts and Analysis
Dr. Bretta King Spelman College	Dr. Margaret R. Pippin Atmospheric Sciences
Dr. Dimitris Lagoudas Texas A&M University	Dr. Thomas S. Gates Structures and Materials

2004 NASA Faculty Fellowship Program Fellows Cont.

<u>Name and Institution</u>   <u>NASA Associate & Competency/Program Office</u>

Dr. Jack Leifer
University of Kentucky

Dr. Keith W. Belvin
Structures and Materials

Dr. Norman K. Loney   (R)
New Jersey Institute of Technology

Mr. Michael Ruiz
Earth and Space Sciences

Dr. Roger Marshall
Bridgewater State College

Dr. Kara A. Latorella
Airborne Systems

Dr. Patricia Mead   (P)
University of Kentucky

Dr. Russell J. DeYoung
Atmospheric Sciences

Dr. Ollie Rose   (P)
Mount Olive College

Dr. Michael J. Hemsch
Aerodyn., Aerothermodyn.., and Acoustics

Dr. Mark D. Sensmeier   (R)
Embry-Riddle Aeronautical Un.

Dr. Jamshid A. Samareh
Aerospace Systems Concepts and Analysis

Dr. Eduardo A. Socolovsky   (R)
Norfolk State University

Mr. Ronnie E. Gillian
Systems Engineering

Mr. Thomas E. Spencer   (R)
University of Virginia

Mr. Michael Ruiz
Earth and Space Sciences

Dr. Alfred Striz   (P)
University of Oklahoma

Mr. Robert E. McKinley, Jr.
AVSTPO

Dr. Gregory Tait
Virginia Commonwealth University

Dr. Robert S. Rogowski
Structures and Materials

Dr. Ira Walker
Hampton University

Dr. Gregory S. Jones
Aerodyn., Aerothermodyn.., and Acoustics

Dr. Harovel Wheat
University of Texas - Austin

Dr. Robert G. Bryant
Structures and Materials

Dr. Deonna F. Woolard   (R)
Randolph-Macon College

Mr. K. Elliott Cramer
Structures and Materials

2004 NASA Faculty Fellowship Program Fellows Cont.

Name and Institution   **NASA Associate & Competency/Program Office**

Dr. David S. Wright   (R)   Dr. Thomas E. Pinelli
Tidewater Community College   Office of Education

Dr. Mohamed Younis   Mr. David A. Haakenson
University of Maryland - Baltimore   Systems Engineering

Ms. Gail Zlotky   Mr. Peter A. Padilla
Middle Tennessee State University   Airborne Systems

R-Designates returnees from 2003
P-Designates prior participants from earlier years

APPENDIX II

LECTURE SERIES

PRESENTATIONS BY RESEARCH FELLOWS

CALENDAR OF ACTIVITIES

2004 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 15	The Search for Our Cosmic Roots: Earth, Mars, and Titan	Dr. Joel S. Levine Atmospheric Sciences Competency Langley Research Center
Tuesday, June 22	Mars Exploration in the Coming Decades	Mr. Prasun N. Desai Aerospace Systems, Concepts, and Analysis Competency Langley Research Center
Tuesday, June 29 ***Early – 10:30 a.m.** **1 1/2 hour talk**	Technology "Future(s)" (A "Wave-Top" Tour Through Emerging Technologies and Their Potential Applications and Implications)	Mr. Dennis M. Bushnell Senior Scientist Langley Research Center
Tuesday, July 6	*No General Lecture – NFFP Proposal Seminar – See Calendar of Events* **NFFP ONLY**	
Tuesday, July 13	The Hyper X-43A…World Record Flight	Mr. Vincent L. Rausch Hyper-X Program Manager Space Access and Exploration Langley Research Center
Tuesday, July 20	The President's New Vision	Mr. Mark Saunders Director, Space Access and Exploration Program Office Langley Research Center
Tuesday, July 27	NASA Engineering and Safety Center Overview	Ms. Dawn M. Schaible Acting Manager, Systems Engr. Office, NASA Engineering and Safety Center Langley Research Center

2004 NASA Faculty Fellowship Program Final Presentations and Best Research Presentation Competition
H.J.E. Reid Conference Center
Tuesday, August 10, 2004   8:00 a.m. – 1:00 p.m.

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

Aerodynamics, Aerothermodynamics, and Acoustics Competency

8:10   "Vision-guided Autonomous Landing of Fixed-wing   Dr. Lynn Abbott
              Aircraft"   Virginia Tech

Aerospace Systems Concepts and Analysis Competency

8:40   "Automatic Aircraft Structural Topology Generation for   Dr. Mark Sensmeier
              Multidisciplinary Optimization and Weight Estimation"   Embry-Riddle Aeronautical University

9:10   Break

Airborne Systems Competency

9:20   "Development of a Staatistical Model for Path Loss   Dr. W. Elliott Hutchcraft
              Prediction in Aircraft"   University of Mississippi

Atmospheric Sciences Competency

9:50   "A Water Vapor Lidar System Study for the Altier   Dr. Patricia Mead
              Unpiloted Atmosphere Vehicle (UAV)"   Norfolk State University

10:20   Break

Structures and Materials Competency

10:30   "A Novel Tunable Solid-State Laser Transmitter for   Dr. Gregory Tait
              Interrogating Fiber Bragg Grating Sensors"   Virginia Commonwealth University

Systems Engineering Competency

11:00   "A Sensor Web for Mars Exploration"   Dr. Mohamed Younis
                                                                       University of Maryland- Baltimore County

11:30   Closing Comments   Dr. Douglas DePriest

              Photo and Lunch Instructions for Fellows   Mrs. Debbie Murray

Agenda Continued:

Presenters and Panel Members please remain for Group Photo.

All other Fellows are invited to go ahead to the Officer's Club after receiving a lunch ticket from Debbie. We will have lunch in the Commander's Room, which is to the right when you go in the front door. The food lines will be to the left from the front door. You will proceed through the lines to get your food. Once you have selected your meal, go to the cashier and give her your ticket. Return to the Commander's Room to eat your meal. You do not have to wait for everyone to arrive before eating.

11:40	Panel to Tally Scores
11:50	Photos of Presenters and Panel Members
12:00	Lunch for NFFP Fellows – LAFB O'Club
12:30	Special Presentations
1:00	Adjourn

2004 NFFP/LARSS/Summer Scholars Calendar of Activities

Date	Function (Additional Office hours, Tours, Site Visits TBD)
Monday, June 7	Office of Education Orientation Program – 8:30 a.m. H.J.E. Reid Conference Center, 14 Langley Boulevard NFFP Ice-Breaker – 4-6 p.m. - H.J.E. Reid Conference Center
Friday, June 11	**Office Hours**: Reid Conference Center – Wythe Room 11:30 a.m. – 1:00 p.m. (Picnic forms, T-shirt orders, etc.)
*Tuesday, June 15	Lecture-H.J.E. Reid Conference Center - *LARSS Pay Date* (Lectures begin at 11:00 a.m., arrive early for pay dates)
Wednesday, June 16	OEd Summer Programs Picnic-H.J.E. Reid Conference Center - Picnic Grounds - 4:00 - 8:00 p.m.
*Tuesday, June 22	Lecture-H.J.E. Reid Conference Center - *NFFP Pay Date*
Friday, June 25	NFFP International Space Station Briefing/Tour – H.J.E. Reid Conference Center – 8:30-9:30 a.m.
*Tuesday, June 29	Lecture-H.J.E. Reid Conference Center - *LARSS Pay Date* (**NOTE: This lecture begins at 10:30 a.m. – Arrive earlier for pay**)
Monday, July 5	Holiday
*Tuesday, July 6	NFFP Proposal Seminar-H.J.E. Reid Conference Center (Info To Follow)– *NFFP Pay Date*
Thursday, July 8	LARSS/NSS Graduate Seminar – H.J.E. Reid Conference Center – Details to Follow NFFP/LARSS Full Scale Wind Tunnel Tour at LAFB; 10-11:00 a.m. – Meet bus in front of Reid Center at 9:30 a.m.
*Tuesday, July 13	Lecture-H.J.E. Reid Conference Center - *LARSS Pay*
Wednesday, July 14	NFFP/NSS Flight Suit Photos – 9-10:30 a.m., Behind B. 1244 (Hangar) Walk to right of Bldg to the back
Friday, July 16	NSS Visit with North Carolina Central University – Details to Follow
Tuesday, July 20	Lecture-H.J.E. Reid Conference Center - *NFFP Pay Date*
Wednesday, July 21	NFFP Simulator Tour; 9:30-10:30 a.m.; Bldg. 1268; enter at side entrance headed towards cafeteria
Tuesday, July 27	Lecture-H.J.E. Reid Conference Center (Info To Follow)- *LARSS Pay Date*
Wednesday, July 28	NFFP R&T Competency Final Presenter Recommendations Due from Colleagues to Administrative Officers
Friday, July 30	NFFP R&T Competency Final Presenter Recommendations Due from Administrative Officers to Debbie
Monday, August 2	LARSS/NSS Poster Session – H.J.E. Reid Conference Center – Details to Follow
Tuesday, August 3	NFFP Poster Session – H..J.E. Reid Conference Center – Details to Follow – *NFFP Pay Date*
Friday, August 6	NFFP/LARSS/Summer Scholars Banquet-LAFB O'Club - 6 - 9:00 p.m. – Participants, Colleagues, and Mentors
Tuesday, August 10	NFFP Final Presentations and Best Research Presentation Competition-H.J.E. Reid Conference Center Followed by luncheon at LAFB Officers' Club (8:00 a.m. - 1:00 p.m.)
Friday, August 13	Last Day of Program - *Final NFFP/LARSS Pay Date* – Process Out for NFFP/LARSS/NSS – 2-4 p.m. – Reid Ctr.

APPENDIX III - GROUP PICTURE OF NFFP FELLOWS

2004 NFFP Group Photo Names:

Kneeling on front row:
Dr. Douglas DePriest, Co-Director, Dr. Vikram Cariapa, Dr. Anthony Dean, Dr. Ira Walker, Dr. Lynn Abbott, Dr. Demetris Geddis

Standing Middle Row:
Dr. Gregory Tait, Dr. Roger Marshall, Dr. Winn Hutchcraft, Dr. Deonna Woolard, Dr. Harovel Wheat, Dr. Bretta King, Dr. Pamela Jones (LFFP), Dr. Jose Granda, Prof. Gail Zlotky, Mrs. Debbie Murray, NFFP Program Manager, Dr. Patricia Mead

Standing Back Row:
Dr. Dimitris Lagoudas, Dr. David Wright, Dr. Tarek Abdel-Fattah, Dr. Mohamed Younis, Dr. Norman Loney, Dr. Mark Sensmeier, Mr. Tom Spencer, Dr. Rex Kincaid, Dr. Michael Baginski, Dr. Ollie Rose, Dr. Terry Beck

Not Pictured:
Dr. Hari Bidasaria, Dr. Jack Leifer, Dr. Eduardo Socolovsky, Dr. Alfred Striz

APPENDIX IV

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

Distribution of 2004 NFFP Fellows by University Rank

Rank	Count
AAAC	4
Professor	9
Assoc. Prof.	9
Asst. Prof.	9
Lecturer	2
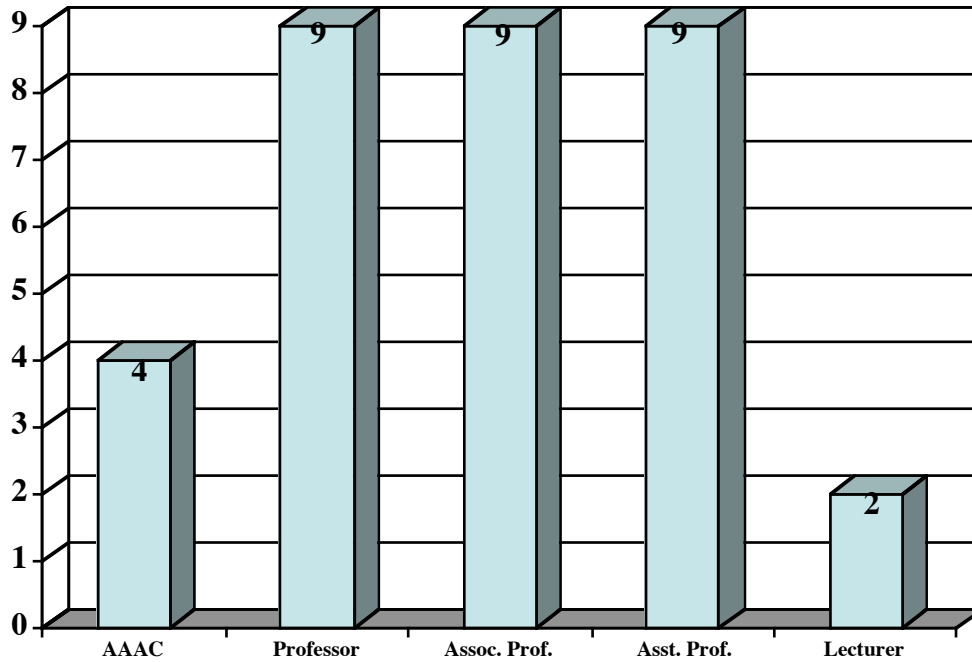
Distribution of 2004 NFFP Fellows by Competency/Program Office

Office	Count
AAAC	5
ASCAC	3
AiSC	3
AtSC	2
BMgt	1
SMC	9
SEC	3
ESSPO	2
AVSTPO	1
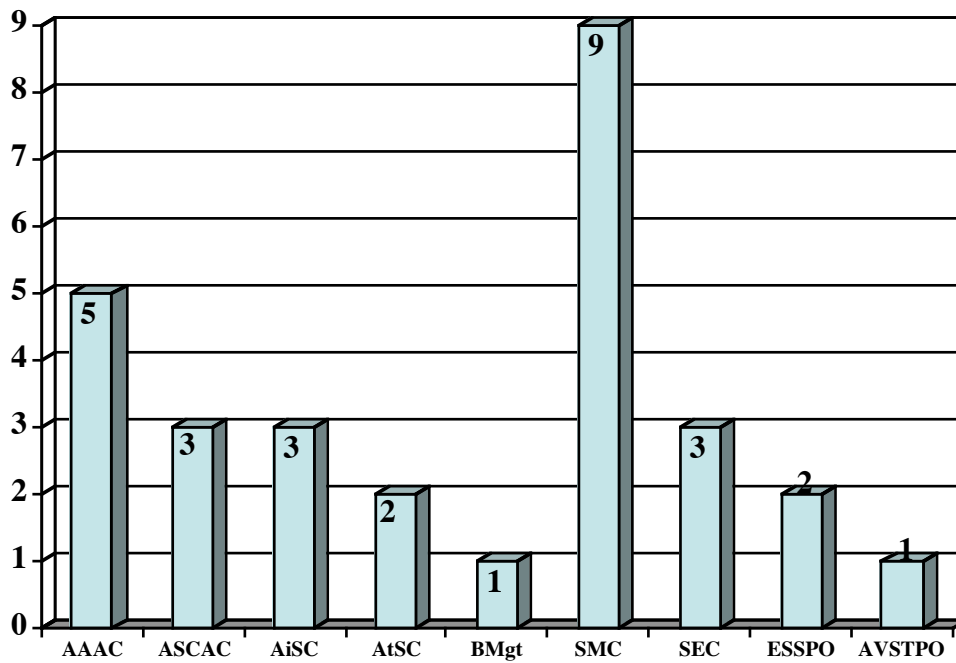
APPENDIX V

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

Distribution of 2004 NFFP Female Fellows by Ethnicity

5 Female Participants
(Represent 17% of all participants)
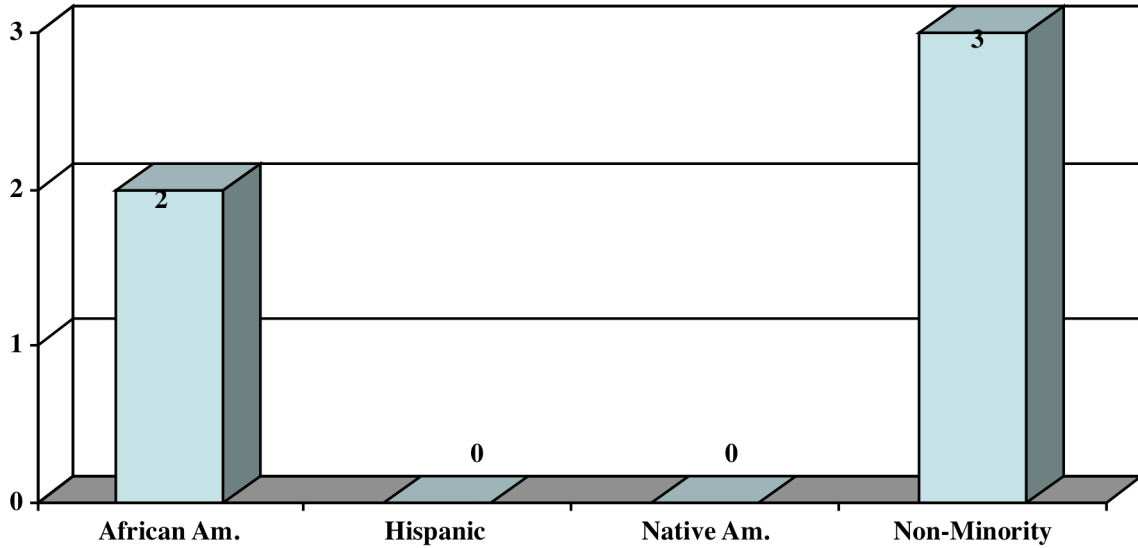
Distribution of 2004 NFFP Male Fellows by Ethnicity

24 Male Participants
(Represent 83% of all participants)
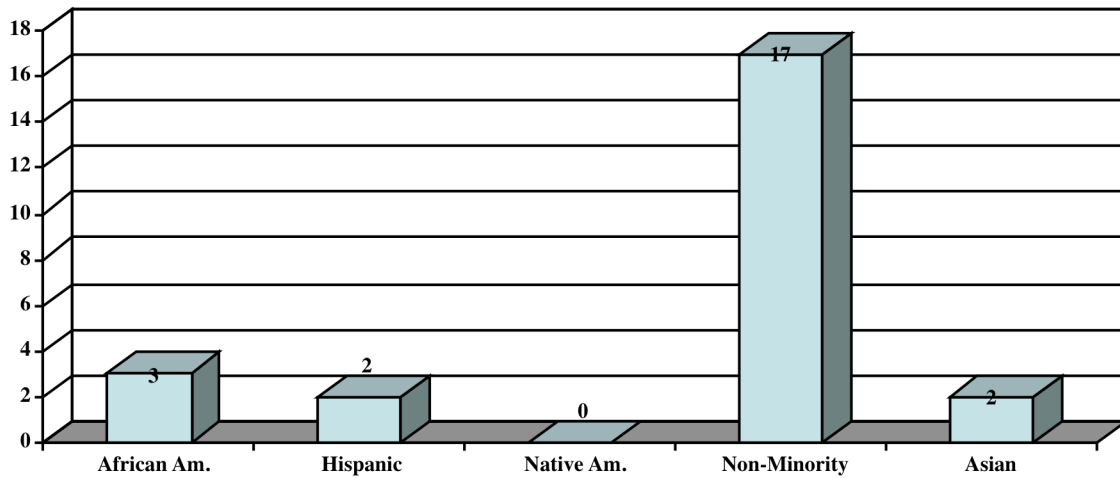
APPENDIX VI

2004 NASA FACULTY FELLOWSHIP PROGRAM
DISTRIBUTION OF FELLOWS BY UNIVERSITY PARTICIPATION

2004 NFFP SUMMER FACULTY FELLOWSHIP PROGRAM
DISTRIBUTION OF FELLOWS BY UNIVERSITY PARTICIPATION

UNIVERSITY/COLLEGE	NO. OF FELLOWS
Auburn University	1
Bridgewater College	1
~California State University- Sacramento	1
Central Michigan University	1
Christopher Newport University	1
College of William and Mary	1
Embry-Riddle Aeronautical University	1
*Hampton University	1
Kansas State University	1
Marquette University	1
Middle Tennessee State University	1
Mount Olive College	1
New Jersey Institute of Technology	1
*Norfolk State University	3
Old Dominion University	1
Randolph-Macon College	1
Spelman College	1
Texas A&M University	1
Tidewater Community College	1
University of Kentucky	1
University of Maryland – Baltimore County	1
University of Mississippi	1
University of Oklahoma	1
University of Texas-Austin	1
University of Virginia	1
Virginia Commonwealth University	1
Virginia Polytechnic Institute and State University	1

Total Number of Fellows	**29**
Total Number of Institutions Represented	**27**

*Indicates a **H**istorically **B**lack **C**ollege or **U**niversity (HBCU).
~Indicates a **H**ispanic **S**erving **I**nstitution (HSI).

APPENDIX VII

ABSTRACTS - RESEARCH FELLOWS

Vision-guided Autonomous Landing of Fixed-wing Aircraft

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The landing of an aircraft is the most demanding routine task that is faced by a pilot. After aligning the aircraft with a runway during an approach, the pilot must carefully control the position, orientation, and velocity relative to a touchdown point. For General Aviation (GA) class aircraft, the pilot attempts to follow a descent trajectory of approximately 3 degrees relative to the horizontal while maintaining a forward speed of 70 to 90 knots. Just prior to touchdown, the vehicle is taken to the verge of a stall condition as the pilot attempts to reduce the vertical distance, speed, and acceleration simultaneously to zero. Because of the difficulties associated with landing, a significant portion of flight training is devoted this topic alone.

In one view of the future, small aircraft will come to represent a viable alternative to automobiles as a means of affordable and convenient transportation. This, however, will require the development of novel sensing and control systems that significantly reduce the level of skill needed to operate these aircraft. A key component of such systems will be the capability for autonomous or semi-autonomous landing.

Several automatic-landing systems have been developed, but most of these rely on externally provided signals that are not available at all airports, such as ground-based radar beacons. And although the global positioning system (GPS) would seem to offer a good solution, altitude measurements obtained using today's GPS are not sufficiently accurate for the control of landing procedures.

A potential alternative to these systems is to use on-board cameras and computer vision techniques to assist in aircraft guidance, navigation, and control. As part of the Autonomous Robust Avionics (AuRA) program, researchers are developing techniques to augment and assist the pilot during landing, and to detect runway/airport hazards. My role within this effort has been to develop algorithms and software to locate the runway in digital images obtained during an approach. Preliminary experimental results have been obtained using image sequences from a camera mounted in the tailfin of an OV-10A aircraft. Future test flights will obtain stereo image sequences using cameras placed in both wingtips. Additional on-board inertial sensors will provide data needed to validate the vision-based results. This work is conducted by the Advanced Sensing and Optical Measurement Branch (ASOMB) of the Aerodynamics, Aerothermodynamics, and Acoustics Competency (AAAC).

Synthesis of Carbon Nanotubes Using Chemical Vapor Deposition

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Since the discovery of Carbon Nanotubes (CNTs) many applications have been proposed, including sensors, field emission displays and radiation sources, nanometer-sized semiconductor devices, probes and interconnects, conductivity and high-strength composites, energy storage and hydrogen storage media. Some of these applications are now realized in products [2]. CNTs have very large Young's modulus [1] and structurally dependent electronic properties [3]. Depending on their chirality, CNTs can be either semiconductor or metallic [3]. Silicon based devices are well-established technology. Combining the outstanding chemical and mechanical properties of CNTs with the mature silicon technology, we can anticipate preparation of hybrid materials owing the advantages of both materials. Therefore, we grow CNTs on surfaces of silicon-based wafers toward nanometer devices. CNTs are usually made by carbon-arc, laser ablation of carbon, or chemical vapor deposition (CVD). The CVD methods are attractive because of their ability to grow CNTs on any shape or size surface. The CVD system has been set up in room 209, building 1230 at NASA Langley Research Center. We have successfully used this system to synthesize CNTs on the surface of silicon wafer as shown in **Figure 1**. We have also successfully synthesized CNTs by chemical vapor deposition (CVD) of methane at 985 °C on supported iron based catalysts. The image indicates that the CNTs grow horizontally to the surface of the silicon wafer. These encouraging results could lead to develop controlled synthesis methods of CNTs on surfaces that are applied in nanoscopic integrated circuits for sensing devices.
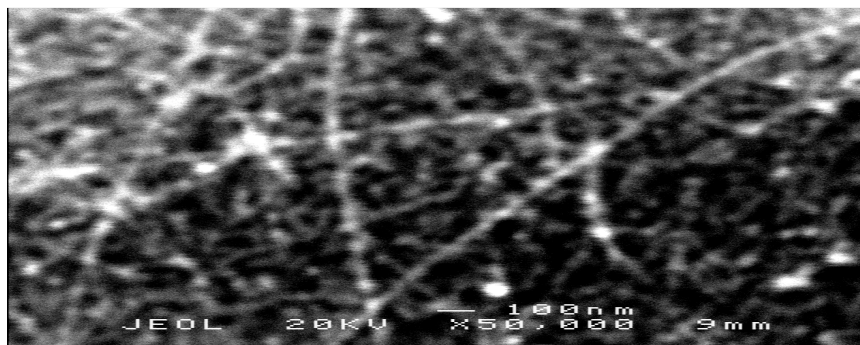

Figure 1. SEM Image of CNTs grown on silicon wafer using CVD method.

References
[1] Treacy, M. M. J.; Ebbesen, T. W.; Gibson, J. M. *Nature* **1996**, 381, 678.
[2] Wei, J.; Zhu, H.; Wu, D.; Wei, B. *Appl. Phys. Lett.* **2004**, 84, 4869.
[3] Louis, S. G. *Top. Appl. Phys.* **2001**, 80, 113.

A Study of the Effects of Structural Deformations on Array Antenna Performance

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The effect of structural deformations on the proposed phase array radiometer's antenna (STAR system) performance operating at 1.413 GHz (L-band) is a vital issue to the overall mission. If a highly accurate method of predicting and/or sensing the bending and rotation of all critical points on the STAR structure was available then the resulting radiation pattern could be accurately predicted. Additionally, this information would allow the antenna pattern to be reconfigured or "steered" back to the original shape through the use of mechanical actuators and electronic beam forming methods.

The STAR antenna system is designed using an ideal phased array antenna system with three 17 meter arms separated by 120 degrees in the x-y plane. Prior to embarking on detailed analyses of this very large antenna array my task in support of the project was to evaluate the STAR radiometer with arm length reduced to 2 meters while maintaining the same geometrical design. The system that was analyzed consisted of a passive 24 element phased array antenna system in a symmetrical 3 arm geometrical configuration with each arm separated by 120° in the x-y plane (8 elements per arm). The radiating elements selected were reduced surface wave (RSW) annular ring patch antennas having an element-to element separation distance of one wavelength (λ) and peak radiation intensity in the z-direction. My tasks in support of this project were the following:

 1) To develop an accurate model of the radiation pattern for the patch antennas (RSW).

 2) To incorporate the element model into an overall model of the STAR antenna and evaluate the antenna performance (24 elements) when dynamic and static loads were applied to the antenna structure.

The structural analysis of the antenna was done using a Finite Element Code (NASTRAN) for a matrix of nominal static and dynamic loads. The analysis provided necessary translational and rotational information ($\Delta x, \Delta y, \Delta z, \Delta\theta_x, \Delta\theta_y, \Delta\theta_z$) for the individual elements and allowed each antenna to be analyzed in it's rotated and translated frame thereby determining the individual element's electric field pattern for a given loading. The total antenna pattern was obtained via a complex mapping of each element's rotated and translated radiated field pattern into the main frame of the antenna system. Degradation in antenna performance was characterized for each mode by assessing the overall gain, main beam location and beam width, and three dimensional radiation pattern signatures for each case. The STAR antenna was found to have a maximum directivity of 227.19 at $\theta = 0$ degrees (no loading) and minimum directivity of 81 with the main beam centered at $\theta \sim 17$ degrees and $\phi \sim 270$ degrees (1g static load) with main beam splitting occurring at $\sim 0.4g$ static load. Dynamic loading showed the expected main beam wobbling (maximum $\Delta\theta \sim 2$ degrees) while maintaining very large gains ($\sim$120-140). The results of this study strongly suggest that the beam pattern is controllable using conventional methods. Furthermore, extending the arm length to 17 meters for satellite operations would significantly increase antenna performance in a controllable manner. Additionally, this antenna structure could be used as a synthetic aperture antenna for remote sensing purposes.

Optical Diagnostic Testing of a Resonant Pulse Detonation Actuator

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A variety of different types of actuators have been previously investigated as flow control devices. Potential applications include the control of boundary layer separation in external flows, as well as jet engine inlet and diffuser flow control. The operating principles for such devices are typically based on either mechanical deflection of control surfaces (which include MEMS flap devices), mass injection (which includes combustion driven jet actuators), or through the use of synthetic jets (diaphragm devices which produce a pulsating jet with no net mass flow).

The research involves the development of a relatively new type of combustion-driven jet actuator that has been proposed based on a pulse-detonation principle. The device is designed to utilize localized detonation of a premixed fuel (hydrogen-air) mixture to periodically inject a jet of gas transversely into the primary flow. This project is a joint research effort between the Hypersonic Air-Breathing Propulsion Branch (HAPB) and the Advanced Sensing and Optical Measurements (ASOMB).

Initial testing successfully demonstrated sustained combustion, and a number of different resonant modes have also been experimentally investigated using high-speed pressure sensors. Schlieren visualization of the pulsating jet structure has revealed axially symmetric vortex flow, along with the formation of shocks. The current work is focusing on the utilization of Planar Laser Induced Fluorescence (PLIF) flow visualization techniques to further investigate the physics of the combustion processes associated with the actuator device. A new windowed combustion chamber test section has been designed which allows visual access inside the actuator device during operation. This will allow both PLIF and Schlieren techniques to be used to further investigate the physics of resonant combustion and the onset of detonation, which has the potential of greatly enhancing the performance of the device.

ATMOSPHERIC IONIZING RADIATION AND HUMAN EXPOSURE

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Atmospheric ionizing radiation is of interest, apart from its main concern of aircraft exposures, because it is a principal source of human exposure to radiations with high linear energy transfer (LET). The ionizing radiations of the lower atmosphere near the Earth's surface tend to be dominated by the terrestrial radioisotopes especially along the costal plain and interior low lands and have only minor contributions from neutrons (11 percent). The world average is substantially larger but the high altitude cities especially have substantial contributions from neutrons (25 to 45 percent). Understanding the world distribution of neutron exposures requires an improved understanding of the latitudinal, longitudinal, altitude and spectral distribution that depends on local terrain and time. These issues are investigated in a combined experimental and theoretical program. This work gives an overview of human exposures and describes the development of improved environmental models.

Since the discovery of the magnetically trapped radiations, no new sources of natural radiations important to human exposure have been found (except of course those of the same classes in other planetary bodies). Even so, human activity has enhanced human exposures to natural radiations due to technological development. In this research work we give a quantitative presentation of the various components of natural radiations and the extent of human exposures. Special attention is given to the quality of the radiations involved as this also relates to the interpretation of the associated risks. Of particular interest is the comparison of the level of exposures and the quality of the radiation received by various groups of exposed individuals.

Annual neutron collective dose equivalents for various exposed groups.	
Category	Collective dose equivalent, person–
Occupational worker	338
Commercial aircraft	7.200

Our research addresses the issue of aircraft exposures and places it in the context of world population exposures. It becomes clear that among occupational exposures that the aircrews are among the most consistently highly exposed individuals. In addition, a large fraction of these exposures are from high energy neutrons for which there is inadequate biological response data. It is also clear from the adjoined table that aircrew are among the highest group exposed by neutrons as a result of their occupation. Still, the largest group exposures to neutrons are those living in the high-altitude cities for which the present study is of interest, especially in view of the uncertainty in the associated risk coefficients. The results of the present study for the development of the high altitude civil transport will reach beyond the objective of evaluation of the radiation safety of the associated operations to an improved understanding of the exposures of the world population which is of considerable interest (UNSCEAR 1993).

Development of a Portable, Variable Energy, X- ray Fluorescence System to Evaluate the
Constituents of Desert Varnish

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Requested that abstract not be printed.

Development of Systemic Methodologies to Address Level-0 and Level-1 Exploration Requirements

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The Vision for Space Exploration (Presidential Statement, January 14, 2004) asserts that NASA shall advance U.S. scientific, technological, security, and economic interests through a robust human and robotic space exploration program. Level-0 and Level-1 requirements, for the space exploration program, further state that NASA shall implement a safe, sustained, and affordable robotic and human program to explore and extend human presence across the solar system and beyond. The complexities of the Level-0 and Level-1 exploration requirements, as they are still very broad and minimally defined, suggest the development of the necessary framework supporting the development, refinement and clarification of the requirements so that:

1. Key program outcomes can be represented by separate independent variables.
2. These variables may then be quantified.
3. Relationships among these variables may be evaluated statistically, or through other quantitative methods.

By looking at the Mars mission in terms of long-term goals and objectives (Level-1), near term criteria (Level-0), detailed criteria and direction can be established to support the exploration requirements.

To support the Aerospace Systems, Concepts and Analysis Competency – Spacecraft and Sensors Branch (ASCAC-SSB) in the clarification, development and analysis of the Level-0 and Level-1 program requirements, my tasks were as follows:

- Participating member of the multi-Center NASA team, led by the Langley Research Center, established to assess mission implementation concepts for two broad lunar mission scenarios. The goal was to emphasize "breadth" of trade options assessed while providing sufficient "depth" of analysis to identify unique performance, risk/reliability, and affordability differences among the trade options. Specific areas of input were on risk/reliability and affordability.

- In furtherance of the analysis required, to support the research and study of Level-0 and Level-1 requirements, participated in the National Institute of Aerospace (NIA)/NASA Workshop on Uncertainty Characterization in Early-Phase Design, and attended relevant seminars and colloquiums at the NIA.

- Provided technical support to the Office of the Space Architect for various Space Exploration Studies and related products.

- Based on changes as suggested by President's Commission on Implementation of United States Space Exploration Policy, and specifically changes in the organizational structure at NASA Langley, as detailed in the Center Reorganization Team Report of July 09, 2004, was further tasked to research the salient literature regarding the structure of Highly-Technical/Research/Project-Oriented organizations and the impact of the organizational structure on project successes and outcomes.

Fabrication of Tunable Optical Fiber Bragg Grating using Macro Fiber Composites (MFC) Actuators

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The demand for high safety and reliability standards for aerospace vehicles has resulted in expensive and time-consuming periodic on-ground inspections. The inspections usually call for the disassembling and reassembling of the vehicle, which can lead to damage or degradation of structures or auxiliary systems. In order to increase aerospace vehicle safety and reliability while reducing the cost of inspection, an on-board real-time structural health monitoring sensing systems is required. These monitoring systems not only can reduce the amount of inspections needed, but also are capable of identifying the location(s) that indicate a need for examination. There are a number of systems that can be used to monitor the structures of aerospace vehicles. Fiber optic sensors have been at the forefront of the health monitoring sensing system research. Most of the research at NASA Langley has been focused on the development of Bragg grating-based fiber optic sensors. Along with the development of fiber Bragg grating sensors has been the development of a grating measurement technique based on the principle of optical frequency domain reflectometry (OFDR), which enables the interrogation of hundreds of very low reflectivity Bragg gratings. One drawback of the NASA Langley OFDR measurement system is the 1 – 3 Hz measurement speed, which is limited by the robust commercially available tunable laser.

NASA Langley's Nondestructive Evaluation Sciences Branch (NESB) has proposed the development of high-speed fiber stretching mechanisms to provide high rate tunable Erbium-doped optical fiber lasers. The branch has successfully stretched optical fibers using the thin-layer composite unimorph ferroelectric driver and sensor (THUNDER) piezoelectric actuator, and obtained 5.3-nm wavelength shift. To reduce the mechanical complexity needed to construct the THUNDER actuator, NESB has proposed to use the NASA Langley Research Center Macro-Fiber Composite (MFC) actuator to stretch Bragg grating based optical fiber. My task within this project were as follows:

1. Determine the amount of free-strain produced by the MFCs using a laser displacement meter.
2. Design different methods for attaching or embedding optical fiber to the MFCs
3. Test strain of the optical fiber attached MFC using the NASA Langley OFDR

The free-strains of MFCs were measured. Commercially available MFCs of different shapes and sizes were obtained and optical fibers were bonded to or embedded in the MFCs. The MFCs produced approximately 1300 -3100 ppm of strain in the optical fiber resulting in a 1.4 – 3.67 nm wavelength shift.

Concepts, Modeling and Simulation technologies for morphing airplanes and Space Structures.

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Predicting on earth the behavior of a new airplanes or space structures which can not be build on earth or that tests brand new technologies presents an engineering and scientific challenge. NASA's Morphing project and the International Space Station are examples of these.
These structures are composed of rigid bodies and flexible bodies, which are to perform as a single complete unit. In order to achieve the design, which will safely carry the astronauts into space and bring them back, engineers resort to making models on computers on earth in order to predict what will happen in Space. This research enables NASA engineers and scientists to fulfill their missions to carry man into space, to maintain the integrity of space structures, to understand the behavior under possible dangerous conditions and finally to inspect and repair the Space Shuttle and the Space Station miles above the earth.

The dynamics of rigid bodies such as airplanes, passenger vehicles, rockets etc is normally controlled by the solution of a set of time dependent second order differential equations. There are methods to find these equations such as Lagrange's method, application of Newton's Laws, and Hamilton's principle. The analysis of flexible bodies requires the solution of continuous media in the time and frequency domains using a set of partial time dependant three-dimensional differential equations. The research concentrates in discovering methods that will automate the generations of the mathematical models using new technology such as Bond Graph Modeling working hand in hand with methodologies which mix solid modeling, finite element modeling and dynamic analysis. The objective is to model and simulate the dynamics and control of the International Space Station (ISS). This requires knowledge of several, distinct engineering disciplines which must be combined to produce a clear picture of the dynamic behaviour of ISS and the new airplanes of NASA Morphing Project.

The task at hand is the study methodologies and evaluates the concepts that will assist in the evaluation and analysis of morphing concepts for flexible wings using computer simulation. The dynamic response of the International Space Station and particularly the new manoeuvres the Scuttle is supposed to do so that the astronauts can inspect it and repair it. Once in space, 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. The required new technology to obtain such models quickly and efficiently is being investigated at CSUS. This work has been done under the support of NASA Faculty Fellowship (NFFP) program in collaboration with NASA Structures and Materials Competency.

Development of a Statistical Model for Path Loss Prediction in Aircraft

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In this research, a power-law path loss model is developed to characterize an airplane's communications environment. The goal of characterizing the airplane environment is to aid in the determination of electromagnetic interference (EMI) of personal electronic devices (PED) with the communications equipment in commercial airlines. Cellphones, Wi-Fi network cards, Bluetooth devices, music players, etc. can contribute interference in the communications bands of the aircraft's navigation system. Each of these device's communication band is actually outside of the aircraft's communication bands; however, they still can have power output at these bands and this could lead to potential problems with the aircraft navigation systems.

The communications channel could be characterized by a deterministic or a probabilistic model. Typically, electromagnetic modeling of an object using the deterministic approach can become extremely CPU intensive. This is particularly true for electrically large objects such as airplanes. Partial differential equation (PDE) techniques such as the finite element method (FEM) and integral equation techniques such as the method of moments (MoM) could require several weeks to run simulations of aircraft. In addition, although this deterministic modeling would be very accurate, it would also be specific to the modeled environment. In this project, a probabilistic approach is taken; this is a much simpler approach and does not require nearly the same processing power as the deterministic model. Initially, a model had to be chosen so that the communications channel could be characterized. That is, how can we model the path from the antennas located on the exterior of the airplane to the interior cavity of the airplane where the PEDs would be located? The statistical model is obtained from the Friis transmission formula from antenna theory $P_{REC} = \frac{P_{RAD}}{d^2}\left(\frac{\lambda}{4\pi}\right)^2$. This equation is for free space propagation, so it is not accurate for our purpose since it does not account for the possibility of reflections from the ground, wings, etc. as well as diffraction from edges on the plane. The path loss model proposed introduces a random variable, n, into the Friis transmission formula such that $P_{REC} = \frac{P_{RAD}}{d^n}\left(\frac{\lambda}{4\pi}\right)^2$. This is done to characterize the losses in the channel and it is the parameter of interest in the statistical analysis. The analysis done here is based on measurements taken from one of Delta's Boeing 757-200s. Magnitude measurements were taken with a spectrum analyzer at different locations inside the cabin. Primarily, the measurements are taken at the windows and doors since these are the primary locations at which electromagnetic energy is expected to enter the cabin. The systems measured include the localizer, glideslope, VOR, TCAS, and ATC systems. Analysis of the measurements obtained from the different antennas will be shown and the resulting probability distributions will be discussed. Different distributions such as normal, lognormal, exponential, gamma, etc. will be compared to find goodness of fit with the measurement's distributions. Conclusions will be drawn from these statistical analyses and it is hoped that these analyses will allow possible methods of detection of PED devices or expected power levels for different aircraft.

Formation of Scale-free Networks: A Discrete-Event Simulation Approach

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Since 1997 at least six books and over 400 research articles have been written about scale-free networks. However, how scale-free networks organize is still far from resolved. Initially the focus was on preferential attachment models. These models left many researchers unconvinced and led to variety of competing models including biobjective optimization, dynamical systems and statistical mechanics.

In light of this we develop a discrete-event simulation to attempt to understand the organizing principles behind scale-free networks. The simulation begins with a set of randomly generated points on a square. Each point (node) is assigned a weight generated from a statistical distribution. We think of the points as cities and the weights as a relative population measure. We call the entities that drive the simulation planes. Initially each plane selects one of the points as an origination node (O) and one as a destination (D) node. If the Euclidean distance between O and D is larger than some user specified threshhold then the flight route must go through an intermediate point (H for hub). H is selected from a set of candidate points by comparing the total weighted travel distance (O to H to D) for all combinations of H with O and D. When a simulated flight is completed a new O/D pair is selected.

During the simulation three pieces of data are collected. The number of times a given point is selection as an O, H, or D (called the hit distribution) is recorded. The number of times a flight leg is traversed between each possible pair of points is recorded. If there are n points then there $n(n-1)/2$ possible flight legs. Lastly, the number of times each point is a node of a distinct flight leg (called the degree distribution) is recorded. Upon completion of the simulation a log-log plot of both the cumulative degree and hit distributions are plotted. If the tails of either (or both) are roughly linear then there is evidence that the underlying network is scale-free.

We found that population size diversity and O/D selection diversity was not enough to form a scale-free network. It was necessary to include a fitness value associated with each point. The fitness values are assigned to each point by a separate simulation. During the simulation the fitness of a point is increased by 10 percent each time it is selected as either an O or D node. At the end of the simulation run the log-log plot for the cumulative distribution of the fitness values is nearly linear. We include these fitness values as inputs to our original simulation model in the selection of D and the selection of H. The resulting log-log plots of the cumulative fitness and hit distributions are nearly linear. Consequently, the resulting network structure is likely to be scalefree. Future developments will include the congestion effects due to queuing delays.

'Upper Atmospheric Concentrations of HCL and HF and Their Role in Ozone Depletion'

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HALOE, the Halogen Occultation Experiment on the NASA Langley Upper Atmospheric Research Satellite (UARS) measures global ozone as well as the chemicals involved in its destruction via solar occultation limb sounding. HF and HCl concentrations are measured from the upper troposphere to the lower mesosphere on two HALOE channels centered at 2.45 microns and 3.4 microns, respectively. These measurements furnish data in regard to stratospheric chlorine input /origin and also atmospheric dynamics. The analyses of HCl/HF ratios over time can disclose the amount of chlorine in the stratosphere that is due to anthropogenic sources. HALOE was the first instrument to establish the effect of mankind on the amount of ozone-destroying chlorine in the stratosphere.

Effective Mechanical Properties of Carbon Nanotube Composites

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Composites reinforced with carbon nanotubes (CNT) are being considered for the aerospace industry and NASA future missions due to their promise of high strength, stiffness to mass ratio and multifunctionality. The focus of my research has been on modeling issues related to mechanical properties of carbon nanotubes and CNT composites. There are three stages associated with modeling: First the elastic properties of CNTs are estimated using ab initio calculations in conjunction with a linear classical lumped-mass-spring system model. Quantum mechanics calculations are used to determine the vibrational frequencies and mode shapes of CNTs which are used to identify the stiffness matrix of the lumped-mass-spring system, and subsequently, the elastic modulus of the CNT. A lattice based continuum mechanics formulation is then introduced in which thermodynamics is used to develop the constitutive behavior of CNTs. Finally, continuum level elastic properties for CNTs and CNT reinforced composites, with appropriate input from the atomistic length scales, are examined through a variety of analytical and numerical micromechanics techniques. In particular, the quantification and modeling of clustering in aligned CNT composites has been undertaken.

During my summer at NASA LaRC a group of researches has been put together from NASA, Texas A&M University and Rice University, to investigate the different aspects of fabrication, characterization, testing, and modeling of CNT composites. Extensive testing and characterization of fiber glass composites with epoxy and vinyl ester matrix and with different dispersion of CNTs is being conducted; in particular nanoindentation and DMA experiments are being performed. The future plan is to fabricate additional composite specimens with carbon fiber reinforcement and with a variety of volume fractions of CNTs that will then be tested for their mechanical stiffness, shear strength and fracture toughness. The plan is to use the testing and characterization results to verify some of the models for nanocomposites being developed at NASA LaRC and at Texas A&M University.

In addition to CNT composites, I have also been involved with modeling of leakage in cryogenic composites due to damage development under thermomechanical loads. In the experimental phase of this work, leakage of hydrogen gas through a composite laminate was measured using NASA Langley's permeability testing system. A simplified model, as well as detailed finite element analysis has been used to estimate the effective permeability of the damaged composite and compare with the experimental results. The simplified model predictions have been validated for accuracy by comparing them with the numerical simulation results. Model predictions of hydrogen leak rates at different mechanical loads, cryogenic and room temperature are eventually compared with the experimental measurements.

A Simplified Computational Model for Shear Compliant Borders in Solar Sails

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WORK is continuing at NASA towards the goal of advancing solar sail systems to a Technology Readiness Level (TRL) of 6, which requires testing and validation of scale–model prototypes in relevant environments. Many of the proposed designs for solar sails envision a square geometry of up to 100 m per side, comprised of triangular quadrants fabricated from thin–film material and attached to lightweight booms at their corners. Sails of this type are currently being designed under the aegis of the NASA In–Space Propulsion Program. One difficulty associated with the tensioned membranes that comprise the sail is the formation of ripples, or reversible structural (elastic) wrinkles, across the surface of the sail. These ripples occur when the membrane is not maintained in a state of biaxial tension, and generally correspond to regions where σ_2, the second principle stress, becomes slightly compressive. The amplitude and extent of such ripples across the membrane can be reduced by the use of an integrated shear compliant border, such as that first described by Talley et al. of SRS Technologies (Huntsville, AL). The SRS shear compliant border consists of thin, thermoformed regions integrated into a membrane normal to its edge. Shear compliant borders maintain the membrane surface in a state of biaxial tension by absorbing the bulk of the applied shear, and hence reduce the formation of ripples. While it has been demonstrated that shear compliant borders can effectively maintain a state of biaxial tension over the entire surface of a membrane, computational tools for optimizing border geometry for a particular membrane have not been developed.

One means of modeling a shear compliant border is to simply incorporate its geometry into the FE code. While this approach permits accurate modeling of performance for small–scale membranes, the resulting FE code is quite large due to its geometric complexity, and hence cannot be efficiently scaled up for full–sized membranes. An alternative approach is to model the three–dimensional thermoformed structures as flat strips that each possess both a low elastic modulus (three orders of magnitude lower than that of the bulk material) and a near–zero Poisson's ratio. Such a model has been implemented, and simulation results compare favorably with those obtained using the geometrically–detailed FE models. Work is currently continuing to justify this new approach via analytical modeling. An experiment to verify the predictions of the model by using photogrammetry to measure the surface contour of a membrane containing a shear compliant border as a function of edge shear is also being planned.

DEVELOP: Maximizing the Use of NASA Mission Data Through Earth Science Applications

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As Science Advisor to the DEVELOP program, I was tasked with guiding/assisting student teams (10) in the selection of NASA associated models to be used in maximizing the use of NASA data. Eight of the ten teams conducted earth science related research on air quality, water management, disaster management, agricultural efficiency, climate change, and homeland security. The ninth and tenth teams developed a Cave Automatic Virtual Environment (CAVE) and provided information technology support respectively.

Interim results from this collaboration were published in an oral presentation by each of the teams to members of the Office of Education at Langley Research Center.

Oral presentations to Virginia Geographic Information Network, NASA CERES S'COOL Project, and NASA Langley Center Director (General Bridges) are scheduled. A public display of the CAVE-teams effort will be available at this year's Goddard Day on August 30. Also, a poster session and final reports of progress from each team will close out the summer activities. A selected number of projects, based on the level of completion will be submitted to peer reviewed journals.

Speech Interfaces for Aviation Weather Information Systems (AWINs)
– Aspects of Analysis and Design

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First generation Aviation Weather Information Systems (AWINs) allow pilots to receive weather information in graphical and textual format while in-flight. The primary goal of these systems is to provide sufficiently accurate, timely and intuitive information to the flight deck which will enable a 50% reduction in aircraft accidents attributable to a lack of weather situation awareness. While these first generation systems have been shown to improve weather situation awareness, the graphical and textual nature of the presentation format has a significant impact on pilot attention distribution in a real operational environment.

To alleviate pilot distractions caused by manual-visual interactions with the weather information system, a speech recognition and generation system interface is currently under development. To eliminate manual (i.e., keyboard and mouse) interactions with the weather information systems, which necessarily involve the pilot, speech grammars have been developed for the voice-based manipulation of weather displays provided by *WSI Inflight*, a commercial weather information systems package. These speech grammars have been compiled and tested using two commercially available speech recognition software packages – *Nuance* and IBM's *Via Voice*.

To partially reduce the visual interactions of the pilot with displayed textual data such as terminal aerodrome forecasts (TAF) and meteorological aviation reports (METAR), a grammar capable of converting and interpreting standardized TAF and METAR reports in plain English has also been experimented with. The output of this grammar which is in text form is then fed into a speech synthesis system (IBM's *TTS*, a commercial off-the-shelf text-to-speech software package) so that the METAR or TAF report can be 'read' in plain English to the pilot. The benefit of this lies in the obvious fact that the pilots no longer need to read through long segments of METAR or TAF text shown on the display unit or rely on their memory on how to properly decipher the encoded weather reports.

Pilot reports (PIREPS) are first-hand reports in natural language of actual weather conditions encountered by pilots during flight. These reports serve to supplement and, if circumstances warrant, supplant surface-based weather reports. The reports need to be cast into standard coded form before they are transmitted to other pilots and weather reporting stations. Interpreting and coding PIREPS is manpower and time intensive and, in some instances, time critical. A preliminary investigation has been conducted on the feasibility of performing an automated analysis of oral pilot reports and converting them into standardized weather reports for further dissemination using commercially available speech recognition software.

Usability aspects of the interfaces, in particular ease of use and usage in the presence of cockpit noise, have also been addressed in designing the speech grammars.

Water Vapor Lidar System Study for Deployment on Altair Unpiloted Atmospheric Vehicle

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Light Detection and Ranging (LIDAR), a technique that was adapted from its radio frequency analog, RADAR, has been used since the 1960's to study the earth's atmosphere. LIDAR is an effective tool for the study of surface topography, global energy transactions, weather modeling and climatology systems, and environmental characteristics of the atmosphere. Researchers at NASA Langley have used LIDAR to characterize water vapor, ozone, aerosols, or pollutants in our atmosphere. Langley's LIDAR studies have previously been deployed from ground-based stations. More recently, LIDAR systems have been deployed on piloted aircraft. However, implementing LIDAR on an unmanned aerial vehicle (UAV) could improve cost performance and improve mission flexibility.

Researchers at the NASA Langley Research Center have proposed the deployment of a water vapor Differential Absorption LIDAR (DIAL) system on an Altair[1] UAV platform. The Altair UAV offers improved payload weight and volume performance, and longer total flight time as compared to the Perseus B[2]. The Altair also provides comparable flight altitude performance with the Perseus B. Therefore, the Altair UAV is a promising platform for jointly sponsored projects and studies. A system study has been implemented to layout a beginning design for the Altair based water vapor DIAL system. The study includes a proposed water vapor DIAL schematic, an assessment of the available capacity for additional instrumentation based on the proposed schematic, and an overview of the possible weight and volume improvements associated with the use of newly developed technologies. Mechanical, electrical, and environmental constraints have also been reviewed and considered in the current design and suggested improvements. The results of the system study show that less than 20% of the available weight and volume capacity and less than 10% of the available electrical capacity is needed for the water vapor DIAL system. Significant improvements are also possible through the use of advanced fiber optic components and the design of a customized computer interface system. Additional investigations to examine the use of self-locking techniques in microchip lasers are also considered. Finally, a medium-term goal of moving toward a microlidar package for space-based platforms is discussed.

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[1] The Altair UAV is manufactured by General Atomics Aeronautical Systems, Inc.
[2] The Perseus B is manufactures by Aurora Flight Sciences, Inc.

Manufactured Solutions, Forcing Functions and Code Verification

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Computational Fluid Dynamic (CFD) simulations are taking on increased importance as more challenging aerodynamic problems are addressed and reliance in such simulations is sought for decision-making. As a consequence, the need for confidence in these simulations becomes increasingly important. Historically several approaches have been taken to verify CFD codes; among these are comparison to exact analytical solutions, comparison to highly accurate benchmark solutions and code to code comparisons. Although one would like to have exact solutions to the equations for comparisons, there are few such solutions available.

A recent technique allows analytical (manufactured) solutions to be used for code verification. With this Method of Manufactured Solutions (MMS), the original governing equations are modified to have forcing functions (sometimes called source terms) that drive the computed results to this previously chosen analytical function. The function can have features of particular interest and need not satisfy the original equation, only the modified equation. This technique opens up a virtually limitless supply of exact solutions of the modified equations for code assessment, in contrast to the limited number of exact solutions available for the original equation. A weakness of MMS, as previously practiced, is that it requires CFD code modifications that are unique to every different manufactured solution examined. These modifications for state-of-the-art CFD codes are typically extensive and may even introduce unknown sources of error.

The present research examined MMS in connection with a representative CFD code to develop an implementation method that minimizes the amount of code modification. With this new implementation, a single modification to a CFD code will allow the assessment of the code with an arbitrary number of manufactured solutions. Thus, repeated code modification for each solution of interest has been eliminated. The amount of modification for this new approach is comparable to prior single-solution MMS implementations.

A limited number of examples were investigated to assess the approach and various issues involved with implementing MMS for a CFD code. Minimizing code modification related to the MMS has the promise of building one's confidence in the simulations while allowing a broader range of manufactured solutions to be examined in a shorter time. Although the present approach appears to be a useful way of implementing the MMS and shows promise, some questions about the subtleties of treating boundary conditions remain. Further development of the present approach to include investigation of additional manufactured solutions (exhibiting a variety of features) and in-depth study of boundary conditions appear to be a fruitful area of additional research.

Automatic Aircraft Structural Topology Generation for Multidisciplinary Optimization and Weight Estimation

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Multidisciplinary optimization and its application to the aero-structural design of aerospace vehicles has been a major research thrust in recent years. While much progress has been made in the ability to rapidly and automatically generate computational fluid grids to assess different external shapes based on parametric designs, the structural aspects of the design optimization problem have not enjoyed the same attention. In the few instances where structural layout is allowed to vary, the model used to analyze and assess candidate designs is usually overly simplistic and suspect from an accuracy perspective. Aircraft manufacturers have very accurate ("down to the last rivet") structural models of existing vehicles, but these models take literally months to generate and are not suitable for rapid consideration of candidate designs. Thus, there is a need for a methodology to create structural models of reasonably high accuracy while incorporating the ability to generate these models automatically for arbitrary external vehicle shapes.

During the summer of 2003, the author conducted the first step towards developing this capability as part of the NASA Faculty Fellows Program. An abstraction of the aircraft structural elements and their layout was constructed so that models can be created quickly for a given structural layout regardless of changes in external shape of size. In addition, a design trend study was conducted to obtain a thorough understanding of current "best practices" in structural design in industry. Trends and patterns were observed and documented for several different classes of aircraft (commercial transports, business jets, combat jets, single-engine propeller aircraft, and twin-engine propeller aircraft).

Once again under the auspices of the NFFP, the author has spent the summer of 2004 developing some initial algorithms to allow the mapping of parametric structural topologies to arbitrary wing shapes. These algorithms allow a structural designer to specify a structural layout in parametric terms, specifying locations in percentages of span and chord rather than actual dimensions. This specification is independent of the aircraft geometry so that upon making a change to the external vehicle shape, finite element models are automatically generated to allow sizing optimization to be performed. This process could then be automated to generate more accurate weight estimates for new aircraft concepts and to facilitate improved aerostructural optimization during the conceptual/preliminary design stages.

Development and Implementation of Hierarchical Clustering Algorithms to Discover Knowledge in Heterogeneously Distributed Data Sets with Data of Arbitrary Dimension

By

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Extracting useful information concealed in (large scale) data repositories is a fundamental need and task in science, engineering, government (intelligence) and business. A prominent approach is through Cluster Analysis, where either a measure of similarity or dissimilarity is used to detect groups or patterns in data. Hierarchical clustering yields a dendrogram, a binary tree where every node identifies a cluster. Data frequently is high dimensional, intrinsically heterogeneous and stored distributed at distinct sites that are only connected by a network. Clustering high-dimensional and heterogeneously distributed data remain current research challenges, as shown at the latest Scientific Data Mining conferences.

Applications often require to aggregate and jointly cluster independent "local" data sets, treating them as the components of a larger "global" distributed data set, without transferring all data to a central site, since for large scale distributed data sets it might not be feasible or effective to transfer and analyze all data in a central site due to the excessive storage, network and time demands it would generate. For instance, in a virtual environment for planning planetary missions it would be necessary to jointly cluster independently stored remote sensing data sets collected by different instruments from several previous missions to the planet of interest. A particular example is the search, in remote sensing data sets from previous Mars missions, of joint patterns that can indicate locations where the presence of water is probable.

A global dendrogram is constructed from the local dendrograms built by clustering each data subset at the site where it is stored. The local clustering should adjust to the characteristics of each source data set, and its influence on the total clustering result has to be weighted according to the relevance, reliability or accuracy of the source.

The project focused on feasible and effective implementations of scalable hierarchical algorithms to cluster heterogeneously distributed datasets with data of arbitrary dimension that satisfy all the above requirements, and continues research conducted at DAIB during prior NFFP appointments and a sabbatical at ICASE. Aiming to optimize performance and resource utilization, the requirements, data structures and complexity of several implementation options were investigated, including new results on the feasibility and correctness of a recursive implementation of a crucial sub-algorithm. Additionally, the preparation of documents and forms to apply to patent the methods was concluded, submitted under NASA Case Number 16948, and referred to SURA. A concept paper and a presentation were also prepared and delivered with the objective of explore funding and announce obtained results.

NASA DEVELOP – Summer Fellowship

Thomas C. Spencer

<u>Technology Advisor</u>

This summer at NASA DEVELOP I have served in the role of Technology Advisor to the eighty-seven students here at DEVELOP. There are four primary domains of work that I have been charged with facilitating this summer. They are as follows:

- Technology Advisor to the Portable CAVE Team – here I have advised the team for a third summer as they strove to build the software that will allow DEVELOP teams to import their visualizations into the 3D virtual world of the CAVE. In addition to hardware improvements, documentation and redesign have been implemented that support the major objective of making the CAVE both portable and user-friendly. The CAVE was successfully demonstrated at GSFC in support of Goddard Day / Goddard Community Day.
- Visualization consultation and support for all seven of DEVELOP's science – based teams – I have worked with each team to help them to learn proper data-mining and documentation techniques. I have helped students to integrate use of models into their projects. I have worked with our students on the implementation of modeling software and storage of data sets on the Linux platform to facilitate advanced modeling work by our students. I have consulted with students on the process of identification and submission of their results to journals and other suitable venues for publication of their resulting pilot application projects.
- Project Advisor to the Enterprise Architecture Team – I have helped to provide direction and organization to a team of two students who have been tasked to develop an understanding of the Federal Enterprise Architecture (FEA), the Virginia State Enterprise Architecture (VASEA). We also have related this work to the Geospatial Interoperability Office (GIO) standards and given DEVELOP direction on how we can operate within such a framework to better serve our customers.
- Technology Advisor and Point of Contact for Information Technology Initiatives– I have provided consulting services in the Information Technology domain to DEVELOP and supervision of IT work in support of all DEVELOP activities. In the hardware domain - work with the IT team has included implementation of an additional internal network, a file server, a storage array, and a security survey and resulting plan – all of which will serve this growing organization in the coming years. In the software domain – I provided a needs assessment based on the visualization software that is currently employed as well as recommendations for current and future acquisitions. Several models that we currently employ required the use of software extensions that we did not own for our current platform. Documentation of the passwords for all server computers on site and a review with recommendations that all licensing servers be moved to a dedicated machine rather than a visualization workstation.

An Assessment of the SOA in Conceptual Design including Noise and Emissions

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It is becoming exceedingly clear that any future increase in air transportation will require a concerted effort to decrease the two most often quoted environmental pollutants, noise and emissions. In order to reduce noise exposure at airports caused by increased traffic, the noise footprint of the departing (and landing) aircraft has to be decreased. Decreased fuel consumption due to more efficient engines and lighter aircraft from advanced materials with less drag will decrease harmful emissions. Changed operating (approach) procedures can reduce both noise levels and emissions.

In order to deal with these two issues as early in the design process as possible and, at the same time, be able to develop policy already in this stage of the aircraft life cycle, the FAA in collaboration with NASA and a number of universities and industry partners has launched an initiative to develop AEDT, the Aviation Environmental Design Tools. An AEDT committee was formed and a workshop organized by the Transportation Research Board of the National Academies in Washington, D.C., in the Spring of 2004. This was to provide guidance to the FAA on how to proceed with the contracting and the subsequent development of a prototype design tool. Subsequently, it was determined that the NASA Aerospace Vehicle Systems Technology Office (AVSTO) at NASA Langley Research Center would have the task of developing or contracting for the development of the conceptual aircraft design tool as a synthesis base for AEDT.

This project attempts to lay a foundation for the AEDT effort by surveying the literature and finding tools for the conceptual design and multidisciplinary optimization of aircraft as well as any noise and emission literature and associated tools that either exist or are in the process of being created by government laboratories, universities, or industry. The incorporation of Life Cycle Cost (LCC), Direct Operating Cost (DOC), and Return on Investment (ROI) is also investigated. Needless to say, not all past, existing, or future projects are captured for various reasons (security, proprietary information, availability of sources), but a concerted effort is made to include analysis and synthesis information, developments, and tools from the US, Europe, and other parts of the world. At the same time, some assessment is given as to the usefulness of the found tools and developments to the proposed AEDT effort. Specifically, there seem to exist enough software tools, from a systems framework (ModelCenter) to legacy discipline tools for conventional aircraft design (FLOPS), noise prediction (ANOPP), and aircraft life cycle cost analysis (ALCCA), to new tools such as SAGE for emissions, to rapidly assemble a rudimentary AEDT system. The only area not yet fully covered seems to be uncertainty analysis, but there DAKOTA might be used. In each case, however, more advanced tools should be implemented in AEDT as they become available, to allow for the design and policy making with regard to future unconventional flight vehicles.

A Novel Tunable Solid-State Laser Transmitter
for Interrogating Fiber Bragg Grating Sensors

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Fiber-optic Bragg gratings (FBG) can be used as miniature, lightweight strain and temperature sensors for applications such as real-time health monitoring of aircraft, space vehicles, and smart materials and structures. Fabricated in the NASA Langley NESB fiber draw tower, a single fiber contains multiple (upwards of thousands) ultra-low-reflectivity Bragg gratings photo-induced holographically by a pulsed excimer UV laser during the draw process. The unique method used by NASA Langley for optically interrogating the sensor utilizes a Fourier-transform demodulation technique that requires a widely and continuously tunable laser over the 1550-1560 nm wavelength range. The diode laser currently used to meet this requirement relies on an external cavity design with a pivoting mirror above a diffraction grating (Littman-Metcalf cavity). This design, although producing stable and highly coherent light output, involves mechanical motion of an optical component actuated by a DC motor and a piezoelectric transducer. Hence, this laser is large, heavy, and costly, and is not practical for use in harsh (vibrational) environments or in remote-sensing applications.

This project investigates the use of a new compact, fully-solid-state laser transmitter in an optical test setup to interrogate FBG sensors. This pre-commercial semiconductor laser, being developed by Agility Communications Inc. for C- and L-band DWDM telecommunications systems, achieves widely tunable, mode-hope-free performance based on the innovative concept of current-controlled mirror reflectivities from sampled-grating distributed Bragg reflectors. The InP-based laser chip monolithically integrates these mirrors with gain and phase sections (also current controlled), as well as an electroabsorption modulator (EAM) that permits AC detection in the receiver electronics. Under microprocessor control, the mirror and phase section currents can be coordinated to achieve rapid, quasi-continuous wavelength tuning.

An optical test setup to interrogate FBGs using this new laser was designed and constructed. The laser light intensity is square-wave modulated at 10-30 MHz using the integrated EAM and is directed through an optical circulator to the NASA sensor fiber under test. The reflected light signal returned from the fiber sensor is mixed with light from an in-line broadband reflector, and the interference signal is detected, amplified, and extracted from the laser intensity and receiver noise by a lock-in amplifier. For proof-of-concept tests, the laser is tuned through an appropriate wavelength range about the Bragg wavelength for both unstrained and strained fibers, and the reflected signals are collected and analyzed. Wavelength versus phase-section control current and spectral properties of the laser light output are characterized with an optical spectrum analyzer. Preliminary results indicate excellent potential for rapidly tuning the laser using current control and for being incorporated in future fiber sensor interrogators to gather real-time data for vehicle health monitoring.

Modification of a Computerized Methodology to Correct Wind Tunnel Measurements for Wall Interference in a Two Dimensional Flow Field Environment

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In spite of the more recent and highly acclaimed advances in the area of Computational Fluid Dynamics as an important research method for the design of various types of aircraft, the wind tunnel still remains today as an indispensable tool for the aerospace engineer. Wind tunnel data play an important role in the validation of theoretical codes such as to evaluate the merits of various turbulence models. It is therefore imperative that experimental data possess a high degree of accuracy and that scaling methods are of good enough quality to infer the proper flight or free-air aerodynamic characteristics of vehicles predicated on ground-based measurements. The challenge faced by the aerospace engineer is to apply the proper corrections to wind tunnel data to account for the interference effects of the tunnel walls that constrain the flow of air over a model, which results in blockage effects and modified streamline curvature.

The Transonic Wall Interference Correction System (or TWICS) is a computer code that determines the free-air equivalent values for aerodynamic coefficients and angle of attack. It was originally developed for the Ames 11-Ft Tunnel and has been modified for use in the National Transonic Facility (NTF) and in 14x12-FT subsonic tunnel, both at NASA Langley Research Center. This code is based on the wall signature correction method, which uses the pressure measurements from the orifices along the tunnel test section walls to determine the strengths of singularities based on potential flow theory. The method of images is then used to superimpose the effects from all of the singularities in the image system. This total effect accounts for the wall interference.

This project is tasked with the responsibility of making further modifications to this existing code to correct wind tunnel measurements obtained from the Basic Aerodynamics Research Tunnel (BART). Specifically, the tasks are as follows:
1. Modify the code to reflect the characteristics of BART pertaining to the geometry of the test section, the layout of wall pressure orifices, and the interference effects of the model support system and of a pressure rake used for wake measurements.
2. Replace the types of singularities in the code to simulate a two-dimensional test article and flow field. The existing code is for three-dimensional applications.
3. Incorporate the proper singularity distribution to model the effect of blowing for a test article fitted with a circulation control system.

Modifications have been implemented to a preprocessor code, which creates a database of perturbation velocities in the BART. Some changes have been made to the code to model to a two-dimensional test article. Features of a wing with an aft blowing jet have also been incorporated into the TWICS program.

Characterization of Cyano-containing Piezoelectric Polyimides

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Polyvinylidene fluoride (PVDF) is one of the most well know piezoelectric polymers. While its properties are impressive, polymers with higher use temperatures and higher values of remanent polarization are desirable. Because of this, the electrical properties of many other polymers, including poly (vinylidene cyanide) (PVDCN), certain nylons and nylon blends, as well as certain polyimides have been studied in recent years.

The overall goal of this work is to study a series of cyano-substituted polyimides and examine the influence of the cyano content and the position of the cyano group on the dielectric and piezoelectric properties of the polymers. A study of dielectric behavior is important because it reflects the polarization state of the material. This information is necessary to understand the mechanism of electromechanical performance of the material.

In order to conduct this dielectric investigation, four homopolymers and nine copolymers are being studied. The homopolymers will be referred to as A, B, C, and D. The copolymers, which are made using homopolymer A in combination with homopolymers B, C, or D, are made with different percentages of each homopolymer. For example, in the case of copolymers of A and B, one copolymer is composed of 25% A and 50% B, the second copolymer is composed of 50% A and 50% B, and the third copolymer is composed of 75% A and 25% B. The copolymers will be referred to as AB-1, AB-2, and AB-3, where the relative amounts of the homopolymers are as indicated above.

Samples were cut from thin films of the polymers that had been cast. Prior to analysis using the Novocontrol system, gold was deposited onto both sides of the samples and thickness values were measured. The Novocontrol system, which uses the Solartron 1260 Impedance Analyzer, Broadband Dielectric Converter, and Novocontrol Novotronic, was then used to determine the dielectric properties of the polymers. An important feature of the Novocontrol system is that its hardware and software are capable of covering a broad frequency and temperature range. In addition, the high sensitivity of the system allows for features such as molecular relaxations, phase transitions, and conductivity to be revealed. In order to obtain this information, however, a large amount of data must be analyzed.

The immediate goal is to examine the influence of the cyano content and the position of the cyano group on the dielectric properties in the group defined by homopolymers A and B, and copolymers AB-1, AB-2, and AB-3.

Thermographic Technique Comparison on Reinforced Carbon-Carbon Samples

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Reinforced Carbon-Carbon (RCC) is a brittle composite material that is used to thermally protect the Space Shuttle's nose section, wing leading edges, and chin panel during reentry.   In August 2003 NASA concluded that the shuttle Columbia accident was due to a breach in the RCC material on the left wing that was caused by an impact from foam off of the external tank during lift-off.   This breach in the thermal protection system permitted superheated air to penetrate the orbiter's aluminum structure ultimately leading to the loss of the vehicle.

Impact tests on the orbiter's RCC panels are ongoing.   Numerous nondestructive techniques have been used to probe the impact site for damage. Thermography has surfaced as a quick, full-field, non-contact inspection method over other techniques. Thermography utilizes differences in thermal diffusivity to identify material flaws, such as delaminations and cracks, within the composite material. The focus of this project is to compare various thermographic techniques on Reinforced Carbon-Carbon materials with manufactured flaws.

Thermographic systems differ by the way they deposit heat onto a sample. Some use an impulse of heat from flash lamps where as others use high-energy lamps for longer heating cycles. The systems under study use both of these heating methods. The specific thermographic systems under comparison are the Thermal Wave Imaging System, the Thermal Line Scanner, and the Thermal Photocopier.

Reinforced Carbon-Carbon samples with a Silicon Carbide layer containing manufactured flaws will be the subject of this study. Some have flat bottom holes at varying depths and diameters while other have graduated steps cut into it decreasing the material thickness through the Silicon Carbide layer. Additional sample tested have surface cracks, delaminations at various depths, and saw cuts at the corners half way through the thickness. Data on these specimens from the three thermographic systems will be collected and processed using the Principal Component Analysis method. Signal to noise ratios on RCC samples will be calculated and used as one method of comparison between the systems. This information will be critical to future selections of thermographic inspection techniques as a function of scanning area, type of flaw, and depth of flaw.

NASA Science Files: Script Development

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The NASA Science Files is a nationally broadcast science education program produced by NASA Langley Research Center as part of its distance-learning program.   It is broadcast by the NASA channel, PBS, and other stations. The Science Files program also involves an interactive website (http://scifiles.larc.nasa.gov) and workbook activities. The program is designed for third to fifth grade students and is tied to national standards for science instruction. The Science Files is Problem Based learning, in which a real-world problem motivates the investigations. It is designed to be fun in addition to educational. The Science Files is viewed by millions of children nation-wide and abroad and some episodes are also dubbed in Spanish.

My tasks with the project were as follows:
1. Research science principles: insure accuracy and relevance
2. Assist in script writing
3. Assist in contacting researchers to participate in the show
4. Assist in program development
5. Play the role of "Dr. D", the kids mentor.

We have completed the scripts for two of the shows, The Case of the Great Space Exploration and The Case of the Ocean Odyssey.   In addition, we have begun the research on two additional shows about animals and geomagnetism.

A Sensor Web for Mars Exploration

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Recent advances in MEMS and low power and highly integrated digital electronics have led to the development of micro sensors. In addition to their signal processing capabilities, these micro sensors are generally equipped with a radio to report collected data to a remote observation center. With the current NASA ambition for flying the first aircraft over Mars to augment the on-going rover-based exploration, establishing an unattended wireless sensor network on the surface of Mars can be very valuable in achieving the scientific goals of such a space mission. The sensor network can increase the spatial and temporal coverage and reveal more mysteries about potential life on that planet. The ARES plane can query the readings of the surface sensors to be correlated with aerial images. In addition, the network can serve as a communication infrastructure to extend the rover's operational range. Moreover, the mission control can designate some of the sensor nodes as waypoints to preprogram a complicated route for autonomous rover navigation.

This summer I have investigated the technical challenges for establishing, operating and managing such a network on Mars. Effective node deployment, autonomous node discovery and location determination, ad-hoc network formation, energy conscious network management, on-time delivery of sensitive data are identified as crucial design goals. Suitable architecture has been proposed for establishing the sensor web. The rover, the ducting station and the ARES airplane are designated as gateway nodes that collect sensor readings, perform data processing and forward combined reports to the command center on Earth through a Martian satellite. Several options for node deployment have been suggested and a set of network management protocols has been proposed.

Most notable among the proposed protocols are those for sensor discovery and localization and routing of delay-constrained traffic. Knowledge of node location is essential in such unattended network setup in order to correlate the reported data to the origin of the sensed phenomena. Given the lack of a reference coordinate system like GPS on Mars, only relative localization is left as an option. We have outlined an efficient protocol in which each node discovers its neighbors and estimates their range and then local range measurements are fused in order to form a network wide unified coordinate system. Our approach minimizes the overhead incurred at the deployed sensors and outputs highly accurate node positions. For routing delay-constrained data, we have proposed novel routing and packet scheduling schemes that boost timeliness and maintain energy efficiency. Several extensions have been also suggested to allow the handling of mobile gateways.

Development of detailed algorithms has already started during the summer and preliminary results have been submitted for publication. A research plan has been drafted for follow-up work and a number of funding opportunities have been identified for aggressive pursuance.

A Study of Current Icing Potential (CIP) Data for Prevention of Aircraft Icing Related Accidents

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Over the last ten years weather has been cited as the cause or contributing factor to a quarter of all aviation accidents. Of these weather conditions icing is the dominate weather event. As a result weather products have received tremendous attention in the form of product refinements, presentation, invention and reinvention. With these refinement come some problems, the pilot now has a tremendous amount of weather information to gather, interpret and act on. Although the textual and graphical information is easy to access, it can also create an excess of information that the pilot must A.) Know what information to collect and B.) Where to locate the information they need. Once they have gathered their information they must create a weather picture and develop a plan of action for their flight.

This study takes one element of the weather information, current icing potential (CIP) reports, and will do the following:

1. Collect National Transportation and Safety Board (NTSB) aviation accident reports for a given period.

2. Identify the NTSB reports that relate to icing.

3. Collect the current icing potential reports (CIP) from National Center for Atmospheric Research (NCAR), to match the time line of the accident reports.

4. Correlate the CIP and the 3D data from NCAR for the time and location of the accidents.

5. The results will be used to develop an automated analysis of CIP data for the identification of icing hazards.

This information will then be incorporated into an automated flight planning decision support tool being developed at NASA - Langley

APPENDIX VIII

2004 NFFP ORIENTATION EVALUATION REPORT

2004 NFFP ORIENTATION EVALUATION REPORT

(Twenty-six Orientation evaluations were returned - 90%.)

1. **Was the Orientation letter with Orientation information received in a timely manner?**
1 - Poor – 0%   4 - Good - 6 (23%)
2 - Fair – 0%   5 - Excellent - 20 (77%)
3 - Average – 0%   No Answer – 0%

2. **Were the meeting facilities adequate?**
1 - Poor - 0%   4 - Good - 8 (31%)
2 - Fair - 0%   5 - Excellent - 18 (69%)
3 - Average - 0%

3. **Was the Welcome Package beneficial?**
1 - Poor - 0%   4 - Good - 7 (27%)
2 - Fair - 0%   5 - Excellent - 19 (73%)
3 - Average - 0%

4. **How do you rate the Program Breakout Session?**
1 - Poor - 0%   4 - Good - 5 (20%)
2 - Fair - 0%   5 - Excellent -20 (77%)
3 - Average - 0%   No Response – 1 (3%)

5. **Was the information and knowledge gained at the Orientation helpful?**
1 - Poor - 0%   4 - Good - 12 (46%)
2 - Fair - 1 (3%)   5 - Excellent - 5 (20%)
3 - Average - 3 (12%)

6. **In general, how do you rate the overall Orientation?**
1 - Poor - 0%   4 - Good - 12 (46%)
2 - Fair - 0%   5 - Excellent - 15 (54%)
3 - Average - 0%

7. **Comments:**
-IT Presentation was dismal! Slides should be run thru spell checker! -Talk on Multimedia Office (MEC) was prointless! Eliminate it. -Half and Half instead of Dairy Creamer for coffee? -Waiver for previous attendees? -Presenters should not cover up the projector while they talked. -Cold. -Computer security should be revamped. -Too cold! -Didn't think there was enough info. on traditional library resources. -Some presentations could be shortened. -All presenters should follow Ed Pryor's example: Brief, complete and clear presentations (for example IT Security was too wordy and long, needs to be more agile) -Very Cold -Great Job! -Very organized, well managed. New people need little more Info. on meeting up w/ NASA Colleague. -Thanks for the Venus Transit Viewing glasses.

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