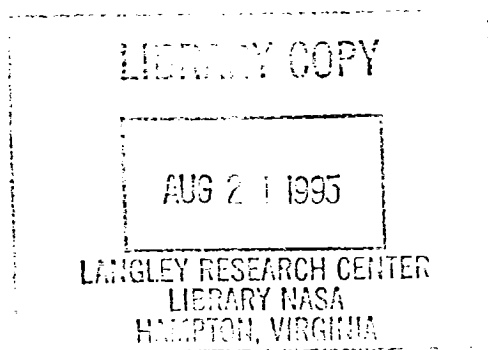


HBCUs Research Conference Agenda and Abstracts

FOR REFERENCE

NOT TO BE TAKEN FROM THIS ROOM



*Proceedings of a conference held at
Ohio Aerospace Institute
Cleveland, Ohio
April 18-20, 1995*





HBCUs Research Conference Agenda and Abstracts

*Proceedings of the Conference
held at the
Ohio Aerospace Institute
Cleveland, Ohio
sponsored by NASA Lewis Research Center
Cleveland, Ohio
April 18-20, 1995*



National Aeronautics and
Space Administration

Office of Management

**Scientific and Technical
Information Program**

1995

LeRC HBCUs CONFERENCE
HBCUs RESEARCH CONFERENCE
APRIL 18-20, 1995

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Lewis Research Center
Cleveland, Ohio
44135

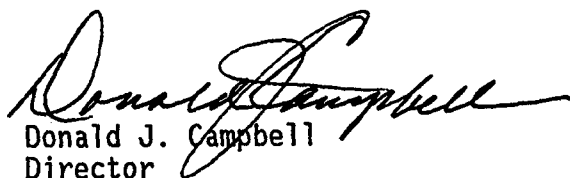
Reply to Attn of:

NASA Lewis Research Center's commitment to excellence continues to grow in terms of investment and support for Historically Black Colleges and Universities (HBCUs). Over the last 2 years, Lewis' total research and development grant awards to 16 HBCUs exceeded its performance goal by a substantial margin.

Lewis' HBCUs Research Program is designed to utilize the ability of HBCUs to conduct fundamental science and develop physical infrastructure related to NASA's disciplines. To reach our goals, we must build partnerships with other government agencies, industry, and academia. Our research partnerships with the Nation's HBCUs are an integral part of our strategy.

The HBCUs Research Conference is a critical element in ensuring the success of Lewis research programs. In addition, it provides a forum for showcasing the research capabilities of the participating HBCUs.

It is with great pleasure that I welcome the participants and congratulate everyone associated with the second NASA HBCUs Research Conference.



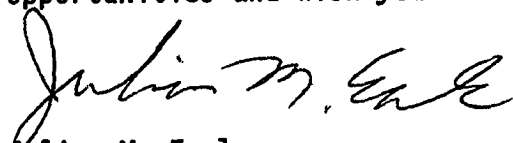
Donald J. Campbell
Director

Lewis Research Center
Cleveland, Ohio
44135

Reply to Attn of:

I welcome all attendees to this second HBCUs Research Conference sponsored by Lewis. The List of Poster Papers covers a broad spectrum of topics and demonstrates that HBCUs are partners in Lewis' mainstream research programs. I congratulate the Principal Investigators, student researchers, and Technical Monitors for the excellent teamwork that has produced the progress and results on display at this Conference.

Lewis, NASA, and the Nation benefit from the high caliber work done by all of you. This Conference provides many opportunities for networking and sharing information. I know you will take full advantage of these opportunities and wish you continued success.



Julian M. Earls
Acting Director of Administration and
Computer Services

**HBCUs RESEARCH CONFERENCE
April 18–20, 1995**

AGENDA

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

Tuesday, April 18, 1995

Afternoon Arrival at Hotel

Wednesday, April 19, 1995

**Ohio Aerospace Institute (OAI)
22800 Cedar Point Road
Cleveland, Ohio**

8:30–9:45 a.m.

Introduction & Welcome:

**Dr. Julian Earls
Assistant Deputy Director for
Business Resources Development**

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

Keynote Address:

**Dr. Carl Spight
Senior Vice President and Chief Scientist
Jackson and Tull**

9:45–10:00 a.m.

Break

10:00–12 noon

Poster Session

12 noon–1:00 p.m.

Lunch (On Your Own)

1:00–4:00 p.m.

Poster Session

Thursday, April 20, 1995

8:30–12 noon

Individual PI/TM Meetings

12 noon–1:00 p.m.

Lunch (On Your Own)

1:00–2:00 p.m.

Center Research Overview

2:00–4:00 p.m.

Tour Lewis

4:00–5:00 p.m.

Remove Poster Presentations

**HBCU Research Conference
List of Poster Papers
April 19, 1995**

| | | |
|-----|--------------------------|--|
| P1 | Alabama A&M University | "Optical Diagnostics of Solution Crystal Growth" |
| P2 | Alabama A&M University | "Integrated Optical Components in Thin Films of Polymers" |
| P3 | Central State University | "Client/Server Study" |
| P4 | Central State University | "Evaporation of Binary Mixtures in Microgravity" |
| P5 | Central State University | "Design, Construction and Testing of Annular Diffusers for High Speed Civil Transportation Combustor Applications" |
| P6 | Central State University | "Research Laboratory for Engineering and Technology (ReLEnT)—Summer Program" |
| P7 | Central State University | "Establishment of a BETA Test Center for the NPARC Code at Central State University" |
| P8 | Clark Atlanta University | "Superconducting Materials Processing" |
| P9 | Clark Atlanta University | "Nonstandard Finite Difference Schemes" |
| P10 | Fisk University | "Investigation of Nucleation and Growth Processes of Diamond Films by Atomic Force Microscopy" |
| P11 | Fisk University | "Metal Colloids and Semiconductor Quantum Dots: Linear and Nonlinear Optical Properties" |
| P12 | Fisk University | "Thruster Momentum Transfer Studies and Magnetoplasmadynamic (MPD) Thruster Use in Materials/Surface Modification" |
| P13 | Howard University | "Advanced Control Design for Hybrid Turboelectric Vehicle" |
| P14 | Howard University | "Expendable Launch Vehicle Studies" |
| P15 | Howard University | "Re-scheduling as a Tool for the Power Management On Board a Spacecraft" |
| P16 | Howard University | "Photoelectrochemical Etching of Silicon Carbide (SiC) and its Characterization" |
| P17 | Howard University | "Optimization of GaN Thin Films via MOCVD" |
| P18 | Howard University | "Design and Development of an All-Solid-State Laser Unit for Microgravity Combustion Applications" |
| P19 | Howard University | "The Growth of Cubic Silicon Carbide on a Compliant Substrate" |

| | | |
|-----|-----------------------------|---|
| P20 | Howard University | "Advanced Controls for Stability Assessment of Solar Dynamics Space Power Generation" |
| P21 | Howard University | "Artificial Neural Network Application for Space Station Power System Fault Diagnosis" |
| P22 | Howard University | "Dynamic Neural Networks Based On-Line Identification and Control of High Performance Motor Drives" |
| P23 | Johnson C. Smith University | "Optimization Methods, Flux Conserving Methods for Steady State Navier-Stokes Equation" |
| P24 | Norfolk State University | "An NMR Study of Microvoids in Polymers" |
| P25 | N. Carolina A&T State U. | "A Simulated RTM Process for Fabricating Polyimide (AMB-21)/Carbon Fiber Composites" |
| P26 | N. Carolina A&T State U. | "Graphite Fiber Textile Preform/Copper Matrix Composites" |
| P27 | Prairie View A&M | "A 3-D Navier-Stokes CFD Study of Turbojet/Ramjet Nozzle Plume Interactions at Mach 3.0 and Comparison with Data" |
| P28 | Savannah State College | "ACTS for Distance Education in Developing Countries" |
| P29 | Tennessee State University | "Implementation of Probabilistic Design Methodology at Tennessee State University" |
| P30 | Tennessee State University | "Research Project for Increasing Pool of Minority Engineers" |
| P31 | Tennessee State University | "Robust Integrated Neurocontroller for Complex Dynamic Systems" |
| P32 | Tuskegee University | "Sputtering Erosion in Ion and Plasma Thrusters" |
| P33 | Wilberforce University | "Wilberforce University Collaborative Program with NASA" |

LeRC HBCUs CONFERENCE**Optical Diagnostics of Solution Crystal Growth***

Yongkee Kim, B.R. Reddy, T.G. George, and R.B. Lal
Department of Physics
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Normal, Alabama 35762

ABSTRACT

Solution crystal growth monitoring of LAP/TGS crystals by various optical diagnostics systems, such as conventional and Mach-Zehnder (M-Z) interferometers, optical heterodyne technique, and ellipsometry, is under development. The study of the dynamics of the crystal growth process require a detailed knowledge of crystal growth rate and the concentration gradient near growing crystals in aqueous solution. Crystal growth rate can be measured using conventional interferometry. Laser beam reflections from the crystal front as well as the back surface interfere with each other, and the fringe shift due the growing crystal yields information about the growth rate. Our preliminary results indicate a growth rate of $6 \text{ \AA}/\text{sec}$ for LAP crystals grown from solution. Single wavelength M-Z interferometry is in use to calculate the concentration gradient near the crystal. Preliminary investigation is in progress using a M-Z interferometer with 2 cm beam diameter to cover the front region of the growing crystal. In the optical heterodyne technique, phase difference between two rf signals (250 KHZ) is measured of which one is a reference signal, and the other growth signal, whose phase changes due to a change in path length as the material grows. From the phase difference the growth rate can also be calculated. Our preliminary results indicate a growth rate of $1.5 \text{ \AA}/\text{sec}$. The seed and solution temperatures were 26.46°C and 27.92°C respectively, and the solution was saturated at 29.0°C . An ellipsometer to measure the growth rate and interface layer is on order from JOBIN YVON, France. All these systems are arranged in such a manner so that measurements can be made either sequentially or simultaneously. These techniques will be adapted for flight experiment.

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Tech. Monitor: T. Glasgow Phone: (216) 433-5013

LeRC HBCUs CONFERENCE**Integrated Optical Components in Thin Films of Polymers**

**Sergey Sarkisov, Hossin Abdeldayem,
Putcha Venkateswarlu, and Zedric Teague
Department of Physics, Alabama A&M University
P.O. Box 1268
Normal, Alabama 35762-1268**

ABSTRACT

The results will be reported on the study of integrated optical components based on nonlinear optical polymeric films. Polymers poly(methyl methacrylate) (PMMA) and polyimide (PI) doped with organic laser dyes 4-dicyanomethylene-2-methyl-6-p-dimethylaminostyryl-4H-pyran (DCM) and 1,3,5,7,8 - pentamethyl-2,6-diethyl-pyrromethene -BF₂-complex (Pyrromethene 567, PM-567) were selected as materials for light guiding films. Additionally, UV polymerized polydiacetylene (PDA) on glass substrate was used as a waveguide material. Optical waveguides were fabricated using spin coating of preoxidized silicon wafers (1.5 micrometer silicon oxide layer) with organic dye/polymer solution followed by soft baking. The modes in slab waveguides were studied using prism coupling technique. Measured values of mode coupling angles in multimode waveguides were used to calculate film thickness and refractive index for different polarizations. Refractive index anisotropy was found in PDA waveguide. The optimal conditions of spin coating for single mode waveguide fabrication were estimated. Propagation losses were measured by collecting the light scattered from the trace of a propagating mode either by scanning photo detector or by CCD camera. Different types of light coupling techniques were used including end-fire coupling, prism and grating coupling. Mechanical printing technique was developed for coupling grating fabrication resulting in gratings with 4% diffraction efficiency. The gratings demonstrated good stability with diffraction efficiency relaxation rate 2.4 dB/hour at a temperature approximately 15-20°C below glass transition point. Dye doped waveguides were transversally pumped with frequency doubled Nd:YAG Q-switched laser producing intensive light emission with apparent 6 kW/sq.cm pump threshold and spectrum narrowing near 617 nm peak in the case of DCM doped waveguide. PM-567 doped waveguide pumped with CW Ar⁺ laser (514 nm wavelength) far below threshold (0.1 W/sq.cm pump power) demonstrated emission spectrum narrowing near 616 nm peak with 18% power conversion slope efficiency. In this case emission spectrum modification was caused by the enhanced light absorption along the direction of propagating waveguide modes. Changing length, thickness, and other morphological waveguide parameters one can modify emission spectrum in predictable direction. The results show that polymeric waveguides, especially based on high temperature polymers such as PI, can be used to produce a variety of active and passive silicon compatible integrated optical components for aerospace applications.

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LeRC HBCUs CONFERENCE**Client/Server Study**

**Kamyar Dezhgosha, Robert Marcus, and Stephen Brewster
Central State University
1400 Brush Row Road
Wilberforce, Ohio 45384**

ABSTRACT

The goal of this project is to find cost-effective and efficient strategies/solutions to integrate existing databases, manage network, and improve productivity of users in a move towards client/server and Integrated Desktop Environment (IDE) at NASA LeRC. The project consisted to two tasks as follows: 1) Data Collection, and 2) Database Development/Integration. Under task 1, survey questionnaires and a database were developed. Also, an investigation on commercially available tools for automated data-collection and net-management were performed. As requirements evolved, the main focus has been task 2 which involved the following subtasks: 1) Data gathering/analysis of database user requirements, 2) Database analysis and design: make recommendation for modification of existing data structures into relational database or propose a common interface to access heterogeneous databases (INFOMAN system, CCNS equipment list, CCNS software list, USERMAN, and other databases), 3) Established a client/server test bed at Central State University (CSU), 4) Investigate multi-database integration technologies/products for IDE at NASA LeRC, and 5) Develop prototypes using CASE tools (ObjectView) for representative scenarios accessing multi-databases and tables in a client/server environment. Both CSU and NASA LeRC have benefited from this project. CSU team investigated and prototyped cost-effective/practical solutions to facilitate NASA LeRC move to a more productive environment. CSU students utilized new products and gained skills that could be a great resource for future needs of NASA.

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Tech. Monitor: R. Arterberrie Phone: (216) 433-5061

LeRC HBCUs CONFERENCE**Evaporation of Binary Mixtures in Microgravity**

**Morris Girgis, Nabil Matta, Kiran Kolli, Leon Brown, and Kevin Chubb
Central State University
1400 Brush Row Road
Wilberforce, Ohio 45384**

ABSTRACT

The motivation of this research is to obtain a better understanding of phase-change heat transfer within single and binary liquid meniscii, both in 1-g and 0-g environments. During phase I and part of phase II, in a glass test cell with an inclined heated plate, 1-g experiments on pentane with additions of decane up to 3% were conducted to determine the optimum concentration that will exhibit the maximum heat transfer and stability [Dickens, MS thesis, 1994]. During phase II emphasis was given to explore fundamental research issues and to ultimately develop a reliable capillary pumped loop (CPL) device for low gravity. In related experimental work [Ku, 1993], and [Richter & Hallinan, 1995], it was found that thermocapillary stresses near the contact line could result in a degraded wettability which ultimately could explain the observed failure of CPL devices in zero-gravity environment. Therefore, the current experimental effort investigates the effect of adding binary constituents in improving the thermocapillary characteristics near the contact line within the loop configuration. Achievements during second phase include: 1) Further enhancement of Central State University's Microgravity Laboratory by adding or improving upon capabilities of photography, video imaging, fluid visualization, and general experimental testing capabilities; 2) Experimental results for the inclined plate cell [Dickens, Girgis, Hallinan, 1995]; 3) Modeling effort with a detailed scaling analysis; 4) Additional testing with a tube loop configuration to extend experimental work by Dickens, et al. [Girgis and Matta, in progress]; 5) Fabrication of a capillary loop to be tested using binary fluid (pentane/decane). The device that has been recently completed will be set up horizontally so that the effect of gravity on the performance is negligible. Testing will cover a wide range of parameters such as decane/pentane concentration, heat input value, heat input location (below or above meniscus), and loop temperature.

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LeRC HBCUs CONFERENCE**Design, Construction and Testing of Annular Diffusers for High Speed
Civil Transportation Combustor Applications**

**Dr. Cyril B. Okhio
114F Jenkins Hall
Central State University
1400 Brush Row Road
Wilberforce, Ohio 45384**

ABSTRACT I

A theoretical and an experimental design study of subsonic flow through curved-wall annular diffusers is being carried out in order to establish the most pertinent design parameters for such devices and the implications of their application in the design of engine components in the aerospace industries. This investigation consists of solving numerically the full Navier Stokes and Continuity equations for the time-mean flow. Various models of turbulence are being evaluated for adoption throughout the study and comparisons would be made with experimental data where they exist. Assessment of diffuser performance based on the dissipated mechanical energy would also be made. The experimental work involves the application of Computer Aided Design software tool to the development of a suitable annular diffuser geometry and the subsequent downloading of such data to a CNC machine at Central State University. The results of the investigations are expected to indicate that more cost effective component design of such devices as diffusers which normally contain complex flows can still be achieved. In this regard a review paper was accepted and presented at the First International Conference on High Speed Civil Transportation Research held at North Carolina A & T in December of 1994.

Phone: (513) 376-6197
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Tech. Monitor: R. Tacina Phone: (216) 433-3588

LeRC HBCUs CONFERENCE**Research Laboratory for Engineering and Technology (ReLEnT)—Summer Program**

**Dr. Cyril B. Okhio
114F Jenkins Hall
Central State University
1400 Brush Row Road
Wilberforce, Ohio 45384**

ABSTRACT II

Central State University students are working at CSU under the supervision of the PI Dr. Cyril Okhio and associates to plan, design and conduct four-week hands on experiments and computer aided design workshops for grade level 9/10 students admitted into this four-week summer program, designed to stimulate them and hence encourage them to come to CSU when they are ready to go to college. CSU is in the Phase II of this exercise. In 1994, ten (10) such students were admitted into the summer program and we have had some success in recruiting. In addition to the group of nine from 1994, a new total of eleven (11 grade 9/10 students are now being interviewed for 1995. This would make a total of twenty (20) such potential recruits for CSU. This grant provides for two students each year to work as undergraduate research assistants, who would already be on ReLEnT tuition scholarships. Simple design projects, workshop practice and laboratory exercises and seminars have been successfully implemented extensively.

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LeRC HBCUs CONFERENCE**Establishment of a BETA Test Center for the NPARC Code at Central State University**

**Dr. Cyril B. Okhio
114F Jenkins Hall
Central State University
1400 Brush Row Road
Wilberforce, Ohio 45384**

ABSTRACT III

As an addendum to Abstract II, Central State University is working to set up a BETA Test Center for the NPARC (National Propulsion Ames Research Center) CFD code. The acquisition of this code forms a beginning step in joining an alliance composed of NASA, AEDC, The Aerospace Industry, and Universities. The major objective of the alliance is to establish a national applications-oriented CFD capability, centered on the NPARC code. By joining the alliance, CSU is putting NPARC to numerous capability tests. Undergraduate the post-graduate students are involved in this process under the supervision of the PI and his associates. At this point CSU is designing a Hands-on Conference/Workshop based on the experience acquired in the first year of the execution of this task, once a year for two days, where HBCU's needing to acquire the capability can benefit and those already involved in any form of CFD work can contribute to the general upkeep our collective capability pool.

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LeRC HBCUs CONFERENCE**Superconducting Materials Processing**

J.S. Hurley, E.K. Karikari, S.O. Hiamang, M. Danjaji, A. Bassey, A. Morgan
Clark Atlanta University
P.O. Box 336
Atlanta, Georgia 30314

ABSTRACT

The effects of materials processing on the properties and behavior of high temperature yttrium barium copper oxide (YBCO) superconductors were investigated. Electrical, magnetic, and structural characteristics of thin films (300 nm) $\text{YBa}_2\text{Cu}_3\text{O}_8$ structures grown by pulsed laser deposition on LaAlO_3 and SrTiO_3 substrates were used to evaluate processing. Pole projection and thin film diffraction measurements were used to establish grain orientation and verify structural integrity of the samples. Susceptibility, magnetization, and transport measurements were used to evaluate the magnetic and electrical transport properties of the samples. Our results verified that an unfortunate consequence of processing is inherent changes to the internal structure of the material. This effect translates into modifications in the properties of the materials, an undesired feature that makes it very difficult to consistently predict material behavior. The results show that processing evaluation must incorporate a comprehensive understanding of the properties of the materials. Future studies will emphasize microstructural characteristics of the materials, in particular, those microscopic properties that map macroscopic behavior.

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LeRC HBCUs CONFERENCE**Nonstandard Finite Difference Schemes**

**Ronald E. Mickens
Clark Atlanta University
Box 172
Atlanta, Georgia 30314**

ABSTRACT

The major research activities of this proposal center on the construction and analysis of nonstandard finite-difference schemes for ordinary and partial differential equations. In particular, we investigate schemes that either have zero truncation errors (exact schemes) or possess other significant features of importance for numerical integration. Our eventual goal is to bring these methods to bear on problems that arise in the modeling of various physical, engineering, and technological systems. At present, these efforts are extended in the direction of understanding the exact nature of these nonstandard procedures and extending their use to more complicated model equations. Our presentation will give a listing (obtained to date) of the nonstandard rules, their application to a number of linear and nonlinear, ordinary and partial differential equations. In certain cases, numerical results will be presented.

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LeRC HBCUs CONFERENCE**Investigation of Nucleation and Growth Processes of Diamond Films
by Atomic Force Microscopy****M.A. George, A. Burger, W.E. Collins, and Z. Hu*****Surface Physics Group
Physics Department
Fisk University
1000 17th Ave. N.
Nashville, Tennessee 37208-3051****ABSTRACT**

The nucleation and growth of plasma enhanced chemical vapor deposited (PECVD) polycrystalline diamond films were studied using atomic force microscopy (AFM). AFM images were obtained for: (i) nucleated diamond films produced from depositions that were terminated during the initial stages of growth, (ii) the silicon substrate-diamond film interface side of diamond films (1–4 μm thick) removed from the original surface of the substrate and (iii) cross-sectional fracture surface of the film, including the Si/diamond interface. Pronounced tip effects were observed for early-stage diamond nucleation attributed to tip convolution in the AFM images. AFM images of the films cross-section and interface however were not affected by tip convolution, and the images indicate that the surface of the silicon substrate is initially covered by a small grained polycrystalline-like film and the formation of this precursor film is followed by nucleation of the diamond film on top of this layer. X-ray photoelectron spectroscopy (XPS) spectra indicates that some silicon carbide is present in the precursor layer.

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*Student participant.

LeRC HBCUs CONFERENCE**Metal Colloids and Semiconductor Quantum Dots:
Linear and Nonlinear Optical Properties**

D.O. Henderson, R. Mu, Y. Tung, A. Ueda, J. Zhu,
W.E. Collins, and Christopher Hall*
Chemical Physics Group
Fisk University
1000 17th Avenue, N
Nashville, Tennessee 37208-3051

ABSTRACT

One aspect of this project involves a collaborative effort with the Solid State Division of ORNL. The thrust behind this research is to develop ion implantation for synthesizing novel materials (quantum dots wires and wells, and metal colloids) for applications in all optical switching devices, up conversion, and the synthesis of novel refractory materials. In general the host material is typically a glass such as optical grade silica. The ions of interest are Au, Ag, Cd, Se, In, P, Sb, Ga and As. An emphasis is placed on host guest interactions between the matrix and the implanted ion and how the matrix effects and implantation parameters can be used to obtain designer level optical devices tailored for specific applications. The specific materials of interest are: CdSe, CdTe, InAs, GaAs, InP, GaP, InSb, GaSb and InGaAs. A second aspect of this research program involves using porous glass (25–200 Å) for fabricating materials of finite size. In this part of the program, we are particularly interested in characterizing the thermodynamic and optical properties of these non-composite materials. We also address how phase diagram of the confined material is altered by the interfacial properties between the confined material and the pore wall.

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*Student participant.

LeRC HBCUs CONFERENCE**Thruster Momentum Transfer Studies and Magnetoplasma dynamic (MPD)
Thruster Use in Materials/Surface Modification****E. Thompson*, W.E. Collins, A. Burger, M.A. George, and J.D. Conner*****Chemical Physics Group
Physics Department
Fisk University
1000 17th Ave. N.
Nashville, Tennessee 37208-3051****ABSTRACT**

This research project involves the systematic study of the MPD thruster for dual uses. Though it was designed as a thruster for space vehicle, the characteristics of the plasma make it an excellent candidate for industrial applications. This project will seek to characterize the system for use in materials processing and characterization. Crystals grown at Fisk University for use with solid state detectors will be studied. Surface modification on ZnCdTe, CdTe, and ZnTe will be studied using AFM, XPS and SAES. In addition to the surface modification studies, design work on a momentum transfer measurement device has been completed. The design and limitations of the device will be presented.

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***Student participant.**

LeRC HBCUs CONFERENCE**Advanced Control Design for Hybrid Turboelectric Vehicle**

**Joseph Abban, Johnesta Norvell, and James A. Momoh
Center for Energy Systems and Controls
Department of Electrical Engineering
Howard University
2300 Sixth Street NW
Washington, DC 20059**

ABSTRACT

The new environment standards are a challenge and opportunity for industry and government who manufacture and operate urban mass transit vehicles. A research investigation to provide control scheme for efficient power management of the vehicle is in progress. Different design requirements using functional analysis and trade studies of alternate power sources and controls have been performed. The design issues include portability, weight and emission/fuel efficiency of induction motor, permanent magnet and battery. A strategic design scheme to manage power requirements using advanced control systems is presented. It exploits fuzzy logic, technology and rule based decision support scheme. The benefits of our study will enhance the economic and technical feasibility of technological needs to provide low emission/fuel efficient urban mass transit bus. The design team includes undergraduate researchers in our department. Sample results using NASA HTEV simulation tool are presented.

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LeRC HBCUs CONFERENCE**Expendable Launch Vehicle Studies**

**Dr. Peter M. Bainum and Dr. Robert Reiss
School of Engineering
Department of Mechanical Engineering
Howard University
2300 Sixth Street NW
Washington, DC 20059**

ABSTRACT

Analytical support studies of expendable launch vehicles concentrates on the stability of the dynamics during launch especially during or near the region of maximum dynamic pressure. The in-plane dynamic equations of a generic launch vehicle with multiple flexible bending and fuel sloshing modes are developed and linearized. The information from LeRC about the grids, masses, and modes is incorporated into the model. The eigenvalues of the plant are analyzed for several modeling factors: utilizing diagonal mass matrix, uniform beam assumption, inclusion of aerodynamics, and the interaction between the aerodynamics and the flexible bending motion. Preliminary PID, LQR, and LQG control designs with sensor and actuator dynamics for this system and simulations are also conducted. The initial analysis for comparison of PD (proportional-derivative) and full state feedback LQR (linear quadratic regulator) shows that the split weighted LQR controller has better performance than that of the PD. In order to meet both the performance and robustness requirements, the H_{∞} robust controller for the expendable launch vehicle is developed. The simulation indicates that both the performance and robustness of the H_{∞} controller are better than that for the PID and LQG controllers. The modelling and analysis support studies team has continued development of methodology, using eigensensitivity analysis, to solve three classes of discrete eigenvalue equations. In the first class, the matrix elements are non-linear functions of the eigenvector. All non-linear periodic motion can be cast in this form. Here the eigenvector is comprised of the coefficients of complete basis functions spanning the response space and the eigenvalue is the frequency. The second class of eigenvalue problems studied is the quadratic eigenvalue problem. Solutions for linear viscously damped structures or viscoelastic structures can be reduced to this form. Particular attention is paid to Maxwell and Kelvin models. The third class of problems consists of linear eigenvalue problems in which the elements of the mass and stiffness matrices are stochastic. Dynamic structural response for which the parameters are given by probabilistic distribution functions, rather than deterministic values, can be cast in this form. Solutions for several problems in each class will be presented.

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LeRC HBCUs CONFERENCE**Re-scheduling as a Tool for the Power Management On Board a Spacecraft**

**Omar AL Basheer and James A. Momoh, Ph.D.
Energy and Expert Systems Institute
Howard University
2300 Sixth Street NW
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ABSTRACT

The scheduling of events on board a spacecraft is based on forecast energy levels. The real time values of energy may not coincide with the forecast values; consequently, a dynamic revising to the allocation of power is needed. The re-scheduling is also needed for other reasons on board a spacecraft like the addition of new event which must be scheduled, or a failure of an event due to many different contingencies. This need of re-scheduling is very important to the survivability of the spacecraft. In this presentation, a re-scheduling tool will be presented as a part of an overall scheme for the power management on board a spacecraft from the allocation of energy point of view. The overall scheme is based on the optimal of use of energy available on board a spacecraft using expert systems combined with linear optimization techniques. The system will be able to schedule maximum number of events utilizing most energy available. The outcome is more events scheduled to share the operation cost of that spacecraft. The system will also be able to re-schedule in case of a contingency with minimal time and minimal disturbance of the original schedule. The end product is a fully integrated planning system capable of producing the right decisions in short time with less human error. The overall system will be presented with the re-scheduling algorithm discussed in detail, then the tests and results will be presented for validations.

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LeRC HBCUs CONFERENCE**Photoelectrochemical Etching of Silicon Carbide (SiC) and its Characterization**

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ABSTRACT

Silicon carbide (SiC) is an attractive semiconductor material for high speed, high density, and high temperature device applications due to its wide bandgap (2.2–3.2 eV), high thermal conductivity, and high breakdown electric field (4×10^6 V/cm). An instrumental process in the fabrication of semiconductor devices is the ability to etch in a highly controlled and selective manner for direct patterning techniques. A novel technique in etching using electrochemistry is described. This procedure involves the ultraviolet (UV) lamp-assisted photoelectrochemical etching of n-type 3C- and 6H-SiC to enhance the processing capability of device structures in SiC. While under UV illumination, the samples are anodically biased in an HF based aqueous solution since SiC has photoconductive properties. In order for this method to be effective, the UV light must be able to enhance the production of holes in the SiC during the etching process thus providing larger currents with light from the photocurrents generated than those currents with no light. Otherwise dark methods would be used as in the case of p-type 3C-SiC. Experiments have shown that the I/V characteristics of the SiC-electrolyte interface reveal a minimum etch voltage of 3 V and 4 V for n- and p-type 3C-SiC, respectively. Hence, it is possible for etch-stops to occur. Etch rates calculated have been as high as 0.67 $\mu\text{m}/\text{min}$ for p-type, 1.4 $\mu\text{m}/\text{min}$ for n-type, and 1.1 $\mu\text{m}/\text{min}$ for pn layer. On n-type 3C-SiC, an oxide formation is present where after etching a yellowish layer corresponds to a low Si/C ratio and a white layer corresponds to a high Si/C ratio. P-type 3C-SiC shows a grayish layer. Additionally, n-type 6H-SiC shows a brown layer with a minimum etch voltage of 3 V.

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LeRC HBCUs CONFERENCE**Optimization of GaN Thin Films via MOCVD**

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ABSTRACT

A unique characteristic of every semiconductor is the amount of energy required to break an electron bond in the lowest band of allowed states, the valence band. The energy necessary to set an electron free and allow it to conduct in the material is termed the energy gap (E_g). Semiconductors with wide bandgap energies have been shown to possess properties for high power, high temperature, radiation resistance damage, and short wavelength optoelectronic applications. Gallium nitride, which has a wide gap of 3.39 eV, is a material that has demonstrated these characteristics. Various growth conditions are being investigated for quality gallium nitride heteroepitaxy growth via the technique of low pressure metal organic chemical vapor deposition (MOCVD) that can be used for device development.

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LeRC HBCUs CONFERENCE**Design and Development of an All-Solid-State Laser Unit for
Microgravity Combustion Applications**

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ABSTRACT

The laser-induced fluorescence (LIF) technique is a sensitive and noninvasive method for imaging of flames and for monitoring of temperature and the presence of transient molecular species in flames. Our research effort has two major objectives: (1) to use LIF to study the fundamentals of microgravity combustion via spectroscopic characterization of free radicals and (2) to design and develop an all-solid-state portable laser unit for combustion studies in a microgravity environment. Well-characterized free radicals, namely hydroxyl (OH) and methoxy (CH_3O), have analytically convenient bands that can be laser-excited in the 280–298 nm spectral region with the newly discovered solid-state tunable laser, which is based on the $\text{LiCaAlF}_6:\text{Ce}^{3+} + (\text{LiCAF}:\text{Ce})$ single crystal pumped by the quadrupled (266 nm) output of a Q-switched YAG:Nd laser. The 266 nm YAG radiation (of about 10 mJ pulse energy) was split into two beams of about equal intensity, one used for photolysis of the free radical precursor and the other used for pumping the laser crystal. Tunability of the LiCAF:Ce laser was provided by a step-motor-driven Littrow-mounted diffraction grating. Laser excitation spectra of the CH_3O radical was recorded in the 291.5–296.5 nm region with 0.15 cm^{-1} resolution. Laboratory experiments have thus successfully shown that the idea of using the LiCAF:Ce laser as a dual-purpose photolysis and excitation source can pay rich dividends and that such a laser can be the center piece of an all-solid-state portable device that can be used for routine analytical investigations of microgravity combustion phenomena.

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LeRC HBCUs CONFERENCE**The Growth of Cubic Silicon Carbide on a Compliant Substrate**

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ABSTRACT

Research has shown that silicon carbide grown on silicon and 6H silicon carbide has problems associated with these substrates. This is because silicon and silicon carbide has a 20% lattice mismatch and cubic silicon carbide has not been successfully achieved on 6H silicon carbide. We are investigating the growth of silicon carbide on a compliant substrate in order to grow defect free silicon carbide. This compliant substrate consists of silicon/silicon dioxide with 1200 Å of single crystal silicon on the top layer. We are using this compliant substrate because there is a possibility that the silicon dioxide layer and the carbonized layer will allow the silicon lattice to shrink or expand to match the lattice of the silicon carbide. This would improve the electrical properties of the film for the use of device fabrication. When trying to grow silicon carbide, we observed amorphous film. To investigate, we examined the process step by step using RHEED. RHEED data showed that each step was amorphous. We found that just by heating the substrate in the presence of hydrogen it changed the crystal structure. When heated to 1000°C for 2 minutes, RHEED showed that there was an amorphous layer on the surface. We also heated the substrate to 900°C for 2 minutes and RHEED data showed that there was a deterioration of the single crystalline structure. We assumed that the presence of oxygen was coming from the sides of the silicon dioxide layer. Therefore, we evaporated 2500 Å of silicon to all four edges of the wafer to try to enclose the oxygen. When heating the evaporated wafer to 900 °C the RHEED data showed single crystalline structure however at 1000 °C the RHEED data showed deterioration of the single crystalline structure. We conclude that the substrate itself is temperature dependent and that the oxygen was coming from the sides of the silicon dioxide layer. We propose to evaporate more silicon on the edges of the wafer to eliminate the escape of oxygen. This will allow us to grow single crystal cubic silicon carbide.

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LeRC HBCUs CONFERENCE**Advanced Controls for Stability Assessment of Solar Dynamics Space Power Generation**

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ABSTRACT

In support of the power requirements for the Space Station Alpha (SSA), a joint program by the U.S. and Russia for a permanently manned space station to be launched into orbit by 1998, a robust control scheme is needed to assure the stability of the rotating machines that will be integrated into the power subsystem. A framework design and systems studies for modeling and analysis is presented. It employs classical d-q axes machine model with voltage/frequency dependent loads. To guarantee that design requirements and necessary trade studies are done, a functional analysis tool CORE is used for the study. This provides us with different control options for stability assessment. Initial studies and recommendations using advanced simulation tools are also presented. The benefits of the stability/control scheme for evaluating future designs and power management are discussed.

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LeRC HBCUs CONFERENCE**Artificial Neural Network Application for Space Station Power System Fault Diagnosis**

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ABSTRACT

This study presents a methodology for fault diagnosis using a Two-Stage Artificial Neural Network Clustering Algorithm. Previously, SPICE models of a 5-bus DC power distribution system with assumed constant output power during contingencies from the DDCU were used to evaluate the ANN's fault diagnosis capabilities. This on-going study uses EMTP models of the components (distribution lines, SPDU, TPDU, loads) and power sources (DDCU) of Space Station Alpha's Electrical Power Distribution System as a basis for the ANN fault diagnostic tool. The results from the two studies are contrasted. In the event of a major fault, ground controllers need the ability to identify the type of fault, isolate the fault to the orbital replaceable unit level and provide the necessary information for the power management expert system to optimally determine a degraded-mode load schedule. To accomplish these goals, the electrical power distribution system's architecture can be subdivided into three major classes: DC-DC converter to loads, DC Switching Unit (DCSU) to Main Bus Switching Unit (MBSU), and Power Sources to DCSU. Each class which has its own electrical characteristics and operations, requires a unique fault analysis philosophy. This study identifies these philosophies as Riddles I, II and III respectively. The results of the on-going study addresses Riddle I. It is concluded in this study that the combination of the EMTP models of the DDCU, distribution cables and electrical loads yields a more accurate model of the behavior and in addition yielded more accurate fault diagnosis using ANN versus the results obtained with the SPICE models.

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LeRC HBCUs CONFERENCE**Dynamic Neural Networks Based On-Line Identification and Control of High Performance Motor Drives**

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ABSTRACT

In the automated and high-tech industries of the future, there will be a need for high performance motor drives both in the low-power range and in the high-power range. To meet very straight demands of tracking and regulation in the two quadrants of operation, advanced control technologies are of a considerable interest and need to be developed. In response a dynamics learning control architecture is developed with simultaneous on-line identification and control. The feature of the proposed approach, to efficiently combine the dual task of system identification (learning) and adaptive control of nonlinear motor drives into a single operation is presented. This approach, therefore, not only adapts to uncertainties of the dynamic parameters of the motor drives but also learns about their inherent nonlinearities. In fact, most of the neural networks based adaptive control approaches in use have an identification phase entirely separate from the control phase. Because these approaches separate the identification and control modes, it is not possible to cope with dynamic changes in a controlled process. Extensive simulation studies have been conducted and good performance was observed. The robustness characteristics of neuro-controllers to perform efficiently in a noisy environment is also demonstrated. With this initial success, the principal investigator believes that the proposed approach with the suggested neural structure can be used successfully for the control of high performance motor drives. Two identification and control topologies based on the model reference adaptive control technique are used in this present analysis. No prior knowledge of load dynamics is assumed in either topology, while the second topology also assumes no knowledge of the motor parameters.

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LeRC HBCUs CONFERENCE

Optimization Methods, Flux Conserving Methods for Steady State Navier-Stokes Equation

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ABSTRACT

Navier-Stokes equation as discretized by new flux conserving method proposed by Chang and Scott results in the system:

$$\vec{F}(\vec{x})=0$$

where \vec{F} is a vector valued function.

The Optimization method we use is based on Quasi-Newton methods:

Given a nonlinear function $\vec{F}(\vec{x})=0$, we solve

$$\Delta\vec{x} = -B\vec{F}(\vec{x})$$

where $\Delta\vec{x}$ is the correction term and B is the inverse Jacobian of F(x). Then, iteratively,

$$\vec{x}_{i+1} = \vec{x}_i + \alpha\Delta\vec{x}_i$$

where α is a line search correction term determined by a line search routine. We use the BFGS's update to update the Jacobian matrix B_k at each iteration. It is well known that $B_k \rightarrow B^*$ at the solution x^* .

This algorithm has several advantages over the Newton-Raphson method. For example, we do not need to calculate the Jacobian matrix at each iteration which is computationally very expensive.

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LeRC HBCUs CONFERENCE**An NMR Study of Microvoids in Polymers**

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ABSTRACT

An understanding of polymer defect structures, like microvoids in polymeric matrices, most crucial to their fabrication and application potential. In this project guest atoms are introduced into the microvoids in PMR-15 and NMR is used to determine microvoid sizes and locations. Xenon is a relatively inert probe that would normally be found naturally in polymer or in NMR probe materials. There are two NMR active Xenon isotopes, ^{129}Xe and ^{131}Xe . The Xe atom has a very high polarizability, which makes it sensitive to the intracrystalline environment of polymers. Interactions between the Xe atoms and the host matrix perturb the Xe electron cloud, deshielding the nuclei, and thereby expanding the range of the observed NMR chemical shifts. This chemical shift range which may be as large as 5000 ppm, permits subtle structural and chemical effects to be studied with high sensitivity. The ^{129}Xe -NMR line shape has been found to vary in response to changes in the pore symmetry of the framework hosts line Zeolites and Clathrasil compounds. Before exposure to Xe gas, the PMR-15 samples were dried in a vacuum oven at 150°C for 48 hours. The samples were then exposed to Xe gas at 30 psi for 72 hours and sealed in glass tubes with 1 atmosphere of Xenon gas. Xenon gas at 1 atmosphere was used to tune up the spectrometer and to set up the appropriate NMR parameters. A single ^{129}Xe line at 83.003498 Mhz (with protons at 300 Mhz) was observed for the gas. With the xenon charged PMR-15 samples a second broader line is observed 190 ppm downfield from the gas line (also observed). The width of the NMR line from the ^{129}Xe absorbed in the polymer is at least partially due to the distribution of microvoid sizes. From the chemical shift (relative to the gas line) and the line width, we estimate the average void sizes to be 2.74 ± 0.20 angstroms. Since ^{129}Xe has such a large chemical shift range (~5000 ppm), we expect the chemical shift anisotropy to contribute to the line width ($\delta\nu = 2.5$ kHz).

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LeRC HBCUs CONFERENCE**A Simulated RTM Process for Fabricating Polyimide
(AMB-21)/Carbon Fiber Composites**

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ABSTRACT

An experimental polyimide matrix, AMB-21—supplied by NASA/LeRC, was especially formulated to be non-carcinogenic. It was also expected to be amenable to a Resin Transfer Molding Process (RTM). AMB-21 is a solid at room temperature and must be heated to a very high temperature to obtain a fluid state. However, even after heating it to a realistic high temperature, it was found to be too viscous for use in a RTM process. As a result, a promising approach was experimented leading to the introduction of the resin into a solvent solution in order to obtain a viscosity suitable for RTM. A mixture of methanol and tetrahydroferone was found to be a suitable solvent mixture. The matrix solution was introduced into carbon-fiber *preform* using two techniques: (a) injection of matrix into a Resin Transfer Mold after positioning the *preform* into the 'mold cavity', and (b) infiltration of matrix into the *preform* using the 'autoclave through-the-thickness transfer process'. After completing the resin transfer (infiltration) process, the 'filled' *preform* was heated to 300 °F for one hour to reduce the solvent content. The temperature was then increased to 400 °F under a vacuum to complete the solvent evaporation and to remove volatile products of the polyimide imidization. The impregnated *preform* was removed from the mold and press-cured at 200 psi and 600 °F for two hours. The resulting panel was found to be of reasonably good quality. This observation was based on the results obtained from short beam shear strength (700–8000 psi) tests and microscopic examination of the cross-section indicating a very low level of porosity. Further, the flash around the molded panels from the compression molding was free of porosity indicating the removal of volatiles, solvents, and other imidization products. Based on these studies, a new RTM mold containing a diaphragm capable of applying 200 psi at 600 °F has been designed and constructed with the expectation that it will allow the incorporation of all of the above processing steps, including the consolidation with the *preform* in the mold cavity. Moreover, the new diaphragm design will enable to process larger *preform* panels. Processing studies with the diaphragm mold are being initiated.

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LeRC HBCUs CONFERENCE**Graphite Fiber Textile Preform/Copper Matrix Composites**

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ABSTRACT

Graphite fiber reinforced/copper matrix composites have sufficiently high thermal conduction to make them candidate materials for critical heat transmitting and rejection components. The term textile composites arises because the preform is braided from fiber tows, conferring three-dimensional reinforcement and near net shape. The principal issues investigated in the past two years have centered on developing methods to characterize the preform and fabricated composite and on braidability. It is necessary to have an analytic structural description for both processing and final property modeling. The structure of the true 3-D braids used is complex and has required considerable effort to model. A structural mapping has been developed as a foundation for analytic models for thermal conduction and mechanical properties. The conductivity has contributions both from the copper and the reinforcement. The latter is accomplished by graphitization of the fibers, the higher the amount of graphitization the greater the conduction. This is accompanied by an increase in the fiber modulus, which is desirable from a stiffness point of view but decreases the braidability; the highest conductivity fibers are simply too brittle to be braided. Considerable effort has been expended on determining the optimal braidability—conductivity region. While a number of preforms have been fabricated, one other complication intervenes; graphite and copper are immiscible, resulting in a poor mechanical bond and difficulties in infiltration by molten copper. The approach taken is to utilize a proprietary fiber coating process developed by TRA, of Salt Lake City, Utah, which forms an intermediary bond. A number of preforms have been fabricated from a variety of fiber types and two sets of these have been infiltrated with OFHC copper, one with the TRA coating and one without. Mechanical tests have been performed using a small-scale specimen method and show the coated specimens to have superior mechanical properties. Final batches of preforms, including a finned, near net shape tube, are being fabricated and will be infiltrated before summer.

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LeRC HBCUs CONFERENCE**A 3-D Navier-Stokes CFD Study of Turbojet/Ramjet Nozzle Plume Interactions at Mach 3.0 and Comparison with Data**

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and
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ABSTRACT

Advanced airbreathing propulsion systems used in Mach 4–6 mission scenarios, usually consist of a single integrated turboramjet or as in this study, a turbojet housed in an upper bay with a separate ramjet housed in a lower bay. As the engines transition from turbojet to ramjet, there is an operational envelope where both engines operate simultaneously. One nozzle concept under consideration has a common nozzle, where the plumes from the turbojet and ramjet interact with one another as they expand to ambient conditions. In this paper, the two plumes interact at the end of a common 2-D cowl, when they both reach an approximate Mach 3.0 condition and then jointly expand to Mach 3.6 at the common nozzle exit plane. At this condition, the turbojet engine operated at a higher NPR than the ramjet, where the turbojet overpowers the ramjet plume, deflecting it approximately 12 degrees downward and in turn the turbojet plume is deflected 6 degrees upward. In the process, shocks were formed at the deflections and a shear layer formed at the confluence of the two jets. This particular case was experimentally tested and the data used to compare with the PARC3D code with k-kl two equation turbulence model. The 2-D and 3-D centerline CFD solutions are in good agreement, but as the CFD solutions approach the outer sidewall, a slight variance occurs. The outer wall boundary layers are thin and do not present much of an interaction, however, where the confluence interaction shocks interact with the thin boundary layer on the outer wall, strong vortices run down each shock causing substantial disturbances in the boundary layer. These disturbances amplify somewhat as they propagate downstream axially from the confluence point. The nozzle coefficient (CFG) is reduced 1/2% as a result of this sidewall interaction, from 0.9850 to 0.9807. This three-dimensional reduction is in better agreement with the experimental value of 0.9790.

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LeRC HBCUs CONFERENCE**ACTS for Distance Education in Developing Countries**

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ABSTRACT

The need for electrical energy supply in the rural communities of developing countries has been well documented. Equally well known is the potential for photovoltaics in cost effectively meeting this need. A major impediment to fulfilling the need is the lack of indigenous personnel with a knowledge of photovoltaic systems, and the associated infrastructure required to implement project. Various delivery schemes for providing the needed training to developing countries personnel have been investigated. Various training methods and programmes that have been employed to remedy the problem have had significant drawbacks in terms of cost, consistency, impact, reach, and sustainability. The hypothesis to be tested in this project posits that satellite-based distance education using ACTS technologies can overcome these impediments. The purpose of the project is to investigate the applicability of the ACTS satellite in providing distance education in photovoltaic systems to developing countries and rural communities. An evaluation of the cost effectiveness of using ACTS unique technologies to overcome identified problems shall be done. The limitations of ACTS in surmounting distance education problems in developing countries shall be investigated. This project will, furthermore, provide training to Savannah State College faculty in photovoltaic (PV) systems and in distance education configurations and models. It will also produce training materials adequate for use in PV training programs via distance education. Savannah State College will, as a consequence, become well equipped to play a leading role in the training of minority populations in photovoltaic systems and other renewables through its Center for Advanced Water Technology and Energy Systems. This communication provides the project outline including the specific issues that will be investigated during the project. Also presented is the project design which covers the participations of the various components of a network of institutions that is formed for optimal project execution. The expected results and project output, including plans for potential leverages and linkages to be derived, are also discussed. Finally, we point out possible extensions from this project and other related projects that could be initiated based on the experiences gained from the project.

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LeRC HBCUs CONFERENCE**Implementation of Probabilistic Design Methodology at Tennessee State University**

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ABSTRACT

The fact that Deterministic Design Method no longer satisfies most design needs calls for methods that will cope with the high trend in technology. The advance in computer technology has reduced the rigors that normally accompany many design analysis methods that account for uncertainties in design parameters. Probabilistic Design Methodology (PDM) is beginning to make impact in engineering design. This method is gaining more recognition in industries than in educational institutions. Some of the reasons for the limited use of the PDM at the moment are that many are unaware of its potentials, and most of the software developed for PDM are very recent. The central goal of the PDM project at Tennessee State University is to introduce engineering students to this method. The students participating in the project learn about PDM and the computer codes that are available to the design engineer. The software being used for this project is NESSUS (Numerical Evaluation of Stochastic Structures Under Stress) developed under NASA probabilistic structural analysis program. NESSUS has three different modules which make it a very comprehensive computer code for PDM. Since this method is new to the students, its introduction into the engineering curriculum is to be in stages. These range from the introduction of PDM and its software to the applications. While this program is being developed for its eventual inclusion into the engineering curriculum, some graduate and undergraduate students are already carrying out some projects using this method. As the students are increasing their understanding on PDM, they are at the same time applying it to some common design problems. The areas this method is being applied at the moment include, Design of Gears (spur and worm); Design of Brakes; Design of Heat Exchangers; Design of Helical Springs; and Design of Shock Absorbers. Some of the current results of these projects are presented.

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LeRC HBCUs CONFERENCE

Research Project for Increasing Pool of Minority Engineers

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ABSTRACT

The Tennessee State University (TSU) Research Project for Increasing the Pool of Minority Engineers is designed to develop engineers who have academic and research experiences in technical areas of interest to NASA. These engineers will also have some degree of familiarity with NASA Lewis Research Center as a result of interaction with Lewis engineers, field trips and internships at Lewis. The Research Project has four components, which are: (1) Minority Introduction to Engineering (MITE), a high school precollege program, (2) engineering and technology previews, (3) the NASA LeRC Scholars program which includes scholarships and summer internships, and (4) undergraduate research experiences on NASA sponsored research. MITE is a two-week summer engineering camp designed to introduce minority high school students to engineering by exposing them to (1) engineering role models (engineering students and NASA engineer), (2) field trips to engineering firms, (3) in addition to introducing youth to the language of the engineer (i.e., science, mathematics, technical writing, computers, and the engineering laboratory). Three MITE camps are held on the campus of TSU with an average of 40 participants. MITE has grown from 25 participants at its inception in 1990 to 118 participants in 1994 with participants from 17 states, including the District of Columbia, and 51% of the participants were female. Over the four-year period, 77% of the seniors who participated in MITE have gone to college, while 53% of those seniors in college are majoring in science, engineering or mathematics (SEM). This first Engineering and Technology Previews held in 1993 brought 23 youths from Cleveland, Ohio to TSU for a two-day preview of engineering and college life. Two previews are scheduled for 1994-1995. The NASA LeRC Scholars program provides scholarships and summer internships for minority engineering students majoring in electrical or mechanical engineering. Presently six (6) engineering students are in the Scholars program. The average GPA for the scholars is 3.239. Each scholar must maintain a minimum GPA of 3.000/4.000. NASA LeRC Fred Higgs has been awarded a GEM Fellowship. In addition, he will be presenting a paper entitled "Design of Helical Spring Using Probablistic Design Methodology" at the Middle Tennessee Section ASME Student Design Presentations in Nashville on March 23rd and at the National Conference on Undergraduate Research to be held at Union College, Schenectady, New York on April 20-22, 1995. Each of the scholars is working on one of the three NASA sponsored research projects in the college.

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LeRC HBCUs CONFERENCE**Robust Integrated Neurocontroller for Complex Dynamic Systems**

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ABSTRACT

The goal of this research effort is to develop an integrated control software environment for the purpose of creating an intelligent neurocontrol system. The system will be capable of estimating states, identifying parameters, diagnosing conditions, planning control strategies, and producing intelligent control actions. The distinct features of such control system are: adaptability and on-line learning capability. The proposed system will be flexible to allow structure adaptability to account for changes in the dynamic system such as: sensory failures and/or component degradations. The developed system should learn system uncertainties and changes, as they occur, while maintaining minimal control level on the dynamic system. The research activities set to achieve the research objective are summarized by the following general items:

1. Development of a system identifier or diagnostic system,
2. Development of a robust neurocontroller system, and
3. Integration of above systems to create a Robust Integrated Control system (RIC-system).

Two contrary approaches are investigated in this research: classical (traditional) design approach, and the simultaneous design approach. However, in both approaches neural network is the base for the development of different functions of the system. The two resulting designs will be tested and simulation results will be compared for better possible implementation.

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LeRC HBCUs CONFERENCE**Sputtering Erosion in Ion and Plasma Thrusters**

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ABSTRACT

An experimental set-up to measure low-energy (below 1 keV) sputtering of materials is described. The materials to be bombarded represent ion thruster components as well as insulators used in the stationary plasma thruster. The sputtering takes place in a 9 inch diameter spherical vacuum chamber. Ions of argon, krypton and xenon are used to bombard the target materials. The sputtered neutral atoms are detected by a secondary neutral mass spectrometer (SNMS). Samples of copper, nickel, aluminum, silver and molybdenum are being sputtered initially to calibrate the spectrometer. The base pressure of the chamber is approximately 2×10^{-9} Torr. The primary ion beam is generated by an ion gun which is capable of delivering ion currents in the range of 20 to 500 nA. The ion beam can be focused to a size approximately 1 mm in diameter. The mass spectrometer is positioned 10 mm from the target and at 90° angle to the primary ion beam direction. The ion beam impinges on the target at 45° . For sputtering of insulators, charge neutralization is performed by flooding the sample with electrons generated from an electron gun. Preliminary sputtering results, methods of calculating the instrument response function of the spectrometer and the relative sensitivity factors of the sputtered elements will be discussed.

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LeRC HBCUs CONFERENCE**Wilberforce University Collaborative Program with NASA**

Dr. Ronald L. Glenn, et al.
Wilberforce University
Wilberforce, Ohio 45384

ABSTRACT

Under the NASA Grant at Wilberforce University, the Science and Engineering Divisions have been able to engage in the following activities:

- Involvement of Wilberforce University in basic research.
 - Collaborations with scientists at NASA and NASA related institutions.
 - Building infrastructure in the Natural Science and Engineering Divisions.
 - Improvement of the teaching of science and engineering courses.
 - Purchase of scientific equipment.
 - Design and execute a five-week summer bridge program—Wilberforce Intensive Summer Experience (WISE).
 - Development of a Chemistry textbook for the Summer Bridge Program.
- The research projects being pursued under the NASA grant are:
- Preparation and Structural Characterization of New Compound.
 - Redetermination of Piperidinium Hydrogen Sulfide Structure.
 - The Study of the Use of Both Lateral and Vertical p-i-n Structures in Solar Cells and Suitability of Ion Implantation Technology for Obtaining p-i-n Structures in Indium Phosphide.
 - The Effect of Perturbations on the Magnetic Energy Levels of $J=5/2$ ion in a Hexagonal Lattice.
 - Cellular Damage and Survivability of Escherichia Coli Species Subjected to ^{60}Co Radiation.
 - The Use of External Combustion Engines to Utilize the Waste Heat from Typical Thermal Cell Devices.

The above research projects are being conducted by Wilberforce University faculty in collaboration with Dr. Al Hepp, other NASA scientists and scientists from other NASA related institutions.

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WHY COSTING IS IMPORTANT ON HBCU GRANTS

WHY IS COST IMPORTANT?

COST

IS OUR ONLY FISCAL MEASURE OF ACTUAL WORK ACCOMPLISHMENT. IT CAN BE UTILIZED BY MANAGEMENT TO EVALUATE THE EFFICIENCY & EFFECTIVENESS OF BUDGET EXECUTION ON OUR PROGRAMS.

WHAT DOES FORWARD FUNDING MEAN?

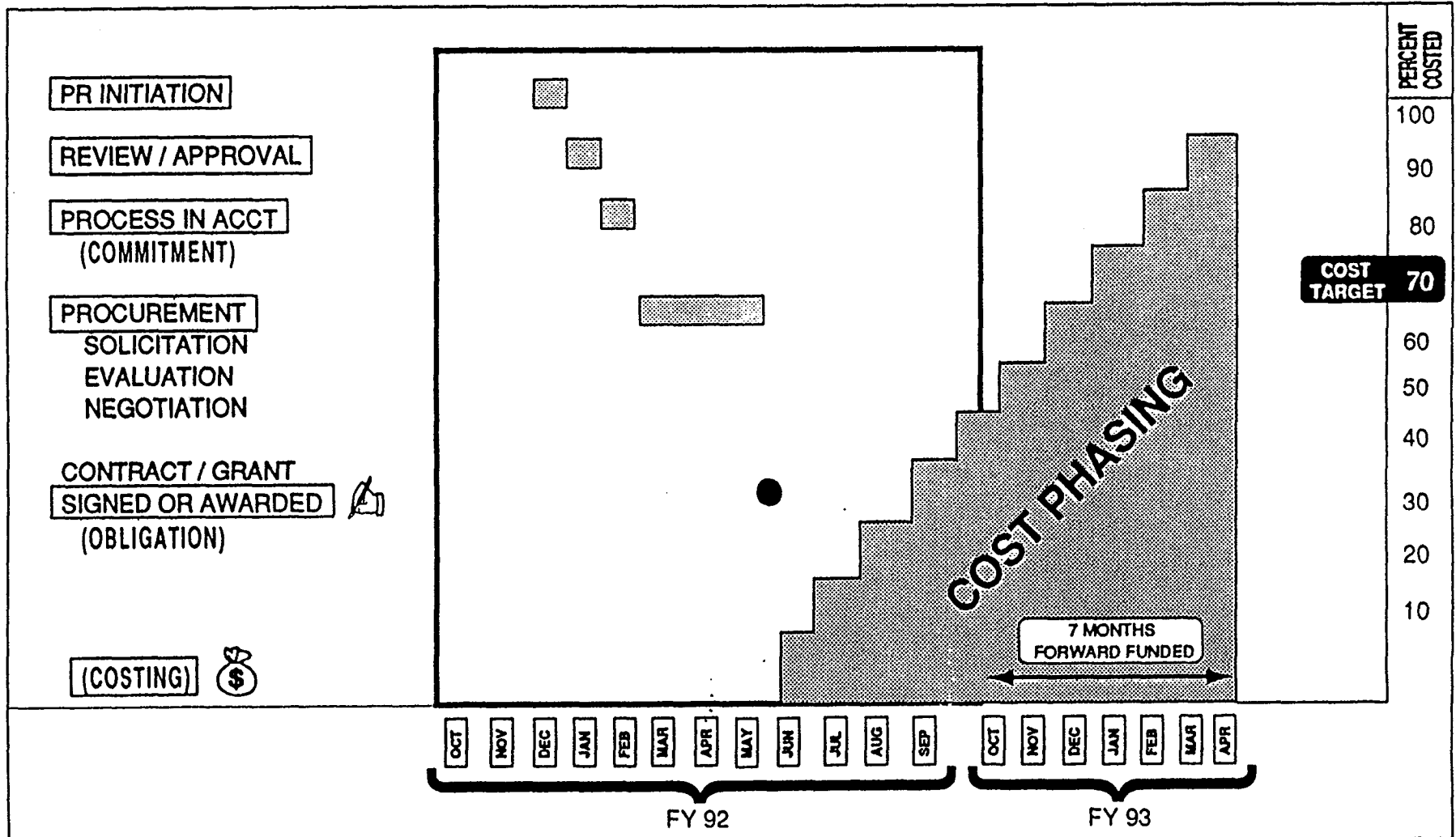
FORWARD FUNDING

IS EXPRESSED AS EITHER

① THE AMOUNT OF FUNDING THAT ONE'S PROGRAM OR CONTRACT WILL NOT "COST" DURING THE CURRENT FISCAL YEAR. OR

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

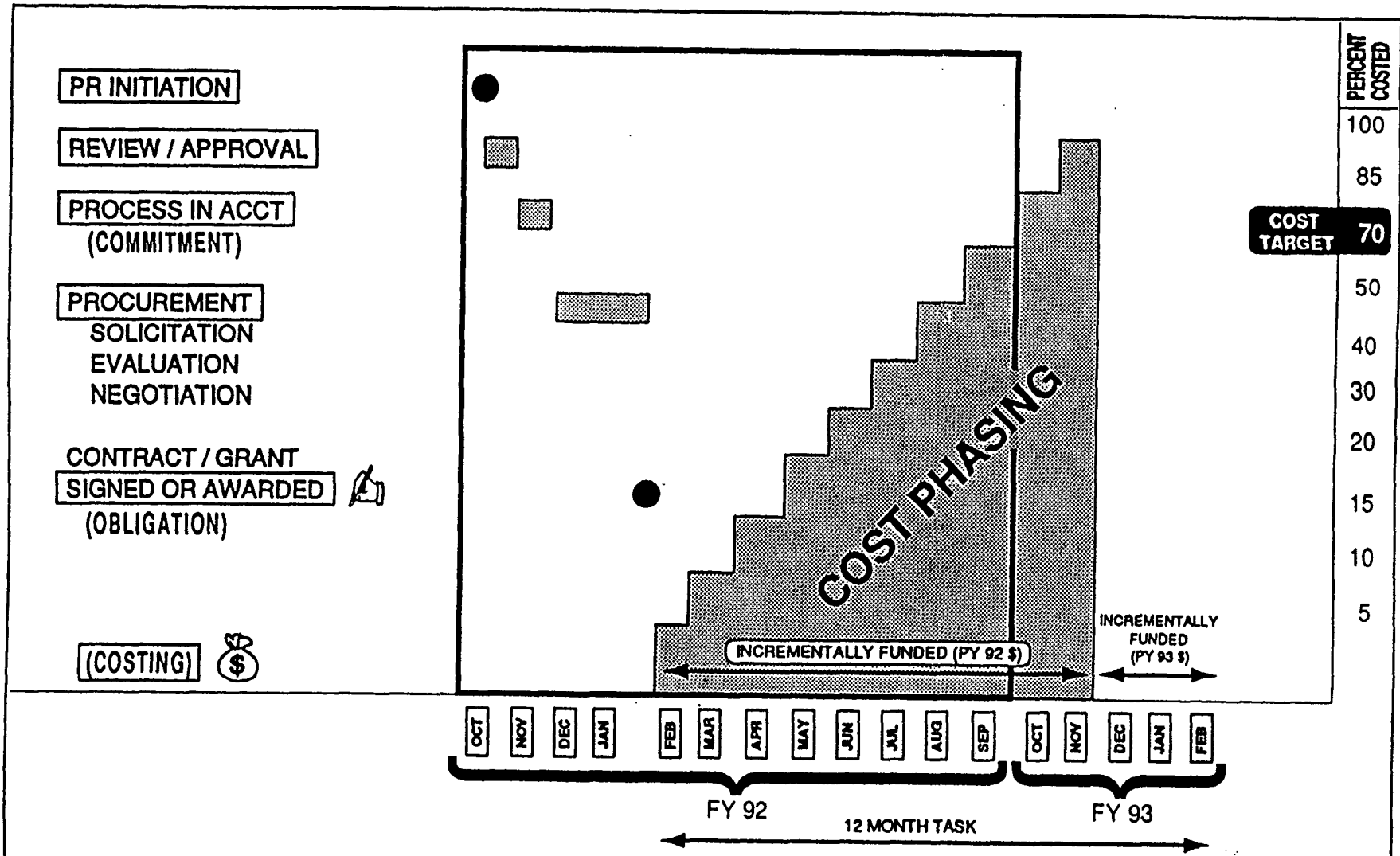


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KEY POINTS:

- 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

EXAMPLE OF GOOD COST MANAGEMENT



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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

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.

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 LEWIS EACH MONTH SO THAT LEWIS MAY PROPERLY REFLECT ACCURATE UP-TO-DATE COSTING ON YOUR HBCU GRANT.**

BIOGRAPHICAL DATA

Carl Spight, Ph. D.

Carl Spight is Senior Vice President of the Technology Systems Division and Chief Scientist of Jackson and Tull, Chartered Engineers.

Dr. Spight obtained a Bachelor of Science degree in Electrical Engineering with highest honors from Purdue University in 1966 and a Master of Arts and Doctorate in Astrophysical Sciences (Plasma Physics) from Princeton University in 1971.

He joined Jackson and Tull in 1990 where he has provided leadership in technology innovation and application. Dr. Spight has performed on research in areas as diverse as the application of probabilistic automata networks to structural optimization and the use of state-of-the-art multimedia computer technologies for creating powerful learning and training environments. At Jackson and Tull he has applied his expertise in intelligent robotic control to solve problems of motion planning and manipulation in on-orbit servicing missions.

His professional career includes roles as research scientist, senior technical manager, university professor and senior university administrator. He has served on the faculties of Southern University and Morehouse College (where he achieved the position of tenured full professor and Chair of the Department of Physics) and has held a visiting professor-ship at the Massachusetts Institute of Technology in the Center for Theoretical Physics. He has held the position of Dean of the School of Arts and Sciences at Clark Atlanta University.

Dr. Spight holds a patent for a machine vision system utilizing programmable optical parallel processing.

Dr. Spight has been nationally recognized and is widely invited as both a technical speaker and as a specialist in the sociology of minority participation in science and technology. He has received numerous awards for his contributions including the William F. Thornton Professional Achievement Award from the National Technical Association in 1989.

He is a native of Indianapolis, Indiana. He and his wife, Marsha Swanston Spight, and their three children reside in Chicago, Illinois.

Donald J. Campbell

Donald J. Campbell is Director of the National Aeronautics and Space Administration's Lewis 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. Lewis 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. Michael J. Salkind
President, Ohio Aerospace Institute**

Michael Salkind was appointed President of the Ohio Aerospace Institute in January 1990. OAI is a consortium of nine Ohio universities, private industry, NASA Lewis Research Center in Cleveland, and Wright-Patterson Air Force Base in Dayton. Its mission is to facilitate collaboration among industry, universities, and federal laboratories to enhance Ohio and U.S. economic competitiveness through research, education, and technology adaptation.

Before his appointment, Dr. Salkind served as Director of Aerospace Sciences, Air Force Office of Scientific Research, in Washington D.C. for 10 years. He was Chief of Structures at NASA Headquarters in Washington, D.C. from 1976 to 1980. From 1964 to 1975, he was with United Technologies Corporation as Chief of Advanced Metallurgy in their corporate research lab and then Chief of Structures and Materials at the Sikorsky Aircraft Division. He received his bachelor's and doctoral degrees in Materials Engineering from Rensselaer Polytechnic Institute in Troy, New York.

A fellow of the American Association for the Advancement of Science and an evaluator for the Accreditation Board for Engineering and Technology, he has published more than 40 articles and a book entitled Applications of Composite Materials.

He has also served on the adjunct faculty of The Johns Hopkins University, University of Maryland, and Trinity College in Hartford, Connecticut.

Dr. Julian M. Earls

Dr. Julian M. Earls is Assistant Deputy Director for Business Resources Development at the National Aeronautics and Space Administration's Lewis Research Center. His Lewis career spans 26 years.

Dr. Earls earned his bachelor's degree in physics from Norfolk State University, his master's degree in health physics from the University of Rochester and his doctorate degree in health 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 his present position, Dr. Earls' responsibilities include leadership of Lewis' efforts to increase research and development contracts and grants with small/disadvantaged businesses and historically black colleges and universities. He also manages the Center's occupational medicine/health programs.

Dr. Earls has written more than 19 publications, both technical and nontechnical. He wrote the first health physics guides used at NASA.

He is a current or past member of numerous community organizations and boards. He served on the Board of Overseers and Visiting Committee at Case Western Reserve University and is currently on the Board of Trustees at Cuyahoga Community College. He was elected 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 is founder of the Development Fund for Black Students in Science and Technology. Members of this fund contribute towards an effort to raise a million dollar endowment for scholarships to black students who major in technical disciplines at historically black colleges.

Dr. Earls and his wife, Zenobia, reside in Beachwood, Ohio. They have two children.

Dr. Sunil Dutta

Dr. Sunil Dutta is Program Manager for Small Disadvantaged Businesses (SDBs) at the National Aeronautics and Space Administration's Lewis 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 Lewis 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 Lewis 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 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. 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.

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.

Dr. Dutta and his wife Kabita reside in Westlake, Ohio. They have three children.

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