

NASA/TM—2003-212207



# HBCUs/OMUs Research Conference Agenda and Abstracts

Sunil Dutta  
Glenn Research Center, Cleveland, Ohio

---

February 2003

## The NASA STI Program Office . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the Lead Center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at <http://www.sti.nasa.gov>
- E-mail your question via the Internet to [help@sti.nasa.gov](mailto:help@sti.nasa.gov)
- Fax your question to the NASA Access Help Desk at 301-621-0134
- Telephone the NASA Access Help Desk at 301-621-0390
- Write to:  
NASA Access Help Desk  
NASA Center for Aerospace Information  
7121 Standard Drive  
Hanover, MD 21076

NASA/TM—2003-212207



# HBCUs/OMUs Research Conference Agenda and Abstracts

Sunil Dutta  
Glenn Research Center, Cleveland, Ohio

Proceedings of a conference held at Ohio Aerospace Institute  
and sponsored by NASA Glenn Research Center  
Cleveland, Ohio, April 17–18, 2002

National Aeronautics and  
Space Administration

Glenn Research Center

Available from

NASA Center for Aerospace Information  
7121 Standard Drive  
Hanover, MD 21076

National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22100

Available electronically at <http://gltrs.grc.nasa.gov>

**GRC HBCUs/OMUs RESEARCH CONFERENCE**  
**April 17–18, 2002**

**Table of Contents**

Letter from the Director, Glenn Research Center ..... 1

Letter from the Deputy Director for Operations ..... 3

Agenda ..... 5

List of Poster Papers ..... 7

Abstracts ..... 9

Why Costing is Important on HBCU Grants ..... 35

Biographical Data ..... 43

List of Attendees ..... 47

National Aeronautics and  
Space Administration  
**John H. Glenn Research Center**  
**Lewis Field**  
Cleveland, OH 44135-3191




Reply to Attn of:

The NASA John H. Glenn Research Center's (GRC) commitment to excellence continues to grow in terms of investment and support for Historically Black Colleges and Universities (HBCU's)/Other Minority Universities (OMU's). Our total research and development grant awards to HBCU's/OMU's continue to exceed our performance goal by a substantial margin.

GRC's HBCU's/OMU's Research Program is designed to utilize the capabilities of HBCU's/OMU's to conduct fundamental science and develop physical infrastructure related to NASA's disciplines. To reach our goals, we build partnerships with other Government agencies, industry, and academia. Our research partnerships with the Nation's HBCU's/OMU's are an integral part of our strategy.

The HBCU's/OMU's Research Conference is a critical element in ensuring the success of GRC's research programs. In addition, it provides a forum for showcasing the research capabilities of the participating HBCU's/OMU's.

It is with great pleasure that I welcome the participants and congratulate everyone associated with the NASA HBCU's/OMU's Research Conference.



Donald J. Campbell  
Director

**Page intentionally left blank**

National Aeronautics and  
Space Administration  
**John H. Glenn Research Center**  
**Lewis Field**  
Cleveland, OH 44135-3191



Reply to Attn of:

I extend my welcome to all attendees at this Historically Black Colleges and Universities (HBCU's)/Other Minority Universities (OMU's) Research Conference. This Conference provides the opportunity to showcase the high quality of the John H. Glenn Research Center (GRC)-sponsored research conducted at the Nation's HBCU's/OMU's. I congratulate the Principal Investigators, Student Researchers, and GRC Technical Monitors for your competence and contributions.

I invite all attendees to actively participate with your questions, comments, and suggestions concerning all aspects of the Conference. Your feedback and support are critical to the success of these Conferences.

A handwritten signature in black ink, appearing to read "Julian M. Earls".

**Julian M. Earls**  
Deputy Director for Operations



**Page intentionally left blank**

# GRC HBCUs/OMUs RESEARCH CONFERENCE

## April 17–18, 2002

### Agenda

Presiding: **Dr. Sunil Dutta**  
SDB Program Manager

#### Wednesday, April 17, 2002

8:00–8:30 a.m. Registration

8:30–9:00 a.m. Introduction and Welcome

**Dr. Julian M. Earls**  
Deputy Director for Operations  
NASA Glenn Research Center

**Dr. Michael Salkind**  
President  
Ohio Aerospace Institute

**Mr. Donald J. Campbell**  
Director  
NASA Glenn Research Center

#### Directorate Panel

9:00–10:30 a.m. **Dr. Arun Sehra**  
Director of Aeronautics

**Dr. Woodrow Whitlow**  
Director of Research and Technology

**Mr. Rudolph L. Saldana**  
Director of Space (Acting)

10:30–11:00 a.m. Break

11:00–12:00 Noon Oral Presentations

12:00–1:30 p.m. Lunch (On Your Own)

1:30–2:45 p.m. Oral Presentations

2:45–3:00 p.m. Break

3:00–5:00 p.m. Oral Presentations

**GRC HBCUs/OMUs RESEARCH CONFERENCE  
April 17–18, 2002**

**Agenda (continued)**

**Thursday, April 18, 2002**

9:00–10:30 a.m.	Oral Presentations
10:30–11:00 a.m.	Break
11:00–12:00 Noon	Oral Presentations
12:00–1:30 p.m.	Lunch (On Your Own)
1:30–3:30 p.m.	Poster Sessions
3:30–4:30 p.m.	Individual Principal Investigator/Technical Monitor Meetings
4:30–5:00 p.m.	Remove Posters

**GRC HBCUs/OMUs RESEARCH CONFERENCE**  
**April 17–18, 2002**

**Poster Papers**

P1	Alabama A&M University	All-Optical Micro Motors Based on Moving Gratings in Photosensitive Media
P2	City College of New York	Ultrasonic Assessment of Impact-Induced Damage and Microcracking in Polymer Matrix Composites
P3	Clark Atlanta University	Developing Novel Fluorescent Materials with Near Infrared Emission by Using m-Phenylene
P4	Clark Atlanta University	Carbon Nanotube Purification and Functionalization
P5	Clark Atlanta University	Characterization of Polyimide Foams for Ultra-Lightweight Space Structures
P6	Clark Atlanta University	Effects of Impact Damage in Midplane Asymmetric Sandwich Composites
P7	Florida A&M University	Robust Fault Detection
P8	Hampton University	Numerical Simulation of One- and Two-Phase Flows in Propulsion Systems
P9	Hampton University	Advanced Methods for Aircraft Engine Thrust and Noise Benefits: Nozzle-Inlet Flow Analysis
P10	Howard University	Experimental Verification of Electric Drive Technologies Based on Artificial Intelligence Tools
P11	Norfolk State University	Novel High Efficient Organic Photovoltaic Materials
P12	North Carolina A&T State University	An Innovative Manufacturing of CCC Ion Thruster Grids by North Carolina A&T's RTM Carbon/Carbon Process
P13	North Carolina A&T State University	Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications
P14	North Carolina A&T State University	Low-Power SOI CMOS Transceiver
P15	Prairie View A&M University	Research to Significantly Enhance Composites Survivability at 550 °F in Oxidative Environments

P16	Savannah State University	On Human Resource Diversity in Distributed Energy Technology
P17	Tennessee State University	Research Project for Increasing the Pool of Minority Engineers
P18	Tuskegee University	A Nonlinear Model for Fuel Atomization in Spray Combustion
P19	Tuskegee University	Structural Evolution and Mechanical Properties of PMR-15/Layered Silicate Nanocomposites
P20	University of New Mexico	Computational Methods for Jet Noise Simulation
P21	University of Texas at El Paso	Characterizing Non-Uniformity of Performance of Thin-Film Solar Cells
P22	University of Texas at San Antonio	Structural Reliability Using Probability Density Estimation Methods Within NESSUS
P23	Wilberforce University	Student Outreach With Renewable Energy Technology
P24	Winston-Salem State University	Generic Divide and Conquer Internet-Based Computing
P25	Winston-Salem State University	P2P Technology for High-Performance Computing: An Overview

**GRC HBCUS/OMUS RESEARCH CONFERENCE****All-Optical Micro Motors Based on Moving Gratings in Photosensitive Media**

M. Curley, S. Sarkisov, and A. Fields  
Alabama A&M University  
4900 Meridian Street  
P.O. Box 1268  
Normal, Alabama 35762

**ABSTRACT**

This research effort was a feasibility study of the concept of an all-optical micro motor with a rotor driven by a traveling wave. The wave was a result of a photo induced surface deformation of a photosensitive material produced by a traveling holographic grating. Two phases modulated coherent optical beams were used to generate the grating in two types of photosensitive materials. The materials that were studied were photorefractive crystals and thin polymer films. Theoretical studies were performed on lithium niobate giving predictions of deformations of the order of nanometers. The experimental deformation size was also on the order of nanometers. The deformations were deep enough to provide conditions for the implementation of the all-optical motor using lithium niobate. We also were able to align micron-size dielectric particles along the holographic gratings by means of the periodic electric forces generated by the grating. These forces can also move the particles along the surface if the grating is moving. We then turned our attention on thin films and obtained a deformation visible on the order of 100 microns. An experimental breadboard demonstration of a prototype was done in the summer of 2001 at GRC. The demonstration included the movement of clocks mechanical workings by an optically driven motor based on a polymer film. The application of this technology can be adapted to government as well as industrial uses. One such project is to make a chemical sensor for the detection of hazardous chemicals. The thin polymer film is highly suited for this purpose since a marker dye could be easily placed on the film in order to detect chemical compounds. This system could be a self-regulating chemical monitoring system used on launches of the space shuttle or locations where hazardous chemicals are present. The project provided support for two black minority graduate students targeting MS and PhD degrees in Applied Optics.

Phone: 256-858-8236

Fax: 256-858-8153

Tech. Monitor: Gregory Adamovsky Phone: 216-433-3736

**GRC HBCU's/OMU's RESEARCH CONFERENCE****Ultrasonic Assessment of Impact-Induced Damage and Microcracking in  
Polymer Matrix Composites**

Benjamin Liaw, Esther Villars, and Frantz Delmont  
City College of New York  
Department of Mechanical Engineering  
Materials Processing and Solid Mechanics Laboratory  
Convent Avenue and 140th Street  
New York, New York 10031

**ABSTRACT**

The main objective of this NASA FAR project is to conduct ultrasonic assessment of impact-induced damage and microcracking in fiber-metal laminated (FML) composites at various temperatures. It is believed that the proposed study of impact damage assessment on FML composites will benefit several NASA's missions and current interests, such as ballistic impact testing of composite fan containment and high strain rate deformation modeling of polymer matrix composites. Impact-induced damage mechanisms in GLARE and ARALL fiber-metal laminates subject to instrumented drop-weight impacts at various temperatures were studied. GLARE and ARALL are hybrid composites made of alternating layers of aluminum and glass- (for GLARE) and aramid- (for ARALL) fiber reinforced epoxy. Damage in pure aluminum panels impacted by foreign objects was mainly characterized by large plastic deformation surrounding a deep penetration dent. On the other hand, plastic deformation in fiber-metal laminates was often not as severe although the penetration dent was still produced. The more stiff fiber-reinforced epoxy layers provided better bending rigidity; thus, enhancing impact damage tolerance. Severe cracking, however, occurred due to the use of these more brittle fiber-reinforced epoxy layers. Fracture patterns, e.g., crack length and delamination size, were greatly affected by the lay-up configuration rather than by the number of layers, which implies that thickness effect was not significant for the panels tested in this study. Immersion ultrasound techniques were then used to assess damages generated by instrumented drop-weight impacts onto these fiber-metal laminate panels as well as 2024-T3 aluminum/cast acrylic sandwich plates adhered by epoxy. Depending on several parameters, such as impact velocity, mass, temperature, laminate configuration, sandwich construction, etc., various types of impact damage were observed, including plastic deformation, radiating cracks emanating from the impact site, ring cracks surrounding the impact site, partial and full delamination, and combinations of these damages.

Phone: 212-650-8022

Fax: 212-650-8090

Tech. Monitor: John Gyekenyesi Phone: 216-433-3210

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

Developing Novel Fluorescent Materials with Near Infrared Emission by Using *m*-Phenylene

Yi Pang and Ling Liao  
Clark Atlanta University  
Department of Chemistry and  
Center for High Performance Polymers and Composites  
Atlanta, Georgia 30314

Michael A. Meador  
National Aeronautics and Space Administration  
Glenn Research Center  
Cleveland, Ohio 44135

**ABSTRACT**

Our research focuses on development of novel *p*-conjugated polymers with desired emission. In the current study, the structure of a highly green-emitting poly[(*m*-phenylenevinylene)-*alt*-(*p*-phenylenevinylene)] has been modified by increasing the content of *p*-phenylene to achieve red- and infrared-emission. The polymer is synthesized via Wittig-Horner condensation, which is known to lead to *trans*-olefin linkage. The polymer is soluble in common organic solvents such as toluene, chloroform and THF. The spectroscopic properties of the polymer in both solution and film states will be discussed in comparison with its model compound.

Phone: 404-880-6896

Fax: 404-880-6890

Tech. Monitor: Michael A. Meador Phone: 216-433-9518



**GRC HBCU's/OMU's RESEARCH CONFERENCE**

## Carbon Nanotube Purification and Functionalization

Marisabel Lebron and Eric Mintz  
Clark Atlanta University  
223 James P. Brawley Drive, SW  
Atlanta, Georgia 30314-4391

Richard E. Smalley  
Rice University  
6100 Main Street  
Houston, Texas 77005-1827

Michael A. Meador  
National Aeronautics and Space Administration  
Glenn Research Center  
Cleveland, Ohio 44135

**ABSTRACT**

Carbon nanotubes have the potential to significantly enhance the mechanical, thermal, and electrical properties of polymers. However, dispersion of carbon nanotubes in a polymer matrix is hindered by the electrostatic forces that cause them to agglomerate. Chemical modification of the nanotubes is necessary to minimize these electrostatic forces and promote adhesion between the nanotubes and the polymer matrix. In a collaborative research program between Clark Atlanta University, Rice University, and NASA Glenn Research Center several approaches are being explored to chemically modify carbon nanotubes. The results of this research will be presented.

Phone: 216-433-2292  
Fax: 216-977-7132  
Tech. Monitor: Michael Meador Phone: 216-433-9518

## GRC HBCUS/OMUS RESEARCH CONFERENCE

### Characterization of Polyimide Foams for Ultra-Lightweight Space Structures

Keithan Hillman and David R. Veazie  
 Clark Atlanta University  
 Department of Engineering  
 223 James P. Brawley Drive, SW  
 Atlanta, Georgia 30314

#### ABSTRACT

Ultra-lightweight materials have played a significant role in nearly every area of human activity ranging from magnetic tapes and artificial organs to atmospheric balloons and space inflatables. The application range of ultra-lightweight materials in past decades has expanded dramatically due to their unsurpassed efficiency in terms of low weight and high compliance properties. A new generation of ultra-lightweight materials involving advanced polymeric materials, such as TEEK™ polyimide foams, is beginning to emerge to produce novel performance from ultra-lightweight systems for space applications. As a result, they require that special conditions be fulfilled to ensure adequate structural performance, shape retention, and thermal stability. It is therefore important and essential to develop methodologies for predicting the complex properties of ultra-lightweight foams. To support NASA programs such as the Reusable Launch Vehicle (RLV), Clark Atlanta University, along with SORDAL, Inc., has initiated projects for commercial process development of polyimide foams for the proposed cryogenic tank integrated structure (see figure 1). Fabrication and characterization of high temperature, advanced aerospace-grade polyimide foams and filled foam sandwich composites for specified lifetimes in NASA space applications, as well as quantifying the lifetime of components, are immensely attractive goals. In order to improve the development, durability, safety, and life cycle performance of ultra-lightweight polymeric foams, test methods for the properties are constant concerns in terms of timeliness, reliability, and cost. A major challenge is to identify the mechanisms of failures (i.e., core failure, interfacial debonding, and crack development) that are reflected in the measured properties. The long-term goal of this research is to develop the tools and capabilities necessary to successfully *engineer* ultra-lightweight polymeric foams. The desire is to reduce density at the material and structural levels, while at the same time maintaining or increasing mechanical and other properties.

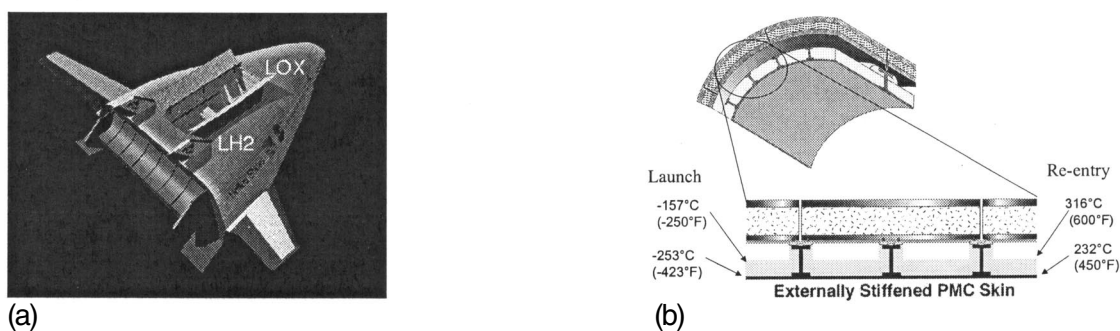


Figure 1. (a) Proposed RLV. (b) Cryogenic tank integrated structure.

Phone: 404-880-6709

Fax: 404-880-6890

Tech. Monitor: Michael Meador Phone: 216-433-9518

## GRC HBCU's/OMU's RESEARCH CONFERENCE

### Effects of Impact Damage in Midplane Asymmetric Sandwich Composites

M. Mensah Webb and David R. Veazie  
 Clark Atlanta University  
 Department of Engineering  
 223 James P. Brawley Drive, SW  
 Atlanta, Georgia 30314

#### ABSTRACT

Several structural sandwich composites are in service on military and commercial aerospace vehicles, however, these components have been limited to secondary structures partly because the impact damage and damage tolerance of these composites have not been extensively characterized. To improve durability, safety, and life cycle performance of PMCs while reducing maintenance costs, combined analysis, and test methods that provide a means of predicting critical engineering properties after impact damage of the structure, must be developed. A key enabling technology here is the establishment of the correlation between the impact test results conducted in the laboratory and the mechanics-based phenomenological solutions. This research was undertaken to investigate the compression and flexural properties following low velocity impact of a nomex/phenolic honeycomb core, fiberglass/epoxy facesheet, midplane asymmetric sandwich composite. One facesheet (thin side) was composed of two plies of the fiberglass/epoxy (0/90), while the other facesheet (thick side) was composed of four plies (0/90/0/90) of fiberglass/epoxy. Due to the differences in facesheet thickness, impact damage was separately induced on the thick side as well as the thin side. The compression and flexural strength properties for each damage arrangement were compared using different levels of impact energy ranging from 0 to 452 Joules (see figure 1). In all cases, higher impact energy resulted in decreased compression and flexural strength. Impact on the thin side showed slightly more retention of compression strength at low impact levels, whereas higher residual compressive strength was observed from impact on the thick side at higher impact levels. Different facesheet thicknesses or midplane asymmetry, played an important role in the flexural strength, however, low velocity impact on the both the thick and thin fiberglass/epoxy facesheet side showed an almost linear loss of flexural strength to saturation.

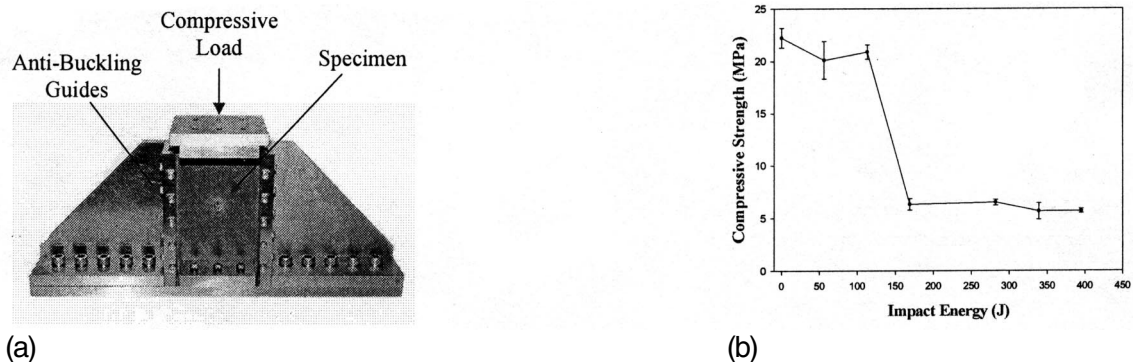


Figure 1. (a) Compression after impact. (b) Residual strength model.

Phone: 404-880-6709

Fax: 404-880-6890

Tech. Monitor: Michael Meador Phone: 216-433-9518

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Robust Fault Detection

Emmanuel G. Collins, Tinglun Song, Tramone Curry, and Majura Selekwa  
Florida A&M University  
Department of Mechanical Engineering  
2525 Pottsdamer Street  
Tallahassee, Florida 32310

**ABSTRACT**

This research used mixed structured singular value theory to develop new estimator (or observer) based approaches to fault detection for dynamic systems. The initial developments were based on minimizing the H-infinity, l-1 and H2 system norms. The resultant fault detection algorithms were each shown to be successful, but the fault detection algorithm based on the l-1 norm was best able to detect abrupt faults. This latter technique was further improved by using fuzzy logic for the fault evaluation. Based on an anomaly observed in this research and apparently ignored in the literature, current research focuses on the determination of a fault using a norm of *the change* in the residual (the difference between the output of the system and observer) and not simply a norm of the residual itself. This research may lead to a fundamental contribution to research in fault detection and isolation.

Phone: 850-410-6373

Fax: 850-410-6337

Tech. Monitor: Ten-Huei Guo Phone: 216-433-3734

## GRC HBCU's/OMU's RESEARCH CONFERENCE

### Numerical Simulation of One- and Two-Phase Flows in Propulsion Systems

Mikhail Gilinsky, Arun Verma, Jay C. Hardin, and Debrup Banerjee  
Hampton University  
Hampton, Virginia 23668

Isaiah M. Blankson and Robert C. Hendricks  
National Aeronautics and Space Administration  
Glenn Research Center  
Cleveland, Ohio 44135

Alexander I. Shvets  
Institute of Mechanics of Moscow State University  
Moscow 117192, Russia

### ABSTRACT

This report presented contains the main results of joint research between the Hampton University Fluid Mechanics and Acoustics Laboratory (FM&AL), NASA GRC, and the Institute of Mechanics at Moscow State University (IM/MSU) in Russia. This research is also supported by a CRDF grant. Four subprojects were conducted using analytical methods, numerical simulation and experimental tests: (A) Shock wave mitigation by spike-shaped blunt bodies with application for the purpose of drag, lift and longitudinal momentum optimization. The main result in this subproject is: application of a single needle against a supersonic flow provides higher benefits for blunt body drag reduction and heat transfer to the body than the application of multiple needles. (B) Solid particles, liquid and air jet injection through the front of a blunt body against a supersonic flow. In this case, the research conducted and analysis of multiple previous investigations in this area have shown essential benefits and preferable application of solid particle injection. (C) Comparison of different methods of fuel injection into supersonic duct flows. Preliminary numerical simulations and theoretical analysis show promising results for Telescope-shaped inlet applications in SCRAMJET; and (D) Development of an acoustic source location method for different applications including propulsion systems. The main outcomes during this reporting period are: (1) Presentation of papers: An AIAA Paper 01-1893 at the AIAA/NAL-NASDA-ISAS 10th International Space Planes and Hypersonic Systems and Technologies Conference, 24-27 April 2001, Kyoto, Japan. Also, an AIAA Paper 01-3204 at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 08-11 July 2001, Salt Lake City, Utah; and 2 reports at the HBCUs/OMUs Research Conference, OAI/NASA GRC, 17-18 April 2001. (2) Four abstracts were submitted and accepted. These will be presented at national and International Conferences and Congresses. The review for NASA entitled: "Spike and Jet Nosed Bodies in Supersonic Flow" is in the final stage of preparation. (3) Submission of Proposals and White Papers: An unsolicited proposal to the NASA GRC, 4 Notices of Intent, two White Papers to NASA and two proposals to the CRDF. (4) Theory and numerical simulations: Analytical theory, numerical simulation, comparison of theoretical with experimental results, and modification of theoretical approaches, models, grids etc. have been conducted for several complicated 2D and 3D nozzle and inlet designs using NASA and IM/MSU codes based on marching and full Euler and Navier-Stokes solvers: CFL3D, VULCAN, GODUNOV, and others. (5) Experimental tests and student training: The course: "Advanced Aerodynamics and Aircraft Performance" was presented in the fall semester, 2001; training and experimental tests using the HU LSWT. (6) Improvement of the FM&AL computer system: installation of third generation software TECPLOT 9.0 for the UNIX SGI workstation, NASA software "Alchemize" as a support for the NASA codes: GRIDGEN, CFL3D and VULCAN and others. (7) Student Research Activity: Involvement of two graduate and one undergraduate students as research assistants in the current research project fulfillment. Note that this research by the FM&AL research team was conducted jointly with the team working on another project under the NASA grant NAG-2249. Therefore outcomes for both projects are partially the same.

Phone: 757-727-5741

Fax: 757-727-5189

Tech. Monitor: Isaiah M. Blankson Phone: 216-433-5823

## GRC HBCUS/OMUS RESEARCH CONFERENCE

Advanced Methods for Aircraft Engine Thrust and Noise Benefits: Nozzle-Inlet Flow Analysis

Morris H. Morgan, Mikhail Gilinsky, Kaushal Patel, and Calvin Coston  
Hampton University  
Hampton, Virginia 23668

Isaiah M. Blankson  
National Aeronautics and Space Administration  
Glenn Research Center  
Cleveland, Ohio 44135

### ABSTRACT

The report presented contains the main results of joint research between the Fluid Mechanics and Acoustics Laboratory at Hampton University (FM&AL), NASA Glenn Research Center, and NASA Langley Research Center. This research was also supported by the CRDF grant RE1-2068 (2000-01) for the NASA GRC and the Institute of Mechanics at Moscow State University (IM/MSU) in Russia. The research is focused on a wide regime of problems in the propulsion field as well as in experimental testing and theoretical and numerical simulation analyses for advanced aircraft and rocket engines. Results obtained are based on analytical methods, numerical simulations and experimental tests at the NASA LaRC and Hampton University computer complexes and experimental facilities. The main objective of this research is injection, mixing and combustion enhancement in propulsion systems. The subprojects in the reporting period are: (A) Aeroperformance and acoustics of Telescope-shaped designs. The work included a pylon set application for SCRAMJET. (B) An analysis of sharp-edged nozzle exit designs for effective fuel injection into the flow stream in air-breathing engines: triangular-round and diamond-round nozzles. (C) Measurement technique improvements for the HU Low Speed Wind Tunnel (HU LSWT) including an automatic data acquisition system and a two component (drag-lift) balance system. In addition, a course in the field of aerodynamics was developed for the teaching and training of HU students. The main outcomes during this reporting period are: (1) Presentation of papers: An AIAA Paper 01-1893 at the AIAA/NAL-NASDA-ISAS 10th International Space Planes and Hypersonic Systems and Technologies Conference, 24-27 April 2001, Kyoto, Japan. Also, an AIAA Paper 01-3204 at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 08-11 July 2001, Salt Lake City, UT; and a report at the HBCUs/OMUs Research Conference, OAI/NASA GRC, 17-18 April, 2001. (2) Four abstracts were submitted and accepted. These will be presented at national and International Conferences and Congresses. (3) Submission of Proposals and White Papers: An unsolicited proposal to the NASA GRC, 4 Notices of Intent, two White Papers to NASA and two proposals to the CRDF. (4) Theory and numerical simulations: Analytical theory, numerical simulation, comparison of theoretical with experimental results, and modification of theoretical approaches, models, grids etc. have been conducted for several complicated 2D and 3D nozzle and inlet designs using NASA and IM/MSU codes based on full Euler and Navier-Stokes solvers: CFL3D, VULCAN and GODUNOV. (5) Experimental tests and student training: The course: "Advanced Aerodynamics and Aircraft Performance" was presented in the fall semester, 2001; training and experimental tests using the HU LSWT. (6) Improving of the FM&AL computer system: installation of third generation software TECPLOT 9.0 for the UNIX SGI workstation, NASA software "Alchemize" as a support for the NASA codes: GRIDGEN, CFL3D and VULCAN and others. (7) Student Research Activity: Involvement of two graduate and one undergraduate students as research assistants in the current research project fulfillment.

Phone: 757-727-5741

Fax: 757-727-5189

Tech. Monitor: Isaiah M. Blankson Phone: 216-433-5823

**GRC HBCU's/OMU's RESEARCH CONFERENCE**

Experimental Verification of Electric Drive Technologies Based on Artificial Intelligence Tools

Ahmed Rubaii  
Howard University  
2300 6th Street, NW  
Washington, DC 20059

**ABSTRACT**

A laboratory implementation of a fuzzy logic-tracking controller using a low cost Motorola MC68HC11E9 microprocessor is described in this report. The objective is to design the most optimal yet practical controller that can be implemented and marketed, and which gives respectable performance, even when the system loads, inertia and parameters are varying. A distinguishing feature of this work is the by-product goal of developing a marketable, simple, functional and low cost controller. Additionally, real-time nonlinearities are not ignored, and a mathematical model is not required. A number of components have been designed, built and tested individually, and in various combinations of hardware and software segments. These components have been integrated with a brushless motor to constitute the drive system. A microprocessor-based FLC is incorporated to provide robust speed and position control. Design objectives that are difficult to express mathematically can be easily incorporated in a fuzzy logic-based controller by linguistic information (in the form of fuzzy IF-THEN rules). The theory and design are tested in the laboratory using a hardware setup. Several test cases have been conducted to confirm the effectiveness of the proposed controller. The results indicate excellent tracking performance for both speed and position trajectories. For the purpose of comparison, a bang-bang controller has been tested. The fuzzy logic controller performs significantly better than the traditional bang-bang controller. The bang-bang controller has been shown to be relatively inaccurate and lacking in robustness. Description of the implementation hardware system is also given.

Phone: 202-806-5767

Fax: 202-806-5258

Tech. Monitor: M. David Kankam Phone: 216-433-6143

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Novel High Efficient Organic Photovoltaic Materials

Sam Sun, James Haliburton, Yiqing Wang, Zhen Fan, Charles Taft, and Shahin Maaref  
Norfolk State University  
Center for Materials Research  
700 Park Avenue  
Norfolk, Virginia 23504

**ABSTRACT**

Solar energy is a renewable, nonpolluting, and most abundant energy source for human exploration of a remote site or outer space. In order to generate appreciable electrical power in space or on the earth, it is necessary to collect sunlight from large areas and with high efficiency due to the low density of sunlight. Future organic or polymer (plastic) solar cells appear very attractive due to their unique features such as light weight, flexible shape, tunability of energy band-gaps via versatile molecular or supramolecular design, synthesis, processing and device fabrication schemes, and much lower cost on large scale industrial production. It has been predicted that supramolecular and nano-phase separated block copolymer systems containing electron rich donor blocks and electron deficient acceptor blocks may facilitate the charge carrier separation and migration due to improved electronic ultrastructure and morphology in comparison to polymer composite system. This presentation will describe our recent progress in the design, synthesis and characterization of a novel block copolymer system containing donor and acceptor blocks covalently attached. Specifically, the donor block contains an electron donating alkyloxy derivatized polyphenylenevinylene (RO-PPV), the acceptor block contains an electron withdrawing alkyl-sulfone derivatized polyphenylenevinylene (SF-PPV). The key synthetic strategy includes the synthesis of each individual block first, then couple the blocks together. While the donor block has a strong PL emission at around 560 nm, and acceptor block has a strong PL emission at around 520 nm, the PL emissions of final block copolymers are severely quenched. This verifies the expected electron transfer and charge separation due to interfaces of donor and acceptor nano phase separated blocks. The system therefore has potential for variety light harvesting applications, including high efficient photovoltaic applications.

Phone: 757-823-2993

Fax: 757-823-9054

Tech. Monitor: Sheila Bailey Phone: 216-433-2228



**GRC HBCU's/OMU's RESEARCH CONFERENCE**

An Innovative Manufacturing of CCC Ion Thruster Grids by  
North Carolina A&T's RTM Carbon/Carbon Process

Kunigal N. Shivakumar  
North Carolina A&T State University  
Center for Composite Materials Research  
Fort IRC Building, Room 205  
1601 East Market Street  
Greensboro, North Carolina 27411

**ABSTRACT**

Electric ion thrusters are the preferred engines for deep space missions, because of very high specific impulse. The ion engine consists of screen and accelerator grids containing thousands of concentric very small holes. The xenon gas accelerates between the two grids, thus developing the impulse force. The dominant life-limiting mechanism in the state-of-the-art molybdenum thrusters is the xenon ion sputter erosion of the accelerator grid. Carbon/carbon composites (CCC) have shown to have less than 1/7 the erosion rates than the molybdenum, thus for interplanetary missions CCC engines are inevitable. Early effort to develop CCC composite thrusters had a limited success because of limitations of the drilling technology and the damage caused by drilling. The proposed is an in-situ manufacturing of holes while the CCC is made. Special low CTE molds will be used along with the NC A&T's patented resin transfer molding (RTM) technology to manufacture the CCC grids. First, a manufacture process for 10-cm diameter thruster grids will be developed and verified. Quality of holes, density, CTE, tension, flexure, transverse fatigue and sputter yield properties will be measured. After establishing the acceptable quality and properties, the process will be scaled to manufacture 30-cm diameter grids. The properties of the two grid sizes are compared with each other.

Phone: 336-334-7411 or 7412, Ext. 2112

Fax: 336-256-0873

Tech. Monitor: Thomas W. Haag Phone: 216-977-7423

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications

Kunigal N. Shivakumar  
North Carolina A&T State University  
Center for Composite Materials Research  
Fort IRC Building, Room 205  
1601 East Market Street  
Greensboro, North Carolina 27411

**ABSTRACT**

Fiber reinforced ceramic composites are materials of choice for gas turbine engines because of their high thermal efficiency, thrust/weight ratio, and operating temperatures. However, the successful introduction of ceramic composites to hot structures is limited because of excessive cost of manufacturing, reproducibility, nonuniformity, and reliability. Intense research is going on around the world to address some of these issues. The proposed effort is to develop a comprehensive status report of the technology on processing, testing, failure mechanics, and environmental durability of carbon fiber reinforced ceramic composites through extensive literature study, vendor and end-user survey, visits to facilities doing this type of work, and interviews. Then develop a cooperative research plan between NASA GRC and NCA&T (Center for Composite Materials Research) for processing, testing, environmental protection, and evaluation of fiber reinforced ceramic composites.

Phone: 336-334-7411 or 7412, Ext. 2112  
Fax: 336-256-0873  
Tech. Monitor: Marc Freedman Phone: 216-433-3284

**GRC HBCU's/OMU's RESEARCH CONFERENCE**

## Low-Power SOI CMOS Transceiver

K. Cheruiyot, J. Cothorn, D. Huang, S. Singh, E. Zencir, and N. Dogan  
North Carolina A&T State University  
551 McNair Hall, Department of Electrical Engineering  
1601 East Market Street  
Greensboro, North Carolina 27411

**ABSTRACT**

This work is being conducted by the RF Microelectronics Laboratory in the Electrical Engineering Department at North Carolina A&T State University under NASA Grant No. NAG3-2584. North Carolina State University at Raleigh, North Carolina is also participating in this research supported by a subcontract. The work aims at developing a low-power SOI CMOS Transceiver for deep-space communications. RF Receiver must accomplish the following tasks: (a) Select the desired radio channel and reject other radio signals, (b) Amplify the desired radio signal and translate them back to baseband, and (c) Detect and decode the information with Low BER. In order to minimize cost and achieve high level of integration, receiver architecture should use least number of external filters and passive components. It should also consume least amount of power to minimize battery cost, size, and weight. One of the most stringent requirements for deep-space communication is the low-power operation. Our study identified that two candidate architectures listed in the following meet these requirements: (1) Low-IF receiver, (2) Subsampling receiver. The low-IF receiver uses minimum number of external components. Compared to Zero-IF (Direct conversion) architecture, it has less severe offset and flicker noise problems. The Subsampling receiver amplifies the RF signal and samples it using track-and-hold Subsampling mixer. These architectures provide low-power solution for the short-range communications missions on Mars. Accomplishments to date include: (1) System-level design and simulation of a Double-Differential PSK receiver, (2) Implementation of Honeywell SOI CMOS process design kit (PDK) in Cadence design tools, (3) Design of test circuits to investigate relationships between layout techniques, geometry, and low-frequency noise in SOI CMOS, (4) Model development and verification of on-chip spiral inductors in SOI CMOS process, (5) Design/implementation of low-power low-noise amplifier (LNA) and mixer for low-IF receiver, and (6) Design/implementation of high-gain LNA for sub-sampling receiver. Our initial results show that substantial improvement in power consumption is achieved using SOI CMOS as compared to standard CMOS process. Potential advantages of SOI CMOS for deep-space communication electronics include: (1) Radiation hardness, (2) Low-power operation, and (3) System-on-Chip (SOC) solutions.

Phone: 336-334-7348, Ext. 223

Fax: 336-334-7716

Tech. Monitor: Gene Fujikawa Phone: 216-433-3495

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

Research to Significantly Enhance Composites Survivability at 550 °F in  
Oxidative Environments

L. Guinn, A. Tewoldeberhan, M. Inkumsah, F. Makori, A. Carty, and L. Carson  
Prairie View A&M University  
University Blvd., New Science Building  
Prairie View, Texas 77446

**ABSTRACT**

Methylene dianiline (MDA) and its derivatives have been used in the synthesis of polyimides to yield polymers with characteristic low-density, high tensile strength, improved solubility in organic solvents, low-melt viscosities and high thermal stability (> 550 °F) in air. Polyimides with such properties are desirable for use in aerospace systems, e.g., jet engines, airframe, missiles, and rockets where weight is critical. Recent research at Prairie View A&M University is focused on developing monomers to generate polyimides with enhanced performance over that of NASA's PMR-15. The objective of this work is to synthesize three ring aromatic diamines which are non-toxic and when reacted with the appropriate dianhydrides will yield polyimides with lower viscosity, improve processability, good retention of mechanical properties, and oxidative stability at high environmental temperatures. Modifications of the three ring aromatic diamines include replacing the methylene linkages with aromatic ethers by nucleophilic aromatic substitution reactions and incorporating mono- and di-substituents to the center aromatic ring. An update of current reactions involved in synthesis efforts to generate three ring aromatic monomers for polyimides with methylene, carbonyl, and ether linkages separating the aromatic moieties will be displayed.

Phone: 936-857-3914

Fax: 936-857-2095

Tech. Monitor: Michael A. Meador Phone: 216-433-9518

**GRC HBCU's/OMU's RESEARCH CONFERENCE**

## On Human Resource Diversity in Distributed Energy Technology

A. Kalu  
Savannah State University  
P.O. Box 20089  
Savannah, Georgia 31404

C. Emrich and G. Ventre  
Florida Solar Energy Center  
1679 Clearlake Road  
Cocoa, Florida 32922

R. Acosta  
National Aeronautics and Space Administration  
Glenn Research Center  
Cleveland, Ohio 44135

**ABSTRACT**

The under representation of African Americans and other minority groups in science and technology is well known. No more so is this fact true than in the renewable energy industry. African Americans are essentially not involved in the advanced energy industry, albeit they can contribute immensely to the growth of the industry due to their cultural ties with developing countries where these emerging energy technologies find vast applications and markets. Not only is there a need to empower HBCUs with the ability to prepare the communities they serve for full participation in this emerging industry, but also HBCUs can play an important role in removing the impediment to a widespread use of renewable energy in developing countries for the mutual benefit of United States energy industry and the developing countries of Africa in particular. Because of their historical and cultural ties with Africa, these institutions can be very effective in training personnel from African and other developing countries to produce a cadre of trained and certified technicians of distributed energy technology. Furthermore, the graduates of HBCUs trained in this field could be very effective in marketing U.S. energy technologies in the rapidly growing markets of emerging democracies. Even though several generically designed programs have been enacted to encourage and enhance the diversification of our technological workforce, with some success, there is a need for a focused effort to include the under represented segments of our society at the early stages of the emergence of distributed energy technologies. An effective means for building the capacity of minority populations to participate in this industry would be the introduction of relevant renewable energy courses in the curricula of HBCUs and MIs. A necessary first step is the design and pilot teaching of a select number of courses in distributed energy technologies. For this reason, Savannah State University (SSU), an HBCU, in partnership with the Florida Solar Energy Center (FSEC) chose to focus on course design as part of the RE SCADA/Training project. Leveraging additional funding by the National Science Foundation (NSF), SSU and FSEC in collaboration with Brevard Community College (BCC) will design fully integrated, industry-based course curricula for training certified technicians that will address the emerging distributed energy commercial and residential needs. The curricula to be produced will address the following advanced energy technologies: Building Trades, Photovoltaics, Microturbines, Fuel Cells, Solar Thermal, Distributed Generation, and Combined Heat and Power. Towards this end, the following five distributed energy courses are under development: Introduction to Distributed Energy Technology, Energy Efficient Buildings, Alternative Fuels and Electric Vehicle Technology, Solar Thermal Technologies, and Distributed Electric Power Generation and Storage.

Phone: 912-356-2282  
Fax: 912-356-2432  
Tech. Monitor: Roberto J. Acosta Phone: 216-433-6640

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

Research Project for Increasing the Pool of Minority Engineers

Decatur B. Rogers  
Tennessee State University  
College of Engineering Technology and Computer Science  
Nashville, Tennessee 37209

**ABSTRACT**

The NASA Glenn Research Center (GRC) funded the 2001–2002 Tennessee State University (TSU) Research Project for increasing the pool of minority engineers. The NASA GRC/TSU Research Project is designed to develop a cadre of SMET professionals who have academic and research expertise in technical areas of interest to NASA, in addition to having some familiarity with the mission of the NASA Glenn Research Center. The goal of increasing minority participation in SMET disciplines was accomplished by: (1) introducing and exposing 96 minority youth to SMET careers and to the required high school preparation necessary to make high school graduation, college attendance and engineering careers a reality through the campus based pre-college SMET program: Minority Introduction to Engineering (MITE); (2) by providing financial support through scholarships for four (4) TSU engineering students to NASA; (3) familiarization with the SMET profession and with NASA through summer internships at NASA GRC for two TSU NASA Glenn Research Scholars; and experiences through research internships at NASA GRC.

Phone: 615–963–5401  
Fax: 615–963–9357  
Tech. Monitor: Susan F. Gott Phone: 216–433–3833

**GRC HBCU's/OMU's RESEARCH CONFERENCE****A Nonlinear Model for Fuel Atomization in Spray Combustion**

Essam A. Ibrahim and Dave Sree  
Tuskegee University  
Department of Mechanical Engineering  
Tuskegee, Alabama 36088

**ABSTRACT**

Most gas turbine combustion codes rely on ad-hoc statistical assumptions regarding the outcome of fuel atomization processes. The modeling effort proposed in this project is aimed at developing a realistic model to produce accurate predictions of fuel atomization parameters. The model involves application of the nonlinear stability theory to analyze the instability and subsequent disintegration of the liquid fuel sheet that is produced by fuel injection nozzles in gas turbine combustors. The fuel sheet is atomized into a multiplicity of small drops of large surface area to volume ratio to enhance the evaporation rate and combustion performance. The proposed model will effect predictions of fuel sheet atomization parameters such as drop size, velocity, and orientation as well as sheet penetration depth, breakup time and thickness. These parameters are essential for combustion simulation codes to perform a controlled and optimized design of gas turbine fuel injectors. Optimizing fuel injection processes is crucial to improving combustion efficiency and hence reducing fuel consumption and pollutants emissions.

Phone: 334-727-8974  
Fax: 334-727-8090  
Tech. Monitor: Nan-Suey Liu Phone: 216-433-8722

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Structural Evolution and Mechanical Properties of PMR-15/Layered Silicate Nanocomposites

Derrick Dean, Mohamed Abdalla, Keith Green, and Sharee Small  
Tuskegee University  
101 James Center  
Tuskegee, Alabama 36088

**ABSTRACT**

In the first year of this research, we successfully synthesized and characterized Polymer/Layered Silicate nanocomposite using the polyimide PMR-15 as the polymer and several layered silicate nanoparticles. We have scaled up the process to allow fabrication of monoliths using these nanocomposites. The morphology of these systems was found to evolve during processing to an exfoliated structure for one system and intercalated for the rest. Correlation with Transmission Electron Microscopy studies is underway. Dynamic mechanical analysis (DMA) results showed a significant increase in the thermomechanical properties ( $E'$  and  $E''$ ) of 2.5 wt.% clay loaded nanocomposites in comparison to the neat polyimide. Increasing the clay loading to 5 wt.% decreased these properties. Higher glass transition temperatures were observed for 2.5 wt.% nanocomposites compared to the neat polyimide. A lower coefficient of thermal expansion was observed only for the PGV/PMR-15 nanocomposite. An improvement in the flexural properties (modulus, strength and elongation) was observed for the 2.5 wt.% nanocomposite but not for the 5 wt.% nanocomposites. The improved barrier properties polymer/silicate nanocomposites suggest that moisture uptake should be decreased for PMR-15 nanocomposites. The results of some recent experiments to examine delineate the ability of the silicate nanoparticles in improving the hydrolytic degradation of PMR-15 will be discussed.

Phone: 334-724-4247

Fax: 334-724-4224

Tech. Monitor: Sandi Campbell Phone: 216-433-8489



**GRC HBCU's/OMU's RESEARCH CONFERENCE**

## Computational Methods for Jet Noise Simulation

Thomas Hagstrom  
University of New Mexico  
415 Humanities Building  
Albuquerque, New Mexico 87131

**ABSTRACT**

The purpose of our project is to develop, analyze, and test novel numerical technologies central to the long term goal of direct simulations of subsonic jet noise. Our current focus is on two issues: accurate, near-field domain truncations and high-order, single-step discretizations of the governing equations. The DNS of jet noise poses a number of extreme challenges to computational technique. In particular, the problem involves multiple temporal and spatial scales as well as flow instabilities and is posed on an unbounded spatial domain. Moreover, the basic phenomenon of interest, the radiation of acoustic waves to the far field, involves only a minuscule fraction of the total energy. The best current simulations of jet noise are at low Reynolds number. It is likely that an increase of one to two orders of magnitude will be necessary to reach a regime where the separation between the energy-containing and dissipation scales is sufficient to make the radiated noise essentially independent of the Reynolds number. Such an increase in resolution cannot be obtained in the near future solely through increases in computing power. Therefore, new numerical methodologies of maximal efficiency and accuracy are required.

Phone: 505-277-4613  
Fax: 505-277-5505  
Tech. Monitor: John W. Goodrich Phone: 216-433-5922

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Characterizing Non-Uniformity of Performance of Thin-Film Solar Cells

Gregory B. Lush  
University of Texas at El Paso  
Department of Electrical and Computer Engineering  
El Paso, Texas 79968

**ABSTRACT**

Thin-film Solar Cells are being actively studied for terrestrial and space applications because of their potential to provide low-cost, lightweight, and flexible electric power system. Currently, thin-film solar cell performance is limited partially by the nonuniformity of performance that they typically exhibit. This nonuniformity of performance necessitates more detailed characterization techniques than the well-known macroscopic measurements such as current-voltage and efficiency. This project seeks to explore methods of characterization that take into account the spatial nonuniformity of thin-film solar cells. In this presentation we show results of electroluminescence images, short-circuit maps, and Kelvin Probe maps. All these mapping characterization and analysis tools show that the non-uniformities can be correlated with device performance and efficiency.

Phone: 915-747-6632  
Fax: 915-747-7871  
Tech. Monitor: Eric B. Clark Phone: 216-433-3926

**GRC HBCU's/OMU's RESEARCH CONFERENCE**

## Structural Reliability Using Probability Density Estimation Methods Within NESSUS

Cody Ric Godines  
University of Texas at San Antonio  
4900 North Loop, 1604 West  
San Antonio, Texas 78249

**ABSTRACT**

A reliability analysis studies a mathematical model of a physical system taking into account uncertainties of design variables and common results are estimations of a response density, which also implies estimations of its parameters. Some common density parameters include the mean value, the standard deviation, and specific percentile(s) of the response, which are measures of central tendency, variation, and probability regions, respectively. Reliability analyses are important since the results can lead to different designs by calculating the probability of observing safe responses in each of the proposed designs. All of this is done at the expense of added computational time as compared to a single deterministic analysis which will result in one value of the response out of many that make up the density of the response. Sampling methods, such as monte carlo (MC) and latin hypercube sampling (LHS), can be used to perform reliability analyses and can compute nonlinear response density parameters even if the response is dependent on many random variables. Hence, both methods are very robust; however, they are computationally expensive to use in the estimation of the response density parameters. Both methods are 2 of 13 stochastic methods that are contained within the Numerical Evaluation of Stochastic Structures Under Stress (NESSUS) program. NESSUS is a probabilistic finite element analysis (FEA) program that was developed through funding from NASA Glenn Research Center (GRC). It has the additional capability of being linked to other analysis programs; therefore, probabilistic fluid dynamics, fracture mechanics, and heat transfer are only a few of what is possible with this software. The LHS method is the newest addition to the stochastic methods within NESSUS. Part of this work was to enhance NESSUS with the LHS method. The new LHS module is complete, has been successfully integrated with NESSUS, and been used to study four different test cases that have been proposed by the Society of Automotive Engineers (SAE). The test cases compare different probabilistic methods within NESSUS because it is important that a user can have confidence that estimates of stochastic parameters of a response will be within an acceptable error limit. For each response, the mean, standard deviation, and 0.99 percentile, are repeatedly estimated which allows confidence statements to be made for each parameter estimated, and for each method. Thus, the ability of several stochastic methods to efficiently and accurately estimate density parameters is compared using four valid test cases. While all of the reliability methods used performed quite well, for the new LHS module within NESSUS it was found that it had a lower estimation error than MC when they were used to estimate the mean, standard deviation, and 0.99 percentile of the four different stochastic responses. Also, LHS required a smaller amount of calculations to obtain low error answers with a high amount of confidence than MC. It can therefore be stated that NESSUS is an important reliability tool that has a variety of sound probabilistic methods a user can employ and the newest LHS module is a valuable new enhancement of the program.

Phone: 210-458-5522

Fax: 210-458-5586

Tech. Monitor: Christos C. Chamis Phone: 216-433-3252

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## Student Outreach With Renewable Energy Technology

D. Buffinger, C. Fuller, and A. Kalu  
Wilberforce University  
CARET (Consortium for Advancing Renewable Energy Technology)  
1055 North Bickett Road  
Wilberforce, Ohio 45384

**ABSTRACT**

The Student Outreach with Renewable Energy Technology (SORET) program is a joint grant that involves a collaboration between three HBCU's (Central State University, Savannah State University, and Wilberforce University) and NASA John H. Glenn Research Center at Lewis Field. The overall goal of the grant is to increase the interest of minority students in the technical disciplines, to encourage participating minority students to continue their undergraduate study in these disciplines, and to promote graduate school to these students. As a part of SORET, Central State University has developed an undergraduate research associates program over the past two years. As part of this program, students are required to take special laboratory courses offered at Wilberforce University that involve the application of renewable energy systems. The course requires the students to design, construct, and install a renewable energy project. In addition to the applied renewable energy course, Central State University provided four undergraduate research associates the opportunity to participate in summer internships at Texas Southern University (Renewable Energy Environmental Protection Program) and the Cleveland African-American Museum (Renewable Energy Summer Camp for High School Students) an activity cosponsored by NASA and the Cleveland African-American Museum. Savannah State University held a high school summer program with a theme of "the Direct Impact of Science on Our Every Day Lives." The purpose of the institute was to whet the interest of students in science, mathematics, engineering, and technology (SMET) by demonstrating the effectiveness of science to address real world problems. The 2001 institute involved the design and installation of a PV water pumping system at the Center for Advanced Water Technology and Energy Systems at Savannah State. Both high school students and undergraduates contributed to this project. Wilberforce University has used NASA support to provide resources for an Applied Renewable Energy Laboratory offered to both Central State and Wilberforce students. In addition, research endeavors for high school and undergraduates were funded during the summer. The research involved attempts to layer photovoltaic materials on a conducting polymer (polypyrrole) substrate. Two undergraduate students who were interested in polymer research originated this concept. Finally, the university was able to purchase a meteorological station to assist in the analysis of the solar/wind hybrid power system operating at the university.

Phone: 937-708-5659

Fax: 937-708-5793

Tech. Monitor: Eric B. Clark Phone: 216-433-3926

**GRC HBCU's/OMU's RESEARCH CONFERENCE**

Generic Divide and Conquer Internet-Based Computing

Atanas Radenski\*

Winston-Salem State University

601 Martin Luther King Jr. Drive

Winston-Salem, North Carolina 27110

\*Presently with Chapman University, Orange, California

**ABSTRACT**

The growth of Internet-based applications and the proliferation of networking technologies have been transforming traditional commercial application areas as well as computer and computational sciences and engineering. This growth stimulates the exploration of Peer to Peer (P2P) software technologies that can open new research and application opportunities not only for the commercial world, but also for the scientific and high-performance computing applications community. The general goal of this project is to achieve better understanding of the transition to Internet-based high-performance computing and to develop solutions for some of the technical challenges of this transition. In particular, we are interested in creating long-term motivation for end users to provide their idle processor time to support computationally intensive tasks. We believe that a practical P2P architecture should provide useful service to both clients with high-performance computing needs and contributors of lower-end computing resources. To achieve this, we are designing dual-*service* architecture for P2P high-performance divide-and-conquer computing; we are also experimenting with a prototype implementation. Our proposed architecture incorporates a master server, utilizes *dual satellite servers*, and operates on the Internet in a dynamically changing large configuration of lower-end nodes provided by volunteer contributors. A dual satellite server comprises a high-performance *computing engine* and a lower-end contributor *service engine*. The computing engine provides generic support for divide-and-conquer computations. The service engine is intended to provide free useful HTTP-based services to contributors of lower-end computing resources. Our proposed architecture is complementary to and accessible from computational grids, such as Globus, Legion, and Condor. Grids provide remote access to existing higher-end computing resources; in contrast, our goal is to utilize idle processor time of lower-end Internet nodes. Our project is focused on a generic divide and conquer paradigm and on mobile applications of this paradigm that can operate on a loose and ever changing pool of lower-end Internet nodes.

Phone: 714-744-7657

Fax: 714-628-7340

Tech. Monitor: Gregory J. Follen Phone: 216-433-5193

**GRC HBCUS/OMUS RESEARCH CONFERENCE**

## P2P Technology for High-Performance Computing: An Overview

Jason Berry  
Winston-Salem State University  
601 Martin Luther King Jr. Drive  
Winston-Salem, North Carolina 27110

**ABSTRACT**

The transition from cluster computing to peer-to-peer (P2P) high-performance computing has recently attracted the attention of the computer science community. It has been recognized that existing local networks and dedicated clusters of headless workstations can serve as inexpensive yet powerful virtual supercomputers. It has also been recognized that the vast number of lower-end computers connected to the Internet stay idle for as long as 90% of the time. The growing speed of Internet connections and the high availability of free CPU time encourage exploration of the possibility to use the whole Internet rather than local clusters as massively parallel yet almost freely available P2P supercomputer. As a part of a larger project on P2P high-performance computing, it has been my goal to compile an overview of the P2P paradigm. I have studied various P2P platforms and I have compiled systematic brief descriptions of their most important characteristics. I have also experimented and obtained hands-on experience with selected P2P platforms focusing on those that seem promising with respect to P2P high-performance computing. I have also compiled relevant literature and web references. I have prepared a draft technical report and I have summarized my findings in a poster paper.

Phone: 336-750-2480

Fax: 336-750-2499

Tech. Monitor: Gregory J. Follen Phone: 216-433-5193

**Page intentionally left blank**

## **Why Costing is Important on HBCU Grants**

CD-02-81961



## What is Important?

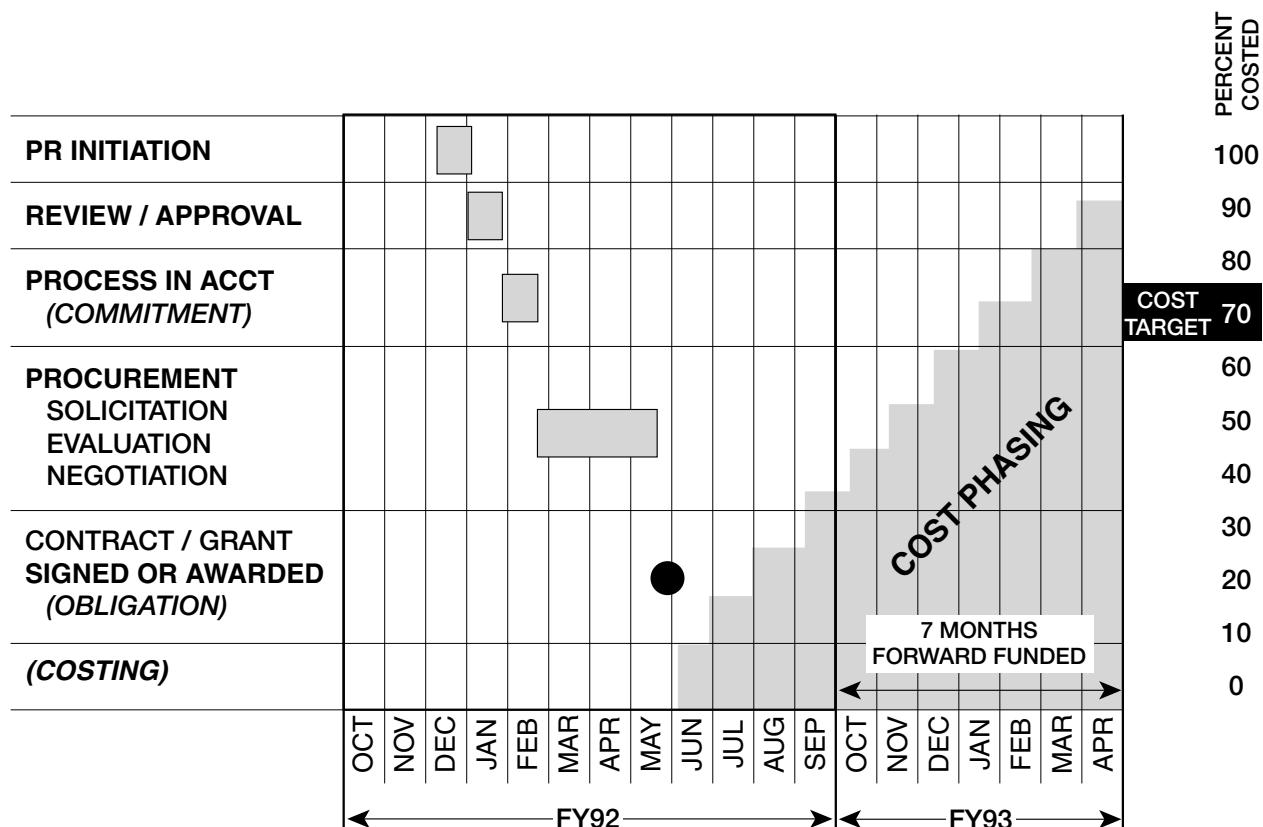
**Cost** is our only fiscal measure of *actual work accomplishment*. It can be utilized by management to evaluate the efficiency and effectiveness of budget execution on our programs.

## What does Forward Funding Mean?

**Forward Funding** Is expressed as either

1. *The amount of funding* that one's program or contract will not "cost" during the current fiscal year.
2. The period of time that your contract is forward funded into the next fiscal year. (*Note: RB's guideline is that forward funding be limited to no more than 2 months on all OAST contracts.*)

## Example of Poor Cost Management

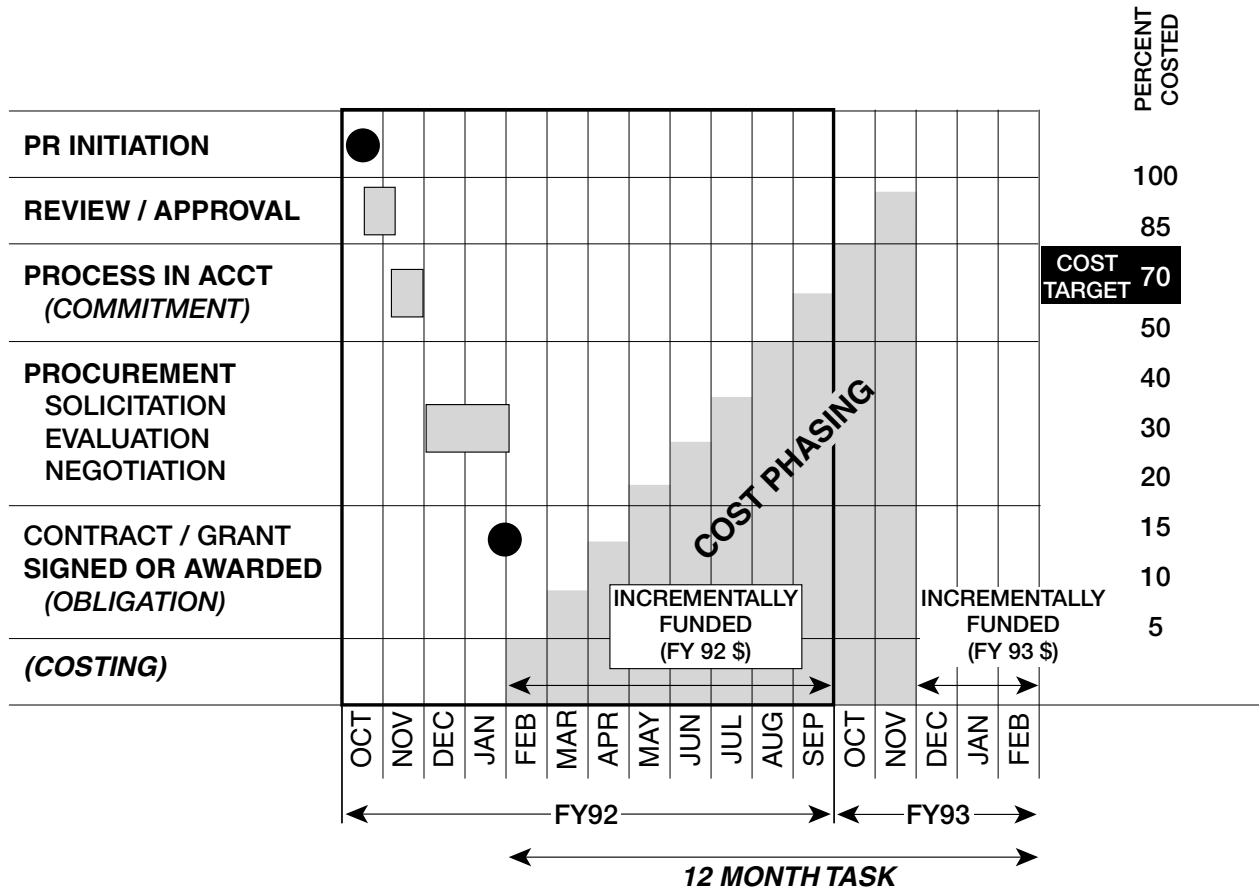


### KEY POINTS

- Early RTOP approval and early 506 release need to translate into early commitments and obligations
- You can't cost funds that are not obligated — Late fiscal year contract awards equate to minimal cost

CD-02-81963

## Example of Good Cost Management



### KEY POINTS

- Early PR initiation / commitment
- Timely obligation / contract award (by mid-year)
- Costing begins in time to effectively use the budgeted funds for current year research work

CD-02-81964

## Cost Management

### Checking account analogy

- ***Code R Policy*** allows ***2 months of forward funding*** on contracts (*beyond 9/30*) and a carryover of 30% of your budget allocation to cover expenditures in the following fiscal year.
- How many months of ***forward funding*** do you maintain in your ***personal checking account?***
- ***Flight centers and major agency programs*** operate with less than 2 weeks of forward funding into the following fiscal year
- ***External audit organizations can't understand*** why we ask for funds in our budget request that we won't spend in the current fiscal year

## Cost Management

### Checking account analogy

- ***NASA MUREP***
  - At least 80% of funds should be costed by the end of Federal fiscal year (September 30)
- ***NASA MUREP Grantees***
  - Incremental funding of large \$ value grants or cooperative agreements
  - Minimize forward funding beyond 2 months into the following fiscal year
  - 100% of funds should be encumbered by the end of the grant year; funds not encumbered will be deducted from the first incremental funding, actual carryover will be deducted from the second incremental funding

## **How can I Improve My Program's Cost Performance?**

### **RB Recommendations**

- 1.** Timelier initiation of procurements
  - "Long lead time" acquisitions (1st qtr)
  - Planning PR's / initiations use while awaiting 506 (1st qtr)
  - Small purchases / off-the-shelf buys (2nd qtr)
  - Tasks on support service contracts (1st half of year)
  
- 2.** Expanded use "Incremental Funding" of contracts
  - Recommended 2 actions per year (1-1st qtr; 2-midyear)
  - Avoid multi year / 100% funding up-front scenarios
  - Use incremental funding on major fixed-price contracts also
  
- 3.** Limit forward funding on incrementally-funded contracts (or major tasks on support service contracts) to only one month
  
- 4.** Implement a one-time adjustment to start dates on major grants/ contracts that are not incrementally funded (startup in 1st qtr, NOT 4th qtr)
  
- 5.** Ensuring that all legitimate accrued cost on your program is recorded in your Center fiscal systems in a timely and accurate manner
  
- 6.** Base budget requests upon how much \$ your program will be able to cost over the 12/1/97 – 12/1/98 time frame

## **Recommendation**

- *Submit all necessary information billing to your college finance, accounting, or billing offices on a timely basis (at least once per month)*
- *Insure that your college billing office submits required billing information to NASA Glenn each month so that Glenn may properly reflect accurate up-to-date costing on your HBCU grant*

## **Donald J. Campbell**

Donald J. Campbell is Director of the National Aeronautics and Space Administration's Glenn Research Center in Cleveland, Ohio. He was appointed to this position by NASA Administrator Daniel Goldin on January 6, 1994.

As Director, Mr. Campbell is responsible for planning, organizing, and directing the activities required to accomplish the missions assigned to the Center. Glenn is engaged in research, technology, and systems development programs in aeronautical propulsion, space propulsion, space power, and space sciences/applications. Campbell is responsible for the day-to-day management of these programs, which involve an annual budget of approximately \$1 billion, just under 2800 civil service employees and 2000 support service contractors, and more than 500 specialized research facilities located near Cleveland Hopkins International Airport and at Plum Brook Station in Sandusky, Ohio.

Campbell earned a bachelor's degree in mechanical engineering from Ohio Northern University, a master's degree in mechanical engineering and did predoctoral work at Ohio State University. He completed the Senior Executive Seminar in Management at Carnegie Mellon School of Urban and Public Affairs and the Federal Executive Institute Executive Leadership program. He also completed several senior management courses at Brookings Institute.

Campbell began his government career in 1960 as a test engineer for gas turbine engines and engine components in the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio. He then worked as a project engineer and later as a program manager for advanced airbreathing propulsion systems.

From February to July 1986, Campbell was assigned as an interim Directorate Chief during the implementation of the National Aerospace Plane (NASP) Program Office, Wright-Patterson Air Force Base. He was Acting Director of the NASP Technology Maturation Directorate. In 1987, he became Acting Deputy Director of the Aero Propulsion Laboratory. In 1988, he was selected for the rank of Senior Executive Service and was appointed Deputy Program Director for the Propulsion System Program Office, Aeronautical Systems Division. He was the senior civilian executive for development and acquisition of new and derivative gas turbine engines for operational aircraft. In 1990, he was appointed Director of the Aero Propulsion and Power Laboratory. He was responsible for the Air Force propulsion and power research and development in the areas of gas turbine engines, ramjet engines, aerospace power systems, and fuels and lubricants.

In 1992, he was named Director of Science and Technology, Office of the Assistant Secretary of the Air Force for Acquisition, Washington, D.C. In this capacity he monitored the Air Force Science and Technology program and other selected research, development, technology, and engineering programs.

Campbell and his wife, Helen, have four children.



## **Dr. Julian M. Earls**

Dr. Julian M. Earls, Deputy Director for Operations at the NASA John H. Glenn Research Center at Lewis Field, is a native of Portsmouth, Virginia. He earned the Bachelor's Degree, with distinction, in Physics from Norfolk State University; the Master's Degree in Radiation Physics from the University of Rochester School of Medicine; and the Doctorate Degree in Radiation Physics from the University of Michigan. He also earned the equivalent of a second Master's Degree in Environmental Health from the University of Michigan and is a graduate of the Harvard Business School's prestigious Program for Management Development. In addition, he was awarded the Honorary Doctor of Science degree by the College of Aeronautics in New York.

He has 21 publications, both technical and educational. He has been Distinguished Honors Visiting Professor at numerous universities throughout the Nation. On two separate occasions, he has been awarded NASA medals for exceptional achievement and outstanding leadership. In addition, he has received the Presidential Rank Award of Meritorious Executive. Dr. Earls is a Jennings Foundation Distinguished Scholar Lecturer.

Dr. Earls is co-founder of an organization whose members make personal contributions for scholarships to black students who attend historically black colleges and universities. He has served on many university Boards of Trustees and is a member of the Advisory Board for the Rock and Roll Hall of Fame. He was inducted into the inaugural class of the National Black College Alumni Hall of Fame, with such distinguished individuals as Dr. Martin Luther King, Jr., and Justice Thurgood Marshall.

He holds life memberships in the NMCP and Kappa Alpha Psi Fraternity. He is an avid runner who has run over 10,000 miles in the past 5 years and successfully completed 22 marathons, including the Boston Marathon.

Dr. Earls is married to the former Zenobia Gregory of Norfolk, Virginia, a former Reading Specialist in the Cleveland School System. They have two sons: Julian, Jr., is a neurologist who graduated from Howard University and Case Western Reserve University Medical School; Gregory is a filmmaker who graduated from Norfolk State University and the American Film Institute in Hollywood, California.

## **Dr. Sunil Dutta**

Dr. Sunil Dutta is Program Manager for Small Disadvantaged Businesses (SDBs) at the National Aeronautics and Space Administration's Glenn Research Center, Cleveland, Ohio. Appointed to this position in 1992, he is responsible for implementing policies that ensure the Small Disadvantaged Businesses (SDBs) and Historically Black Colleges and Universities (HBCUs) are encouraged and afforded an equitable opportunity to compete for NASA contracts and research grants. The goal is to increase R&D contracts with SDBs and research grants with HBCUs at Glenn Research Center. Before assuming the present position, his career has been devoted to research and development of materials science and technology, particularly in the area of processing, characterization, and mechanical behavior of high performance ceramics and ceramics matrix composites, for heat engines and high speed civil transport applications. In addition, he monitored numerous R&D contracts and grants for more than 10 years as project/program manager.

Dr. Dutta joined NASA Glenn Research Center in 1976 after 8 years at the U.S. Army Technology Laboratory, Watertown, Massachusetts. Born in India, he received his B.Sc (Hons), and M.S. from Calcutta University, and M.S. and Ph.D. from the University of Sheffield, England. He also received an MBA degree from Babson College, Wellesley, Massachusetts.

Dr. Dutta has written more than 50 publications including 4 patents and 5 chapters in books.

He is a Fellow of the American Ceramic Society, and the Institute of Ceramics in England. He is an elected Full Member of the International Institute for the Science of Sintering (IISS). Dr. Dutta is listed in American Men and Women in Science, Who's Who in Engineering, and Who's Who in the United States.

Dr. Dutta was invited to Japan for one year as Nippon Steel Endowed Chair Visiting Full Professor, at the University of Tokyo's Research Center for Advanced Science & Technology. Dr. Dutta was the first recipient of the Ishikawa Carbon Prize for his international contributions in structural ceramics/composites with the United States. Also, he was the first recipient of the Science and Technology Agency Senior Fellowship Award at the Japan Fine Ceramics Center at Nagoya. Since 1987, he visited Germany, Japan, Korea, Singapore, Australia, and India to present invited technical papers/lectures. Also, actively consulted for industry and government including the CSIR (Council of Scientific and Industrial Research) laboratories in India, under the United Nations Development Program (UNDP).

He has actively participated in Local School PTA programs, as Vice-president of Canterbury Homeowners Association, as President of India Association in Boston, Massachusetts, and in Cleveland, Ohio; and co-convenor of 5th biennial National Convention of All Asian-Indians in North America.

**Page intentionally left blank**

**HBCUs/OMUs RESEARCH CONFERENCE**  
**List of Attendees April 17–18, 2002**

**Mohammad Abdalla**

Tuskegee University  
Tuskegee, AL 36088

Phone

Fax

E-mail [abdalla@tusk.edu](mailto:abdalla@tusk.edu)

**Jason Berry**

Winston-Salem State University  
Winston-Salem, NC 27110

Phone

Fax

E-mail [jasun@aol.com](mailto:jasun@aol.com)

**Eric Brass**

Hampton University  
Hampton, VA 23668

Phone 757-727-5923

Fax 757-727-5955

E-mail [ebrass.eric@gprc.hamptonu.edu](mailto:ebrass.eric@gprc.hamptonu.edu)

**Nagy Abed**

Howard University  
2300 Sixth Street, N.W.  
Washington, DC 20059

Phone

Fax

E-mail [nyabed@yahoo1.com](mailto:nyabed@yahoo1.com)

**Thomas Biesiadny**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3967

Fax

E-mail [thomas.biesiadny@grc.nasa.gov](mailto:thomas.biesiadny@grc.nasa.gov)

**Jake Breland**

OAI  
22800 Cedar Point Road  
Cleveland, OH 44142

Phone 440-962-3010

Fax 440-962-3200

E-mail [JakeBreland@oai.org](mailto:JakeBreland@oai.org)

**Phillip Abel**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-6063

Fax

E-mail

**Dean Bitler**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-2226

Fax

E-mail [dean.bitler@grc.nasa.gov](mailto:dean.bitler@grc.nasa.gov)

**Delbert R. Buffinger**

Wilberforce University  
1055 N. Bickett Road  
Wilberforce, OH 45384

Phone 937-376-2911, x659

Fax

E-mail [dbuffing@payne.wilberforce.edu](mailto:dbuffing@payne.wilberforce.edu)

**Clifford Arth**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3460

Fax

E-mail [carth@grc.nasa.gov](mailto:carth@grc.nasa.gov)

**Isaiah M. Blankson**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-5823

Fax

E-mail [blankson@grc.nasa.gov](mailto:blankson@grc.nasa.gov)

**Dan Bulzan**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-977-7455

Fax 216-433-8311

E-mail

**Sheila G. Bailey**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-2228

Fax

E-mail

**Richard Blech**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3657

Fax 216-433-5802

E-mail [richard.a.blech@grc.nasa.gov](mailto:richard.a.blech@grc.nasa.gov)

**Donald J. Campbell**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-2929

Fax

E-mail [donald.campbell@grc.nasa.gov](mailto:donald.campbell@grc.nasa.gov)

**Renee J. Batts**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3081

Fax 216-433-8285

E-mail [renee.j.batts@grc.nasa.gov](mailto:renee.j.batts@grc.nasa.gov)

**Lawrence Bober**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3944

Fax 216-433-8581

E-mail [bober@grc.nasa.gov](mailto:bober@grc.nasa.gov)

**Christos Chamis**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone 216-433-3252

Fax

E-mail

**Peter Chen**

Spelman College  
P.O. Box 307, 350 Spelman Lane, SW  
Atlanta, GA 30314-4399  
Phone 404-223-7615  
Fax 404-223-1449  
E-mail pchen@spelman.edu

**Calvin Costen**

Hampton University  
Hampton, VA 23668  
Phone  
Fax  
E-mail tut7699@hotmail.com

**Numan Dogan**

North Carolina A&T State University  
1601 E. Market Street, McNair Hall Room 551  
Greensboro, NC 27411  
Phone 336-334-7348, x223  
Fax 336-334-7716  
E-mail dogan@ncat.edu

**Kennedy Cheruiyot**

North Carolina A&T State University  
Greensboro, NC 27411

Phone  
Fax  
E-mail

**John Cothorn**

North Carolina A&T State University  
Greensboro, NC 27411

Phone  
Fax  
E-mail

**Cindy Dreibelbis**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2912  
Fax 216-433-5531  
E-mail cldreibelbis@grc.nasa.gov

**Derrick J. Cheston**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone  
Fax  
E-mail

**Jim Criss**

Clark Atlanta University  
Atlanta, GA 30314

Phone  
Fax  
E-mail

**Sunil Dutta**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-8844  
Fax 216-433-5266  
E-mail sunil.dutta@grc.nasa.gov

**Kathy Chuang**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135

Phone  
Fax  
E-mail

**Michael Curley**

Alabama A&M University  
4900 Meridian St., P.O. Box 1268  
Normal, AL 35762  
Phone 256-858-8236  
Fax 256-851-8560  
E-mail mcurley@aamu.edu

**Walter M. Duval**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5023  
Fax  
E-mail walter.m.duval@grc.nasa.gov

**Eric Clark**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3926  
Fax 216-433-6106  
E-mail eric.clark@grc.nasa.gov

**Tramone Curry**

Florida A&M University  
Tallahassee, FL 32310  
Phone  
Fax  
E-mail tracurry@eng.fsu.edu

**Julian Earls**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3014  
Fax 216-433-5266  
E-mail Julian.M.Earls@grc.nasa.gov

**Emmanuel Collins**

Florida A&M University  
2525 Pottsdamer St.  
Tallahassee, FL 32310  
Phone 850-410-6373  
Fax 850-410-6337  
E-mail ecollins@eng.fsu.edu

**Derrick Dean**

Tuskegee University  
101 Chappie James Center  
Tuskegee, AL 36088  
Phone 334-724-4247  
Fax 334-724-4224  
E-mail deand@acd.tusk.edu

**Carol L. Emrich**

Florida Solar Energy Center, UCF  
1679 Clearlake Road  
Cocoa, FL 32922  
Phone 407-638-1507  
Fax 407-638-1010  
E-mail carol@fsec.ucf.edu

**Aisha Fields**  
Alabama A&M University  
Physics Department  
Normal, AL 35762  
Phone 256-851-5305  
Fax  
E-mail [afields@aamu.edu](mailto:afields@aamu.edu)

**John Gaff**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2940  
Fax  
E-mail [j.w.gaff@grc.nasa.gov](mailto:j.w.gaff@grc.nasa.gov)

**John W. Goodrich**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2610  
Fax  
E-mail

**Gregory J. Follen**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5193  
Fax  
E-mail [gfolen@grc.nasa.gov](mailto:gfolen@grc.nasa.gov)

**Sanjay Garg**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2685  
Fax 216-433-8643  
E-mail [sanjay.garg@grc.nasa.gov](mailto:sanjay.garg@grc.nasa.gov)

**Dan Gorican**  
QSS/NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44142  
Phone  
Fax  
E-mail

**Marc Freedman**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3284  
Fax  
E-mail

**Raymond Gaugler**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5882  
Fax 216-433-5802  
E-mail [raymond.e.gaugler@grc.nasa.gov](mailto:raymond.e.gaugler@grc.nasa.gov)

**Susan F. Gott**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3833  
Fax  
E-mail [susan.f.gott@grc.nasa.gov](mailto:susan.f.gott@grc.nasa.gov)

**Gene Fujikawa**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Mikhail Gilinsky**  
Hampton University  
Hampton, VA 23668  
Phone 757-727-5741  
Fax 757-727-5189  
E-mail [mikhail.gilinsky@hampton.edu](mailto:mikhail.gilinsky@hampton.edu)

**Leslie A. Greenbauer-Seng**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail [leslie.a.greenbauer-seng@grc.nasa.gov](mailto:leslie.a.greenbauer-seng@grc.nasa.gov)

**Clark Fuller**  
Central State University  
1400 Brush Row Road  
Wilberforce, OH 45384  
Phone 937-376-6312  
Fax 937-376-6598  
E-mail [pwnb84a@prodigy.com](mailto:pwnb84a@prodigy.com)

**Cody Godines**  
University of Texas at San Antonio  
6900 N.W. Loop 1604  
San Antonio, TX 78249  
Phone 210-458-5586  
Fax  
E-mail [cgodines@lonestar.utsa.edu](mailto:cgodines@lonestar.utsa.edu)

**Ten-Huei Guo**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3734  
Fax 216-433-8643  
E-mail [ioguo@grc.nasa.gov](mailto:ioguo@grc.nasa.gov)

**Randall Furnas**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail [randall.furnas@grc.nasa.gov](mailto:randall.furnas@grc.nasa.gov)

**Marvin Goldstein**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5825  
Fax 216-433-5531  
E-mail [marvin.e.goldstein@grc.nasa.gov](mailto:marvin.e.goldstein@grc.nasa.gov)

**John P. Gyekenyesi**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3210  
Fax 216-433-8300  
E-mail [John.P.Gyekenyesi@grc.nasa.gov](mailto:John.P.Gyekenyesi@grc.nasa.gov)

**Thomas Hagstrom**  
University of New Mexico  
Albuquerque, NM 87131  
  
Phone 505-277-8920  
Fax 505-277-5505  
E-mail Hagstrom@math.unm.edu

**Maria Hill**  
OAI  
22800 Cedar Point Road  
Cleveland, OH 44142  
Phone 440-962-3230  
Fax 440-962-3200  
E-mail mariahill@oai.org

**M. David Kankam**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-6143  
Fax 216-433-8311  
E-mail mark.d.kankam@grc.nasa.gov

**James H. Haliburton**  
Norfolk State University  
Norfolk, VA 23504  
  
Phone  
Fax  
E-mail jhollyrock@hotmail.com

**Dennis Huff**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3913  
Fax 216-433-3918  
E-mail dennis.l.huff@grc.nasa.gov

**Jim Kiraly**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-6023  
Fax  
E-mail kiraly@grc.nasa.gov

**Anwarul Haque**  
Tuskegee University  
Tuskegee, AL 36088  
  
Phone  
Fax  
E-mail ahaque@tusk.edu

**Janet Hurst**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Marisabel Lebron**  
NASA Glenn Research Center/CAU  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail marisabel.lebron@grc.nasa.gov

**J. Michael Harris**  
QSS/NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Lou Iganczak**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44142  
Phone  
Fax  
E-mail

**Chi-Ming Lee**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3413  
Fax 216-433-3954  
E-mail chi-ming.lee@grc.nasa.gov

**Robert C. Hendricks**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-7507  
Fax  
E-mail robert.c.hendricks@grc.nasa.gov

**Dexter Johnson**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-6046  
Fax  
E-mail

**Jih-Fen Lei**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-6328  
Fax 216-433-8643  
E-mail jih-fen.lei@grc.nasa.gov

**Don Hilderman**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3538  
Fax  
E-mail dhilderman@grc.nasa.gov

**Elva Jones**  
Winston-Salem State University  
CB 19438 – Carolina Hall 130  
601 Martin Luther King, Jr. Drive  
Winston-Salem, NC 27110  
Phone 336-750-2485  
Fax 336-750-2499  
E-mail jonese@wssu.edu

**Benjamin Liaw**  
City College of New York  
Mechanical Engineering Department  
Convent & 138th Street  
New York, NY 10031  
Phone 212-650-8022  
Fax 212-650-8090  
E-mail liaw@ccny.cuny.edu

**Gregory Lush**  
University of Texas at El Paso  
500 W. University Avenue  
El Paso, TX 79965-0587  
Phone 915-747-6632  
Fax  
E-mail lush@ece.utep.edu

**Kerry McLallin**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5389  
Fax 216-433-2995  
E-mail k.l.mclallin@grc.nasa.gov

**James A. Momoh**  
Howard University  
2300 Sixth Street, N.W.  
Washington, DC 20059  
Phone 202-806-6585  
Fax 202-806-6588  
E-mail jm@scs.howard.edu

**Donald R. Lyons**  
Hampton University  
Research Center for Optical Physics  
Hampton, VA 23668  
Phone 757-727-5923  
Fax 757-727-5955  
E-mail dlyons@gprc.hamptonu.edu

**Michael A. Meador**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-9518  
Fax  
E-mail

**Frank Montegani**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail fjm@grc.nasa.gov

**Valerie Lyons**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5970  
Fax 216-433-2306  
E-mail vlyons@grc.nasa.gov

**James Min**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail James.B.Min@grc.nasa.gov

**Matthew Moran**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail mmran@grc.nasa.gov

**John K. Lytle**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3213  
Fax 216-433-5188  
E-mail jlytle@grc.nasa.gov

**Eric A. Mintz**  
Clark Atlanta University  
223 James P. Brawley Drive, SW  
Atlanta, GA 30314  
Phone 404-880-6886  
Fax  
E-mail emintz@cau.edu

**Vinod Nagpal**  
MTC  
7530 Lucerne Drive  
Middleburg Heights, OH 44136  
Phone 440-243-8488  
Fax 440-243-8490  
E-mail vinodnagpal@msn.com

**George Madzsar**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Felix Miranda**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Cynthia Naiman**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Lawrence Matus**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3650  
Fax  
E-mail

**Tony Miranda**  
AlphaPort, Inc.  
Cleveland, OH 44135  
Phone  
Fax  
E-mail anthony.j.miranda@grc.nasa.gov

**Sylvia Owens**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail



**Yi Pang**

Clark Atlanta University  
223 James P. Brawley Drive, SW  
Atlanta, GA 30314  
Phone 404-880-6886  
Fax  
E-mail ypang@cau.edu

**Decatur Rogers**

Tennessee State University  
3500 John A. Merritt Boulevard  
Nashville, TN 37209-1561  
Phone 615-963-5401  
Fax 615-963-9357  
E-mail drogers@picard.tustate.edu

**Arun K. Sehra**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3397  
Fax  
E-mail arum.k.sehra@grc.nasa.gov

**Atanas Radenski**

Winston-Salem State University  
  
Phone  
Fax  
E-mail radenski@champman.edu

**Ahmed Rubaai**

Howard University  
2300 Sixth Street, N.W.  
Washington, DC 20059  
Phone 202-806-5767  
Fax 202-806-5767  
E-mail rubaai@scs.howard.edu

**Gary Seng**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3732  
Fax 216-977-7133  
E-mail gary.t.seng@grc.nasa.gov

**Calvin Ramos**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-9391  
Fax  
E-mail

**Rudolph Saldana**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2970  
Fax  
E-mail

**Paul Senick**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-977-7024  
Fax  
E-mail senick@starfire.grc.nasa.gov

**D.R. Reddy**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-8133  
Fax 216-433-2306  
E-mail dreddy@grc.nasa.gov

**Michael Salkind**

OAI  
22800 Cedar Point Road  
Cleveland, OH 44142  
Phone 440-962-3000  
Fax 440-962-3120  
E-mail michael.salkind@oai.org

**Kunigal Shivakumar**

North Carolina A&T State University  
1601 E. Market St.  
Greenboro, NC 27411  
Phone 336-334-7411  
Fax 336-334-7397  
E-mail kunigal@ncat.edu

**Concho Reid**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail drogers@tnstate.edu

**Terry Sanders**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Rickey Shyne**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3595  
Fax 216-433-3918  
E-mail rickey.j.shyne@grc.nasa.gov

**Terri Rodgers**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail terri.rodgers@grc.nasa.gov

**Steven Schneider**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**Carl L. Silski**

NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-2786  
Fax  
E-mail carl.l.silski@grc.nasa.gov

**Rainee Simons**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail [rainee.e.simons@grc.nasa.gov](mailto:rainee.e.simons@grc.nasa.gov)

**Margaret Tuma**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-977-8665  
Fax 216-433-8643  
E-mail [margaret.l.tuma@grc.nasa.gov](mailto:margaret.l.tuma@grc.nasa.gov)

**James Zakrajsek**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3968  
Fax  
E-mail

**Bhim S. Singh**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-5396  
Fax 216-433-8660  
E-mail [bhim.s.singh@grc.nasa.gov](mailto:bhim.s.singh@grc.nasa.gov)

**Uday Vaidya**  
University of Alabama at Birmingham  
1150 10th Ave S., BEC 254  
Birmingham, AL 35294  
Phone  
Fax  
E-mail [uvaidya@coe.uab.edu](mailto:uvaidya@coe.uab.edu)

**Erwin V. Zaretsky**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3241  
Fax  
E-mail [erwin.v.zaretsky@grc.nasa.gov](mailto:erwin.v.zaretsky@grc.nasa.gov)

**Sonia Singh**  
North Carolina A&T State University  
Greensboro, NC 27411  
  
Phone  
Fax  
E-mail

**Woodrow Whitlow, Jr.**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3193  
Fax 216-433-8581  
E-mail [woodrow.whitlow@grc.nasa.gov](mailto:woodrow.whitlow@grc.nasa.gov)

**Tyrone Smith**  
OAI  
22800 Cedar Point Road  
Cleveland, OH 44142  
Phone 440-962-3011  
Fax 440-962-3200  
E-mail [tyrone.smith@oai.org](mailto:tyrone.smith@oai.org)

**W. Dan Williams**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3725  
Fax 216-433-8643  
E-mail [dwilliams@grc.nasa.gov](mailto:dwilliams@grc.nasa.gov)

**George Stefko**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone 216-433-3920  
Fax  
E-mail

**Susan Wrbanek**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail [Susan.Y.Wrbanek@grc.nasa.gov](mailto:Susan.Y.Wrbanek@grc.nasa.gov)

**Sam Sun**  
Norfolk State University  
Norfolk, VA 23804  
  
Phone  
Fax  
E-mail [ssun@nsu.edu](mailto:ssun@nsu.edu)

**Amy Young**  
NASA Glenn Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone  
Fax  
E-mail

**REPORT DOCUMENTATION PAGE**Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

<b>1. AGENCY USE ONLY (Leave blank)</b>		<b>2. REPORT DATE</b> February 2003	<b>3. REPORT TYPE AND DATES COVERED</b> Technical Memorandum	
<b>4. TITLE AND SUBTITLE</b>  HBCUs/OMUs Research Conference Agenda and Abstracts			<b>5. FUNDING NUMBERS</b>  WBS-22-772-10-03	
<b>6. AUTHOR(S)</b>  Sunil Dutta, complier				
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b>  National Aeronautics and Space Administration John H. Glenn Research Center at Lewis Field Cleveland, Ohio 44135-3191			<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>  E-13318	
<b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b>  National Aeronautics and Space Administration Washington, DC 20546-0001			<b>10. SPONSORING/MONITORING AGENCY REPORT NUMBER</b>  NASA TM-2003-212207	
<b>11. SUPPLEMENTARY NOTES</b>  Responsible person, Sunil Dutta, organization code 0100, 216-433-8844.				
<b>12a. DISTRIBUTION/AVAILABILITY STATEMENT</b>  Unclassified - Unlimited Subject Categories: 01, 23, 27, and 29 Available electronically at <a href="http://gltrs.grc.nasa.gov">http://gltrs.grc.nasa.gov</a> This publication is available from the NASA Center for AeroSpace Information, 301-621-0390.			<b>12b. DISTRIBUTION CODE</b>	
<b>13. ABSTRACT (Maximum 200 words)</b>  The purpose of this Historically Black Colleges and Universities (HBCUs/OMUs) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Glenn Research Center to HBCUs. The conference generated extensive networking between students, principal investigators, Glenn technical monitors, and other Glenn researchers.				
<b>14. SUBJECT TERMS</b>  Research; Aeropropulsion; Space propulsion; Fluid mechanics; Design; Materials; Structures			<b>15. NUMBER OF PAGES</b> 60	
			<b>16. PRICE CODE</b>	
<b>17. SECURITY CLASSIFICATION OF REPORT</b> Unclassified	<b>18. SECURITY CLASSIFICATION OF THIS PAGE</b> Unclassified	<b>19. SECURITY CLASSIFICATION OF ABSTRACT</b> Unclassified	<b>20. LIMITATION OF ABSTRACT</b>	