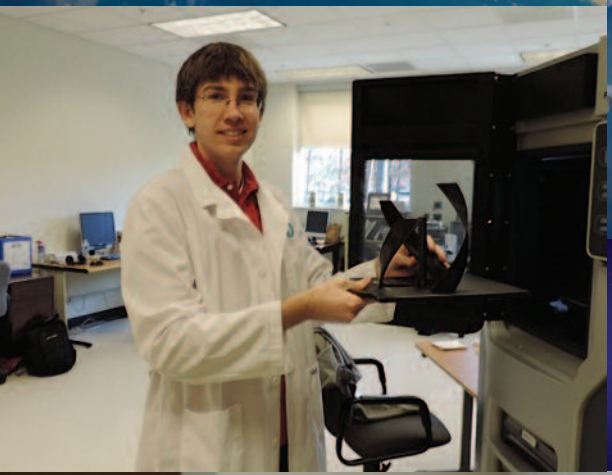
NIA

NATIONAL INSTITUTE OF AEROSPACE

RESEARCH • GRADUATE EDUCATION • OUTREACH



2014 Annual Report

NATIONAL INSTITUTE OF AEROSPACE

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Dr. Douglas O. Stanley

In 2014, NIA and our employees received many honors and awards as you will discover in exploring this Annual Report. The one that I am most proud of is being named the 12th Best Non-Profit to Work For in the US out of tens of thousands of qualified non-profits! I am particularly proud because this honor is a reflection of how much our employees feel that we value them. It is based on an analysis of our employee benefits and an anonymous 70-question survey of our employees for which we had an 80 percent response rate. I strongly believe that creating a culture that develops happy, motivated employees will continue to provide our customers and stakeholders with the highest quality of research, education, and outreach products.

Our strategy of establishing world-class research Centers continued with the dedication in 2014 of the Center for High-Performance Aerospace Computations (HiPAC) under the leadership of NIA Fellow Dr. Boris Diskin. In 2014, the Center involved 10 different universities, six NIA researchers, two students, and more than a dozen visiting researchers. Active International collaborations are in place with DLR in Germany, JAXA in Japan, and ONERA and INRIA in France. The Center also sponsored over 20 seminars in a variety of subject areas. It received $1.2M/year in research funding and a grant from the City of Hampton for a 3000-core high-performance computing cluster with 18 Tera-Flops of processing power. Dr. Diskin was also named the AIAA Hampton Roads Section Engineer of the Year and won the very prestigious 2014 H.J.E Reid Award for the Best NASA Langley Research Publication of the Year for his work in adjoint-based methods for computational fluid dynamics.

In 2014, NIA researchers had many other accomplishments and awards. In addition to an NIA researcher winning the H.J.E. Reid Best Paper Award for the first time, the second place paper was also authored by three NIA researchers: Dr. Yi Lin, Dr. Kent Watson, and Dr. Jae-Woo Kim in the field of nano-materials. These first and second place finishes demonstrate the high quality of research NIA is providing to our largest customer, NASA Langley. Dr. Sriram Rallabhandi of NIA also received the NASA Associate Administrator's Technology and Innovation Award for his work in sonic boom and drag prediction. Our Center for Planetary Atmospheres and Flight Sciences, led by Dr. Jared Bell of NIA, continued growing with collaborators from 14 different universities and government labs, active total research funding $2.3M,and 12 major research proposals in 2014.

Our unique graduate education program reached a milestone of 150 cumulative Masters and PhD graduates in 2014. Our students can earn degrees from any of our nine member universities and take up to half of their classes from other member universities. We also sponsored a record 73 seminars at NIA from distinguished faculty and researchers from all over the world. One of our Langley Professor Faculty-in-Residence, Prof. Chris Fuller of Virginia Tech, is featured below in this Annual Report.

You will also read below about the many accomplishments of NIA's Peninsula Technology Incubator (PTI), which is now nurturing 14 small businesses with over $4M in annual revenues. PTI was named the 2nd Best New Knowledge Based Incubator in the World by Technopolicy, and one of the companies in residence was named the Hottest Tech Start-up in the Nation by Tech Cocktail.

Finally, our world-class educational and public outreach programs continued to garner new customers, audiences, and awards. We developed and led the Exploration Design Challenge, sponsored by Lockheed Martin, to design and develop radiation shielding for the NASA Orion Space Capsule. We reached 163,000 students on 6,700 teams from all US states and 94 countries! The winning experiment was announced by NASA Administrator Charlie Bolden and got to fly on the first Orion flight in December. Our flagship NASA 360 TV program continued to reach millions of viewers in 2014 and has over 3 million Facebook friends. Our Innovation Now radio program broadcast 280 programs reaching over 7 million daily listeners with exciting innovations in aerospace. Our Center for Integrative STEM Education also continued to provide unique and exciting teacher training, curriculum development, student competitions, and a variety of educational outreach activities. For example, our SpaceMath@NASA website reached a milestone in 2014 of our 10 millionth download of space-related math problems by teachers all over the country.

I look forward to working with each of you and all of our stakeholders in 2015 as we continue to create a unique research, education, and outreach capability at NIA.

Research

Bo Walkley

As I reflect on my experiences over the past year as NIA's Vice President for Research, I always come back to how much I appreciate the continuing and unwavering support I receive each day from the Research leadership team. Without these folks and their dedication to NIA's overall mission and their individual program responsibilities, we would not be able to deliver the highest quality research products to our customers. Many of you reading this report already know some or all of my Team, and I'd like to introduce them to those of you who have not yet interacted with them (left to right):

Dr. David Peake
VP for Commercial Aeronautics Programs

Avanti Aparentado
Sr. Program Analyst

Kenneth "Bo" Walkley
Vice President of Research

Carly Bosco
Program Director for NASA Langley Programs

Dr. Lise Schioler
Director, Other Government Programs

Bianca Clark
Administrative Assistant

Fred Brooks
Program Director for FAA Programs

This Team provides the business, management, administrative, proposal and customer support for our research programs. Each of these activities is critical to the research performed by the NIA Research Staff.

As a part of our research strategy, NIA has established research Centers of Excellence that bring together experts from NIA, multiple universities, industry, and NASA to perform focused collaborative research activities. These Centers are complementary to NASA's research and actively seek funding from outside sources. Each Langley Professor has their own NIA-based research Center for which they serve as Directors. In addition, two members of NIA's research staff also lead Centers. NIA markets these Centers through web sites and brochures, and actively assists our Center Directors in the identification of new research opportunities, proposal preparation and submission, and program management and staffing on successfully proposed research programs.

NASA Langley 2014 H.J.E. Reid Award

1st Place, "Discrete Adjoint-Based Design for Unsteady Turbulent Flows on Dynamic Overset Unstructured Grids," **Dr. Boris Diskin,** Eric Nielsen (LaRC)

Samuel P. Langley Distinguished Professor Chris Fuller, Virginia Polytechnic Institute and State University

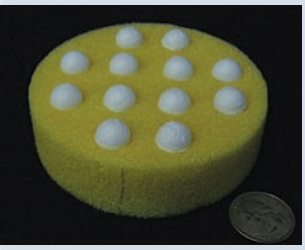
Professor Chris Fuller began the Langley Professorship position at NIA in the first quarter of 2011 after moving from Virginia Tech in Blacksburg, VA where he was the Roanoke Electric Steel Professor of Engineering and Director of the Vibration and Acoustics Laboratories. His research interests are in acoustics, vibration, active noise control, advanced composite materials for noise reduction and beam forming techniques. Recently he has begun working in multi-functional materials as well as medical applications of acoustics in conjunction with the Eastern Virginia Medical School (EVMS).

Prof. Fuller is carrying out research in a number of areas that are at the forefront of technology development. One of these is the investigation and development of Acoustic Meta Materials (AMM). These material systems consist of embedded dynamic elements, which allow the AMM to have properties not achievable in nature and to be designable. A number of new, seminal material systems have been modeled and successfully tested in the NIA and NASA laboratories. Another cutting edge technology he has been working on is Active Control of Jet Noise. This work involves implementing active, vibrating chevrons to provide control inputs to the flow at the jet nozzle exit. The control inputs modify the flow to reduce the growth of large scale mixing vortices thus leading to a reduction in radiated jet noise. Initial testing in the Jet Noise Facility at NASA Langley has shown much promise. Prof. Fuller has also been working on Virtual Acoustics applied to the simulation of aircraft/rotorcraft flyover noise. Recently he has been applying this technology to develop virtual sound fields for a virtual laboratory and teaching environments.

Professor Fuller was invited to give the Boeing Distinguished BENS presentation in Seattle, October, 2014. This presentation summarized recent work in active noise control in aircraft and included summary of much of Prof. Fuller's work. The presentation was broadcasted worldwide to all Boeing facilities.

A significant part of Prof. Fuller's activities as the VT Langley Professor is to maintain strong contacts with the home campus in Blacksburg. He has chosen to achieve this by maintaining an active research program and staff in the Vibration and Acoustics Laboratories at Virginia Tech.

This necessitates regular travel to Blacksburg to monitor progress and maintain contact with the students and staff. Projects at the VT Lab include development of an active pillow to reduce the sound at a patient's ears inside Blackhawk Medevac helicopters and the development and testing of a non-invasive wire sensor for monitoring pressure inside fluid-filled piping systems. Prof. Fuller is also the advisor to a VT Senior Design project funded by NASA and concerned with developing an autonomous vehicle for automatically deploying microphones in large arrays. In 2015 the students successfully designed and constructed the vehicle at the VT campus in Blacksburg and then demonstrated it at the Acoustics Technical Work Group meeting at NASA LaRC.



Brüel & Kjær Center for Aerospace Acoustics, Chris Fuller, Ph.D., Director

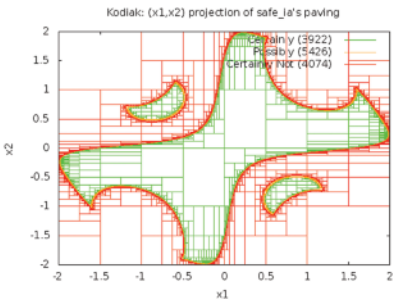
The Brüel & Kjær Center for Aerospace Acoustics is located in the NIA Innovation Laboratory. The Center focuses on developing novel understanding and devices for reduction of noise and vibration in aerospace applications. Due to its sponsorship by Brüel & Kjær, the Center has access to cutting edge, sophisticated and expensive equipment not normally seen in quantity in the university laboratory environment. Systems such as an 83-element beam forming array and software are readily available for research, and this enhances our research capabilities and achievements to a high degree. The Center's close location with NASA Langley creates strong interaction with NASA staff and proximity to Hampton Roads Technology Incubator also enhances interactions with industry, as evidenced by a number of joint projects with HRTI resident companies. The Center is able to provide a unique educational and research environment which blends university research with government related work and interactions with companies. Such environments are not seen on the normal university campus.

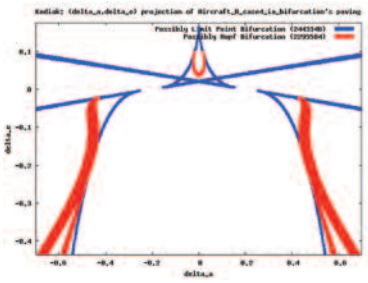
Bifurcation Analysisf of Dynamic Systems Using Rigorous Branch and Bound Methods

Dr. Andrew Smith, NIA Research Scientist

In the design and certification of controllers for safety-critical nonlinear dynamic systems, such as flight dynamics, it is essential to assure stability over the operational range of a multi-dimensional parameter vector. Local bifurcations delineate regions of stable and unstable behavior in the parameter space; knowledge of their location is therefore crucial for an effective analysis. Using the traditional numerical continuation method for bifurcation analysis, trajectories are used to find and traverse the equilibrium set, however the approach suffers from two main drawbacks: it is only applicable to low-dimensional parameter vectors and it is possible that the search may miss unconnected branches of the equilibrium set and associated bifurcations. The research focuses on an approach to overcome these limitations and thereby increase the fidelity of the bifurcation analysis prior to the simulation and testing phases.

A method is developed to rigorously enclose all local bifurcations within a specified computational domain, without the need to determine the equilibrium set in advance. Starting with an initial box (hyper-rectangle) for the ranges of variables and parameters, a branch and bound algorithm proceeds by successively subdividing into smaller boxes and by computing corresponding guaranteed local bounds for each of the function ranges, using an enclosure technique such as interval arithmetic. Sufficient conditions for the existence of steady-state and Hopf bifurcations, in the form of algebraic inequality constraints, are generated automatically. It is also possible to compute a sizeable high-dimension box subset wherein bifurcations of the considered types are guaranteed to be excluded. This technique is implemented in Kodiak, a C++ tool for generic branch and bound computation.



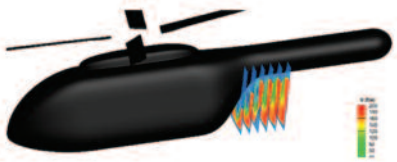


The approach has been tested on the NASA Generic Transport Model (GTM), a mathematical representation of the remotely-operated AirSTAR UAS, a 5.5% scale model of a jet airliner produced at NASA Langley. The longitudinal dynamics subject to uncertain center of gravity (CG) location and variable mass and elevator/aileron angles in various throttle scenarios have been studied. At maximum throttle input, the stability with respect to the nominal CG position is seen to be marginal. For lower throttle input, a 9D exclusion (safe) box is computed where all parameters are permitted to vary simultaneously.

Advanced Rotorcraft Scaled Testing in 14x22 Wind Tunnel

Dr. Peter Copp, NIA Research Engineer

Military operations, earthquake relief in Nepal and Ebola aid in Liberia have highlighted how indispensable rotorcraft are. This has led to a renewed push to increase future rotorcraft speed and range. Peter is part of a unique joint Army-NASA team that designs and carries out testing of state-of-the-art rotorcraft technologies on scaled models. The team integrates many directorates into its testing, thus taking full advantage of the expertise at Langley Research Center. This includes flow visualization (PIV, shadowgraph, LDV) and advanced manufacturing methods in both metal and composites. The team comes up with its own innovations while also providing a testing base for these ot groups to test out their ideas. The small size allows the team to respond to short term customer concerns as they arise.



Recent work in active flow control has demonstrated significantly reduced fuselage drag and rotor download. Flow visualization showed that injecting momentum into the flow around the fuselage did not stop the flow from separating, but instead formed a virtual boat fairing so the flow sees a streamlined structure.

Faster rotorcraft will require monitoring of the blade deformations over the entire span. This requires new sensing and means to transfer large amounts of data from the rotating blade to the fixed frame. With the team's ability to measure small blade deflections in the wind tunnel, validation of a new sensor to measure blade deformations in-flight will begin. Also, an optical slipring will vastly increase the data that can be collected from the rotating blades.

Experimental and Finite Element Modeling of Near-Threshold Fatigue Crack Growth for improving ASTM K-Decreasing Test Method

Dr. Banavara R. Seshadri, NIA Senior Research Scientist

The experimental methods to determine near-threshold fatigue crack growth rate data are prescribed in ASTM E647. To produce near-threshold data at a constant stress ratio (R), the applied stress-intensity factor (K) is decreased as the crack grows based on a specified K-gradient. Consequently, as the fatigue crack growth rate threshold is approached and the crack tip opening displacement decreases, remote crack wake contact may occur due to the plastically deformed crack wake surfaces thus shielding the growing crack tip. This leads to reduced crack tip driving force resulting in a non-representative crack growth rate data. If such data are used to life a component, the evaluation could yield highly non-conservative predictions. Although this anomalous behavior has been shown to be affected by K-gradient, starting K level, residual stresses, environmental assisted cracking, specimen geometry, and material type, the specifications within the standard to avoid this effect are limited to a maximum fatigue crack growth rate and a suggestion for the K-gradient value. In the current research, parallel experimental and computational simulations (Figure 1) for the K-decreasing method for two materials (an aluminum alloy, AA 2024-T3, and a titanium alloy, Ti 6-2-2-2-2) will aid in establishing a clear understanding of appropriate testing conditions.

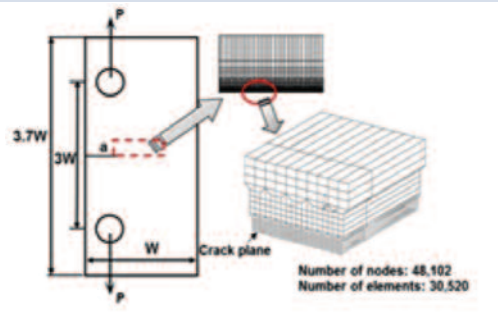


Figure 1. A typical finite element mesh for the ESE(T) specimen

These simulations investigate the effect of K-gradient, the maximum value of stress-intensity factor applied, and material type. A material independent term (–C(Kmax,i /σy)2) has been shown to be appropriate to determine reliable values of K-gradient and Kmax for both the materials examined in this research (Figure 2).

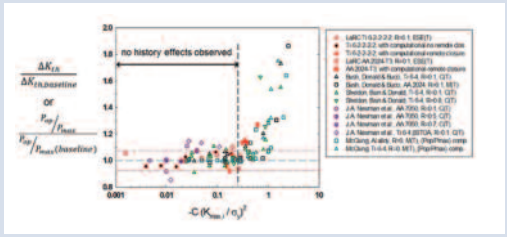


Figure 2. Normalized threshold value versus a dimensionless K-decreasing parameter

The data generated in this study were compared to experimental and computational results in the literature to further support this observation. With the use of such a term, near-threshold fatigue crack growth rate tests can be performed at accelerated rates, resulting in the acquisition of near-threshold data in days instead of weeks without having to establish testing criteria through trial and error.

NASA Group Achievement Award

Engineered Surfaces Flight Test Team,
Dr. Jereme Doss

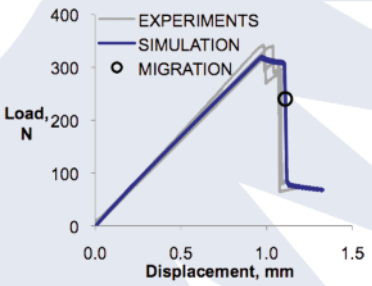
Modeling Delamination migration: quasi-static and fatigue loading.

Dr. Nelson V. De Carvalho, NIA Research Engineer

Damage in composite materials generally occurs as a combination of different and interacting failure mechanisms, e.g. delamination and matrix cracking. Capturing these interactions accurately is essential to confidently model and predict progressive damage and failure.

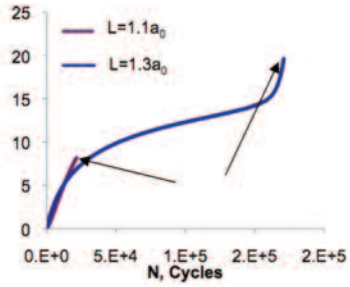
A novel approach is proposed for high-fidelity modeling of progressive damage and failure in composite materials that combines a new numerical method, Floating Node Method (FNM), and the Virtual Crack Closure Technique (VCCT) to represent multiple interacting failure mechanisms in a mesh-independent fashion. Delamination, matrix cracking, and migration events are all modeled within the same framework using fracture-mechanics-based failure and migration criteria.

The method proposed was applied to the Delamination Migration test recently developed at NASA's Langley Research Center to investigate interacting failure modes. In a test, a delamination is observed to propagate from a pre-inserted crack of length a0 at a (0o/90o) interface and after a given amount of growth Δa, controlled by the loading position L, migrate via a matrix crack to a different (0o/90o) interface. The method proposed was applied to quasi-static and fatigue loading showing good qualitative and quantitative agreement with the experimental results available (currently only quasi-static) capturing the sequence of events, failure morphology and loads, see figures below.

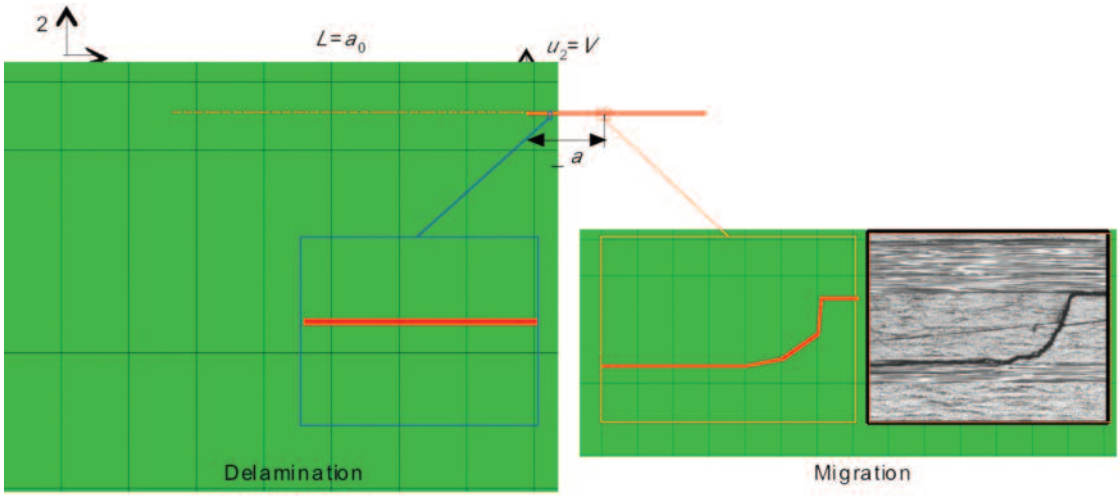


Load-Displacement curve

The success of the approach has led to the extension of the method to 3D. Its demonstration and validation is ongoing, by applying the methodology proposed to various specimens and test configurations.



Cycles to migration



NASA Group Achievement Award

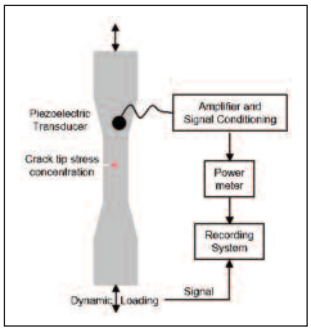
SLS Aerodynamics and Aeroelasticity Team, **Dr. Peter Covell**

Experimental Failure Analysis

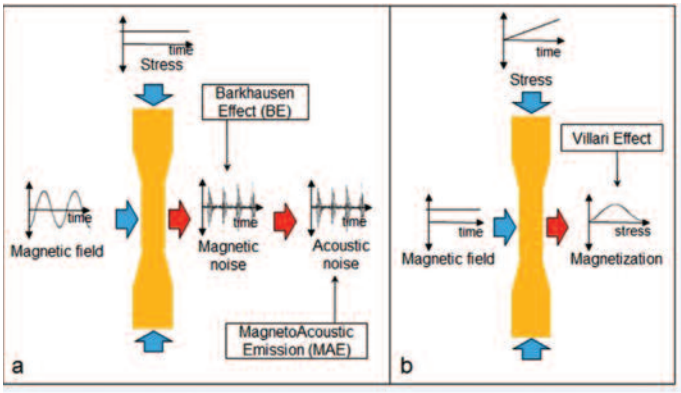
Dr. Michael R. Horne, NIA Senior Research Engineer

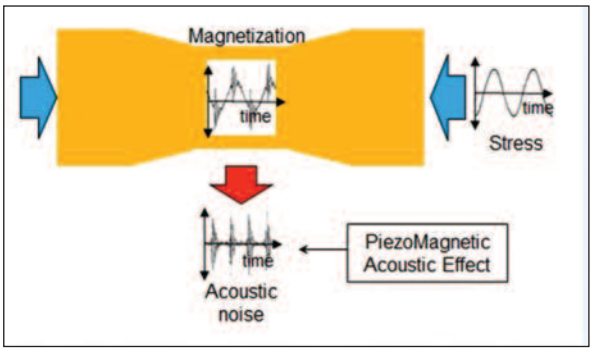
Started in the 1930's to improve mine safety by detecting sub-audible micro-fractures to predict large scale rock bursts, Acoustic Emission Testing (AET) can be considered Experimental Failure Analysis. This technique, for real-time structural health monitoring evaluates structure-borne ultrasonic acoustic emission (AE) generated by microstructural damage development under operating conditions.

One factor against using AET as an Integrated Vehicle Health Monitoring system (IVMH) in aerospace structures has been the network of sensors, associated cabling, and weight. Reducing the number of required sensors could make AET more attractive. One way to do that is to create materials that are more easily inspected. This could be accomplished by embedding particles that create larger or different AE than the bulk material for a given stress level. Ferromagnetic materials could be used for these particles as a result of some new research into magneto-elastically generated AE in these materials prior to any plastic behavior. This equates to reversible behavior which could allow damage tracking for the lifetime of a structure.



This also may lead to a new consideration of damage. A typical mindset concerning the applicability of AE is based on the "flaw and crack" definition of damage. However, as design and materials have progressed, the size of a "critical flaw" (the threshold size that creates very short fatigue life) has become smaller. At some point, detecting precursor changes in the material prior to crack initiation, may be required. Therefore a new definition of damage will not be defined by physical size but by the local changes of the response to load, in service.





NASA Langley 2014 H.J.E. Reid Award

2nd Place, "Bulk Preparation of Holey Graphene via Controlled Catalytic Oxidation," ***Drs. Yi Lin, Jae-Woo Kim, and Kent Watson;*** *John Connell and Dennis Working (LaRC)*

Research

Research Publications

Aeronautical Sciences

B.S. Beck, "Grazing Incidence Modeling of a Metamaterial-Inspired Dual-Resonance Acoustic Liner," in *Proceedings of SPIE 9064, Health Monitoring of Structural and Biological Systems 2014,* 9-13 March 2014, San Diego, CA, doi: 10.1117/12.2059834

P.D. Dunning, B.K. Stanford, and H.A. Kim, "Aerostructural Topology Optimization of the Internal Structure of a Common Research Model Wing," Paper AIAA 2014-0634, in *Proceedings of the 10th AIAA Multidisciplinary Design Optimization Conference,* AIAA SciTech 2014, 13-17 January 2014, National Harbor, MD, doi: 10.2514/6.2014-0634

P.D. Dunning, B.K. Stanford, H.A. Kim, and C. Jutte, "A Study on the Application of Functionally Graded Materials for Aeroelastic Tailoring of a Plate-like Wing," Paper AIAA 2014-0344, in *Proceedings of the 55th AIAA/ASME/ASCE/AHS/SC Structures, Structural Dynamics, and Materials Conference,* AIAA SciTech 2014, 13-17 January 2014, National Harbor, MD, doi: 10.2514/6.2014-0344

W. Li and **S.K. Rallabhandi,** "Inverse Design of Low-Boom Supersonic Concepts Using Reversed Equivalent Area Targets," *J. Aircraft,* 51 (2014): 29-36, doi=10.2514/1.C031551

S.K. Rallabhandi, E.J. Nielsen, and **B. Diskin,** "Sonic Boom Mitigation through Aircraft Design and Adjoint Methodology," *J. Aircraft,* 51 (2014): 502-510, doi: 10.2514/1.C032189

T. Spalt, T. Brooks, C. Bahr, L. Becker, D. Stead, and **G. Plassman,** "Calibrations of the NASA Langley 14- by 22-Foot Subsonic Tunnel in Acoustic Configuration," Paper AIAA 2014-2344, in *Proceedings of the 20th AIAA/CEAS Aeroacoustics Conference,* AIAA Aviation 2014, 16-20 June 2014, Atlanta, GA, doi: 10.2514/6.2014-2344)

B. Stanford and **P.D. Dunning, "**Optimal Topology of Aircraft Rib and Spar Structures under Aeroelastic Loads," Paper AIAA 2014-0633, in *Proceedings of the 10th AIAA Multidisciplinary Design Optimization Conference,* AIAA SciTech 2014, 13-17 January 2014, National Harbor, MD, doi: 10.2514/6.2014-0633

Aerospace Systems

L.G. Crespo, S.P. Kenny, and D. Giesy, "The NASA Langley Multidisciplinary Uncertainty Quantification Challenge," Paper AIAA 2014-1347, in *Proceedings of 16th AIAA Non-Deterministic Approaches Conference,* AIAA SciTech 2014, 13-17 January 2014, National Harbor, MD, doi: 10.2514/mnda14

M. Dhanasar, **W. Edmonson,** F. Ferguson, and I.M. Blankson, "Small Satellite Solar Thermal Propulsion System Design: An Engineering Model," Paper AIAA 2014-1729, in *Proceedings of the 13th International Conference on Space Operations,* AIAA SpaceOps 2014, 5-9 May 2014, Pasadena, CA, doi: 10.2514/6.2014-1729

W. Edmonson, J. Chenou, **H. Herencia-Zapana,** and **N. Neogi,** "Small Satellite Systems Design Methodology: A Formal and Agile Design Process," in *Proceedings of the 8th IEEE International Systems Conference,* 31 March-3 April 2014, Ontario, Canada, doi: 10.1109/SysCon.2014.6819305

G. Glidden and **A. Wilhite,** "Performance of Existing Launch Vehicle Stages for Earth Departure with Refuel from Orbital Propellant Depot," Paper AIAA 2014-4272, in *Proceedings of the AIAA Space 2014 Conference and Exposition,* AIAA Space 2014, 4-7 August 2014, San Diego, CA, doi: 10.2514/6.2014-4272

J.R. Skuza, Y. Park, H.J. Kim, S.T. Seaman, G.C. King, S.H. Choi, K.D. Song, H. Yoon, and K. Lee, "Feasibility study of green energy-powered dirigible transportation," *NASA/TM-2014-218241*, May 2014

A. Wilhite and **P. Chai,** "Plan B for U.S. Human Space Exploration Program," Paper AIAA 2014-4237, in *Proceedings of the AIAA Space 2014 Conference and Exposition,* AIAA Space 2014, 4-7 August 2014, San Diego, CA, doi: 10.2514/6.2014-4237

F.J. Xu, **F.G. Yuan,** J.Z. Hu, and Y.P. Qiu, "Miniature Horizontal Axis Wind Turbine System for Multipurpose Application," *Energy,* 75 (2014): 216-224, doi: 10.1016/j.energy.2014.07.046

Airspace Management & Systems

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Atmospheric Science

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Unmanned Aerospace Systems

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In 2014 **2** of NIA researchers became U.S. citizens!

PENINSULA TECHNOLOGY INCUBATOR

Peninsula Technology Incubator (PTI)

NIA is committed to the mission of economic development in the City of Hampton and the Virginia Peninsula. We strongly believe that entrepreneurship must play a more significant role in job creation, wealth creation and the retention of our best and brightest graduates from the regional universities. In pursuit of this mission, the PTI was incorporated in April 2012 by NIA as a subsidiary 501(c)3 Virginia Corporation. Funded by the City of Hampton, The Commonwealth of Virginia, other municipalities, local companies, and license fees paid by clients, PTI provides startups with necessary resources as they mature, raise capital and implement their business plan.

Over the last year PTI has rapidly expanded its reputation as a world class Incubator. We and our clients have been recognized for our accomplishments regionally and internationally:

- *Winner Hottest Tech Startup in Washington D.C. – FreePing*
- *Winner Hottest Tech Startup in Baltimore – HIS Energy*
- *Winner Hottest Tech Startup in the Nation – HIS Energy*
- *Winner Semper Startup – Aesop Technologies*
- *Winner Get Started NOVA – Feedback Enterprises*
- *Winner Babson College / Goldman Sachs 10,000 Small Businesses – CrossRope*
- *Named an Emerging Global Entrepreneur by the White House and Small Business Administration –FreePing*
- *Accepted into Google's Elite Marketing Program - FreePing*
- *Recognized as one of the top 50 Accelerators in the Nation by Small Business Administration – Peninsula Technology Incubator*
- *Recognized by Technopolicy as one of the top two knowledge based Incubators in the World in the "New" category – Peninsula Technology Incubator*

We focus on an annual "Pipeline Process" starting in October with "Pitch Perfect", a series of workshops designed to assist entrepreneurs with skills necessary to deliver a successful elevator speech. This is followed in November with Start! Peninsula, a weekend-long intensive competition to get resources to the best ideas and entrepreneurs. Start! Peninsula is followed by an eight week intensive Accelerator Program that gives the entrepreneur additional skills they may be lacking in areas ranging from accounting, to financial modeling, human resources, intellectual property and business law, sales and marketing. After successful completion of the Accelerator, clients' companies are given the opportunity to pitch to real investors. The very best have received hundreds of thousands of dollars in investment capital, created dozens of jobs, and will, this year, generate millions of dollars of revenue.

2014 NIA Visitor Program

NIA's Visitor Program facilitates research collaborations between scientists and engineers at NIA, NASA Langley Research Center, and researchers, faculty, and graduate students from other institutions. The typical visit is for a semester or summer, but longer or shorter durations are easily accommodated. NIA supports this program with concierge services to assist with securing local lodging and transportation, visas for our international guests, access badges for NASA Langley Research Center, office accommodations and compensation. Participants usually conclude their stay with a seminar for our resident faculty, research staff, students, and researchers from the NASA Langley Research Center Community. In 2014 NIA hosted 43 visiting student, researchers and professors.

Visiting Researchers:

Catalanotti, Giuseppe
University of Porto, Portugal
"Structural Integrity of Advanced Composites"

Chen, Jung-San
National Cheng Kung University, Taiwan
"Stability Analysis for Heliogyro Spinning Membrane under Solar Pressure"

Crespo, Luis
Sandia National Laboratory, United States
"Computation, Modeling, and Simulation"

Denison, Marie
"New Methods for Turbulence Drag Reduction and Modeling"

Eisfeld, Bernhard
DLR-German Aerospace Center, Germany
"Turbulence Modeling"

Juang, Jer-Nan
National Cheng Kung University, Taiwan

Lew, Jiann-Shium
Tennessee State University, United States
"Robustness Studies of Generalized Predictive Controller"

Lowe, Todd
Virginia Polytechnic Institute and State University, United States
"Demonstration & Optimization of Laser Diagnostics Methods Near Surfaces"

Manolios, Panagiotis
Northeastern University, United States
"Formal Verification, Design Automation for Aerospace Systems"

Mead, M. Iqbal
University of Cambridge, United Kingdom
"PTR-MS Measurements of Non-Methane Hydrocarbons"

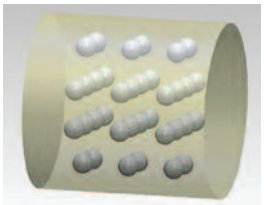
Mitra, Sayan
University of Illinois-Champaign, United States
"Formal Methods"

Miyauchi, Masahiko
Kaneka Corporation, Japan
"High Temperature Composite Matrix Resins"

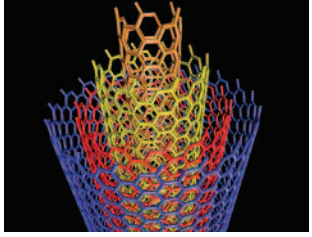
Mizukaki, Toshiharu
Tokai University, Japan
"Advanced Measurement Techniques for Wind Tunnel Measurement"

Sen, Sudip
Lancaster University, United Kingdom
"Nowcast of Atmospheric Ionizing Radiation for Aviation Safety"

Sheplak, Mark
University of Florida, United States
"Investigations of Drag Due to Flow"



Visiting Students

Adnan, Mohammed
Rice University, United States
"AFOSR LDM Program"

Amanor, David
North Carolina A&T University, United States
"GPS-denied Navigation"

Barnard, Casey
University of Florida, United States
"Investigations of Drag Due to Flow"

Borges Avelar, Andreia
University of Brazil, Brazil
"Formal Methods"

Angel Flores-Abad
New Mexico State University, United States
"Dynamics and Control"

Chen, Nan
Stevens Institute of Technology, United States
"Radiative Transfer"

Clary, Tavin
North Carolina A&T University, United States
"GPS-denied Navigation"

Conklin, Lindsey
University of Arizona, United States
"Structural Mechanics"

Degenhardt, David
University of Technology Carolo-Wilhelmina Braunschweig, Germany
"Composite Structures and Materials"

Depuru Mohan, N. Karthik
University of Cambridge, United Kingdom
"Aeroacoustics"

Eddy, Joshua
Virginia Polytechnic Institute and State University, United States
"GPS-denied Navigation"

Gemma, Stefania
University of Rome "La Sapienza", Italy
"Multidisciplinary Design Analysis and Optimization"

Ghosh, Ritwika
University of Illinois, Urbana-Champaign, United States
"Verification of Safety Properties of a Parallel Landing Protocol"

He, Min
Stevens Institute of Technology, United States
"Surface Parameter Retrieval from CALIPSO Data"

Hsiao, Tien-Hao (Randy)
National Cheng Kung University, Taiwan
"Real Time Image Processing for Heliogyro Spinning Membrane"

Hu, Yile
University of Arizona, United States
"Holistic High Fidelity Modeling Strategy for Advanced Composites"

June, Jason
University of Florida, United States
"Investigations of Drag Due to Flow"

Kersten, Rody
Radboud University Nijmegen, The Netherlands
"iDiSE/JAVA PathFinder"

Khakimova, Regina
DLR-German Aerospace Center, Germany
"Buckling of CFRP Thin-Walled Truncated Cones"

Laurent, Jonathan
Ecole Normale Supérieure, France
"Formal Methods"

Legrand, Maxime
Ecole Normale Supérieure, France
"Formal Methods"

Liao, Yunlong
University of Puerto Rico, Puerto Rico
"Synthesis and Characterization of Boron Nitride Nanomaterials"

Madhugiri, Niti
University of North Carolina-Chapel Hill, United States
"GPS-denied Navigation"

Markevicius, Mantas
University of York, United Kingdom
"Verification of Numerical Software"

Meurer, Alex
Leibniz Universität Hannover, Germany
"Buckling of Cylindrical Shells"

Raimondo, Antonio
University of Naples, Italy
"Composite Materials"

Ryan, Robert
Christopher Newport University, United States
"GPS-denied Navigation"

Scholz, Artur
Etamax Space GmbH, Germany
"Heliogyro Membrane Deployment and Cubsat Design"

Schwingel, Johannes
DLR-German Aerospace Center, Germany
"Nonlinear Analysis of Deployable Composite Structures"

NASA HQ 2013 ARMD Associate Administrator Award (AA)
presented in 2014, Technology and Innovation Category, "High Fidelity Tool-Validation for Sonic Boom and Drag Prediction", ***Dr. Sriram Rallabhandi***

North Carolina State University and NIA PhD student, Donato Girolamo, Receives "Best Engineering Thesis of the Year 2013 in the Netherlands" Award

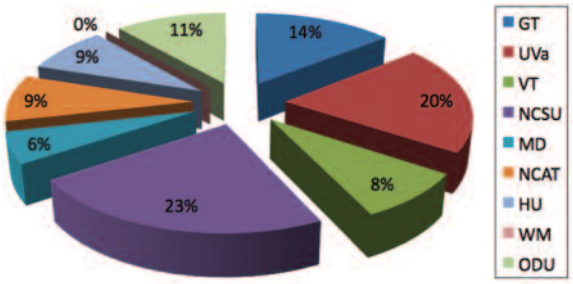
Donato Girolamo, NCSU PhD student working with Langley Professor Fuh-Gwo Yuan, graduated from Delft University of Technology with a Masters in Science, with a thesis entitled "Progressive Damage Analysis of Bonded Composite Joints". His work has been awarded the best thesis prize by the Netherlands Association of Aeronautical Engineers & The Royal Institute of Engineers in the Netherlands. This research, which was conducted at NASA LaRC, was part of the NASA Bonded Composite Joints Project, within the SLS Program. The project aimed to investigate and characterize three different sandwich composite bonded joint designs (Conventional Splice Joint, Durable Redundant Joint, and Fluted Core Sandwich Joint) conceived to bond different sections of the SLS payload shroud during the assembly. The effort involved multiple branches within NASA LaRC from different Directorates: RD, ED, and SLS. The Boeing Company, Seattle, took part in the project under a Space Act Agreement.

Graduate Education:

The NIA Graduate Program offers M.S. and Ph.D. degrees from all nine member universities; Georgia Tech, Hampton University, the University of Maryland, North Carolina A&T, North Carolina State, Old Dominion University, the University of Virginia, Virginia Tech, and the College of William and Mary. Our educational opportunities are available to NASA employees, contractors, and members of the local community through local instruction and advanced distance-learning facilities. Presentations are made by distinguished professors-in-residence, visiting and adjunct faculty, and on-site research staff. In 2014, 35 full-time students were enrolled in our graduate education program. Of these students, 11% were female; 66% were Ph.D. students; and 34% were working towards an M.S. degree. NIA had 24 part-time students enrolled in the program. Students are technically and geographically diverse.

NIA Full-Time Students by University: 2014

The distribution of our full-time students is: Georgia Tech (5), Virginia (7), Virginia Tech (3), NC State (8), Maryland (2), North Carolina A&T (3), Hampton (3), William & Mary (0), Old Dominion (4).



Member University	Degree Programs Offered
Georgia Tech	Aerospace Engineering
Hampton University	Planetary and Atmospheric Sciences*
North Carolina A & T	Mechanical, Electrical and Computer Engineering
North Carolina State	Mechanical and Aerospace Engineering
Old Dominion University	Aerospace Engineering
University of Maryland	Aerospace Engineering
University of Virginia	Mechanical and Aerospace Engineering, Electrical and Computer Engineering, Materials Science & Engineering, Engineering Physics, Systems & Info. Engineering.
Virginia Tech	Aerospace, Mechanical, Ocean Engineering, Materials Science & Engineering, Engineering Mechanics, Electrical and Computer Engineering, Computer Science
William and Mary	Applied Science*

*Courses typically available on campus only.

NIA has 4 distance learning classrooms. Three rooms, with maximum capacities of 12-36 students, are equipped with monitors, smart boards, VCRs, cameras, microphones, document projector (Elmo), electronic screens, and projectors to accommodate typical classes of eight or twelve students. One room is equipped with stand-alone video conferencing equipment, monitors, and VCRs to accommodate two to four students. In the spring 2014 semester, NIA offered 119 classes to students; 114 classes were available during the fall 2014 semester. NIA had its first graduates at the end of the Spring Semester 2004. Since then we have grown rapidly and now list a total of 153 graduates, comprised of 48 Ph.D. degrees and 105 M.S./M.E. degrees.

2014 Graduates

Patrick Chai
Georgia Institute of Technology/December 2014
Ph.D., Aerospace Engineering, Dr. Alan Wilhite
Thesis Topic: Stochastic Feasibility Assessments of Orbital Propellant Depot and Commercial Launch Enabled Space Exploration Architecture Present Position: NASA Civil Servant/ Space Mission Analysis Branch

Taylor Brooke Spalt
Virginia Polytechnic Institute and State University/December 2014
Ph.D., Aerospace Engineering, Dr. Chris Fuller
Thesis Topic: Constrained Spectral Conditioning for the Spatial Mapping of Sound Present Position: NASA Civil Servant/ Aeroacoustics Branch

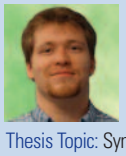
Cornelia Altenbuchner
University of Maryland/December 2014
Ph.D., Aerospace Engineering, Dr. James E. Hubbard
Thesis Topic: Flexible Multi-Body Dynamics Model of a Bio-Inspired Ornithoper with Experimental Validation Present Position: NIA Contractor for NASA/LaRC in the Structural Dynamics and Concepts Branch

Steven Andrew Tobin
North Carolina State University/December 2014
M.S., Aerospace Engineering, Dr. Andre Mazzoleni
Thesis Topic: (non-thesis) A Probabilistic Design Demonstration of Flexible Thermal Protection System for a Hypersonic Inflatable Aerodynamic Decelerator Present Position: Aerospace Thermal Engineer, NASA LaRC in the Structural and Thermal Systems Branch

Eliot W. Quon
Georgia Institute of Technology/August, 2014
Ph.D., Aerospace Engineering, Dr. Marilyn J. Smith
Thesis Topic: Data Transfer Strategies for Overset and Hybrid Computational Methods Present Position: Postdoctoral Researcher, National Renewable Energy Laboratory

Aimy Wissa
University of Maryland/August 2014
Ph.D., Aerospace Engineering, Dr. James Hubbard
Thesis Topic: Analytical Modeling and Experimental Evaluation of a Passively Morphing Ornithopter Wing Present Position: Post Doc Fellow at Stanford University for one year and then has accepted appointment at Assistant Professor as University of Illinois

Kevin Antcliff
Virginia Polytechnic Institute and State University/ August 2014
M.S., Aerospace Engineering, Dr. Mark Guynn, Dr. Craig Woolsey, Dr. Pradeep Raj
Thesis Topic: Investigation of the Impact of Turboprop Propulsion on Fuel Efficiency and Economic Feasibility Present Position: NASA Pathways, will pursue PhD



Johnathan Hardwick
Virginia Polytechnic Institute and State University/May 2014
M.S., Mechanical Engineering, Dr. Chris Fuller
Thesis Topic: Synthesis of Rotocraft Noise from Flyover Data

Prasad Kutty
Georgia Institute of Technology/May 2014
M.S., Aerospace Engineering, Dr. Alan Wilhite
Thesis Topic: Reconstruction and Uncertainty Quantification of Entry, Descent and Landing Trajectories Using Vehicle Aerodynamics Present Position: NASA/LaRC Atmospheric Flight & Entry Systems Branch

Rafael Andres Lugo
North Carolina State University/ May 2014
Ph.D., Aerospace Engineering, Dr. Robert Tolson
Thesis Topic: Statistical Entry, Descent, and Landing Flight Reconstruction with Flush Air Data System Observations Using Inertial Navigation and Monte Carlo Techniques Present Position: NASA/LaRC Atmospheric Flight and Entry Systems Branch contractor with Analytical Mechanics Associates, Inc. as a Flight Mechanics Engineer

Doug Wells
Georgia Institute of Technology/May 2014
M.S., Aerospace Engineering, Dr. Dimitri Mavris
Present Position: Civil Servant at NASA/LaRC Aeronautics Systems Analysis Branch

Timothy Michael Moeller
Georgia Institute of Technology/May 2014
M.S., Aerospace Engineering, Dr. Alan Wilhite
Present Position: Systems Engineer with Sierra Nevada Corporation

Adam Christopher Slagle
Virginia Polytechnic Institute and State University/ May 2014
M.S., Mechanical Engineering, Dr. Chris Fuller
Thesis Topic: Low Frequency Noise Reducing Using Poro-Elastic Metamaterials and Bicroperformated Panels Present Position: continuing studies toward Ph.D. at Virginia Tech

Continuing Education

NIA recognizes the importance of continuing and lifelong learning for all individuals engaged in technical fields of study. We also understand that the education and training needs of engineers and scientists established in their fields often differ from those of individuals entering the field for the first time. For those seeking to enhance and expand their knowledge in focused fields, NIA has developed a program of short courses, workshops, conferences, seminars and colloquia. In 2014, NIA offered more than 73 seminars, 1 workshop, and 3 short courses. A number of our short courses are open to NASA and the general public and some of the seminars are video recorded and web-archived onthe NIA web site.

Martin L. Drews Scholarship

The 2014 Martin L. Drews Memorial Scholarship was awarded to Shane T. Seaman, Virginia Tech Ph.D. candidate studying material science and engineering at the National Institute of Aerospace. The supplemental scholarship is intended for a student who is engaged in research related to the exploration of space.

Outreach

Educational Outreach

NIA's team of STEM education specialists, Educators-in-Residence and program managers work closely together and with our customers to develop and deliver signature national and regional programs to advance STEM literacy and inspire the next generation of scientists and engineers.

Our award winning outreach covers the continuum of education—from the young to the young at heart — through programs that capture early fascination with science, technology, engineering and math; feed that interest through the formative years; and share exciting discovery and innovation to public audiences across the nation.

- **Teacher training through pre-service and in-service teacher professional development**
- **K-12 student engagement through formal and informal integrative STEM learning programs**
- **University student engagement through internships and rigorous engineering challenges**
- **STEM literacy and awareness through national radio, web-based, and television programming**

K-12 Educator Programs and Classroom Resources

CENTER FOR INTEGRATIVE STEM EDUCATION
NATIONAL INSTITUTE OF AEROSPACE

NIA's Center for Integrative STEM Education (CISE) focuses on the unique needs of the K-12 formal and informal STEM learning community. Started in 2012, CISE has grown in reputation and reach providing dozens of successful state and national programs to school districts, local, state and federal government and industry.

NIA Educators facilitated

80 Educational outreach events during 2014, impacting more than

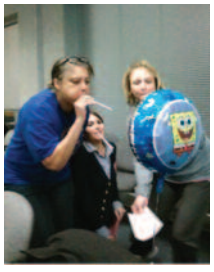
1,500 formal and informal educators and

over **17,000** students.

Graduate Courses in Elementary STEM

NIA has developed and delivers six graduate courses in partnership with McDaniel College. These courses comprise the Elementary STEM Instructional Leader (ESIL) program. The program is approved by the Maryland Higher Education Commission (MHEC) and the Maryland State Department of Education (MSDE). Completion of the ESIL program and a final digital portfolio satisfies MSDE requirements for an elementary Leadership: STEM PK-6 endorsement for in-service teachers. Five of the six courses also earn candidates a STEM Education certificate from McDaniel College.

Five cohorts of in-service teachers, three in Maryland and two in Virginia, are completing the ESIL program. The courses are offered both on-campus and off-campus and can be differentiated to align with school systems' STEM initiatives.



The NIA-McDaniel course design follows research-based best practice incorporating active learning, job-embedded tasks, systemic and coherent design, on-going and sustainable learning, and reflective feedback. The courses are hybrids with both online and face-to-face instruction.

NASA-NIA Integrative STEM Pre-Service Teacher Institute

NIA educators developed and delivered the 2014 Pre-Service Teacher Institute to 27 university students preparing for teaching careers in the K-8 classroom. During the two-week program, participants were immersed in inquiry learning with a focus

on real-world connections and the design of authentic integrative STEM lessons into standards-based curriculum. NASA's portfolio of educational resources was paired with 21st century learning skills and instructional technology to engage participants in NASA-based STEM education. Through a series of engineering design challenges and interactions with NASA engineers and scientists, the participants experienced engineering design in action and learned how design challenges exemplify best practices and align with the Next Generation Science Standards. Participants had opportunities to practice the NASA activities with students in local summer school programs.

www.nianet.org/pstsp

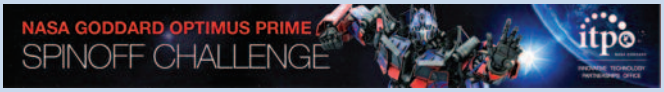
NASA eClips™

NASA eClips™ is an award-winning national educational program developed to inspire and engage K-12 students by helping them see real-world connections to STEM education. Short, relevant video segments and educator materials offer unlimited flexibility in the classroom for timing, sequencing, and pacing of instruction to meet the needs of students and classroom instructors. All NASA eClips™ products are aligned with current national curriculum standards as identified by the National Council of Teachers of Mathematics, the National Science Teachers Association and the International Society for Technology in Education.

Addressing the new engineering standards, NASA eClips™ provides material for teachers to integrate engineering practices into core subjects.

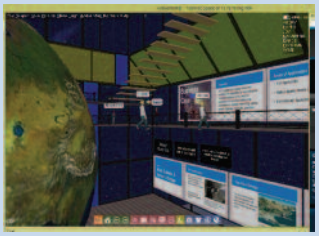
One new NASA eClips™ segment was produced for NASA in 2014 featuring Planetary Science content, bringing the suite to a total 252 video segments. Related NASA resources are continuously aligned with video segments and posted on the NASA eClips website and social media outlets.

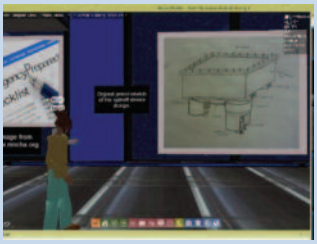
http://nasaeclips.arc.nasa.gov

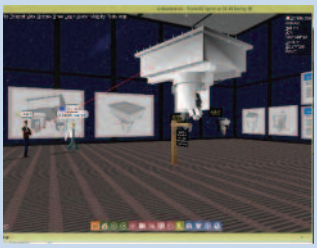


OPTIMUS PRIME Spinoff InWorld Challenge

NIA partnered with the NASA Goddard OPTIMUS PRIME Spinoff Challenge and the James Webb Space Telescope Mission to develop the OPTIMUS PRIME Spinoff InWorld (OPIW) Challenge. Students in grades 6 – 12 worked with college engineering students to develop their video spinoff ideas within a 3D multi-user game platform to create 3D virtual models of possible spinoff technologies.







Participating students used the virtual world setting to work collaboratively with college engineering students and to "chat" with subject matter experts, including James Webb Space Telescope scientists, engineers, and patent, marketing, and trademark specialists.

The OPIW was a spinoff of the RealWorld-InWorld NASA Engineering Design Challenge. All virtual communications were housed within the NIA Universe, a protected 3D gaming platform that supports students' use of 21st Century tools to refine designs and create 3D models.

Finalist teams presented "live" to an expert panel of educators, NASA engineers, and US Patent educators. The winning team joined the OPTIMUS PRIME video challenge winners for a workshop at NASA's Goddard Space Flight Center and to present and discuss their spinoff ideas with James Webb Space Telescope researchers.

http://itpo.gsfc.nasa.gov/optimus/challenge_overview.php
http://jwst.nasa.gov/realworld.html

SpaceMath@NASA

In 2013, Dr. Sten Odenwald, an astrophysicis researcher with a passion for STEM, joined NIA's Center for Integrative STEM Education team as the PI for SpaceMath@NASA. SpaceMath@NASA produces one-page problems featuring a NASA discovery or engineering issue. The problems are designed for direct classroom use by students and teachers in grades 3 through 12, and use authentic, on-grade-level math topics rooted in real-world science and engineering data. SpaceMath@NASA was developed to help NASA missions upgrade their education and public outreach offerings by explicitly integrating mathematics problems into the science content.

Problems are commonly extracted from NASA press releases and written to feature some surprising but quantifiable aspect of an image or discovery that can be paraphrased as mathematical problems. These can be as diverse as a problem on fractions and percentages using Kepler exoplanet data, or as complex as determining the volume of Comet Hartley-2 using integral calculus.

During 2014, SpaceMath developed a series of innovative 5-E –based multimedia STEM modules covering NASA's Mars Insight mission and its studies of the interior of Mars, and the upcoming SAGE-III atmospheric aerosol mission to the ISS.

SpaceMath also developed a suite of interactive Excel spreadsheets to allow students to directly interact with simple mathematics models of climate change events and investigate the interior of Mars through seismic data.

SpaceMath@NASA regularly receives over 35,000 visitors a month, and has had over 11 million downloads since its inception in 2003. Support for SpaceMath comes from NASA's Science Mission Directorate.
http://spacemath.gsfc.nasa.gov/

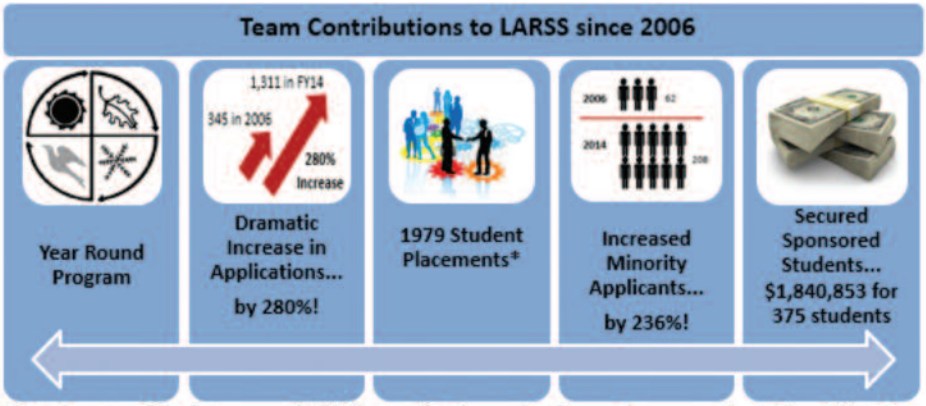
University Internships and Design Competitions

Langley Aerospace Research Student Scholars (LARSS) Program

Celebrating its 28th Anniversary in 2014, the LARSS Program experienced a record-breaking 322 student internships placed at Langley Research Center (LaRC). LARSS, a highly competitive research internship program, targeted undergraduate and graduate students pursuing degrees in science, technology, engineering, and math (STEM), as well as fields relevant to work conducted at LaRC. Designed to bridge the gap between academic concepts and real-world experience, LARSS offered students studying STEM disciplines the opportunity for research, academic engagement and collaboration with NASA's professional STEM work force.

October 1, 2014 marked the official end of the LARSS program, and future LaRC internships will be processed through the agency-wide NASA Internships, Fellowships, and Scholarships (NIFS) program.

Between 2006 and 2014, LARSS has exceeded goals:



*Original target was 75 students per year. LARSS Program Team has consistently grown the program to host well over 200 students annually through LARSS. LARSS hosted a record-breaking 322 students in FY14.

The **LARSS team, NIA** and its subcontractor, **Virginia Space Grant Consortium,** was awarded the prestigious *NASA Group Achievement Award* in 2014, for outstanding support of the NASA mission through the development of a national, award-winning, internship program for university engineering and science students.

Revolutionary Aerospace Systems Concepts – Academic Linkage (RASC-AL)

RASC-AL is an annual undergraduate and graduate level engineering design competition, managed by NIA for NASA. The competition focuses on human scale architecture and systems. This year's Forum was held in Cocoa Beach, Florida in June 2014. Fourteen university teams competed for top honors for mission architecture design relevant to NASA's current human space exploration program goals.

The steering committee, comprised of NASA and industry experts, scores and judges all aspects of the competition including abstracts, technical papers, oral presentations, posters and education/public outreach activities against a list of criteria and constraints announced at the onset of each year. In 2014, Virginia Tech garnered first place and University of Maryland placed second.

RASC-AL Exploration Robo-Ops

Robo-Ops is a university level engineering design competition focused on robotics systems, managed by NIA for NASA. University teams vied for one of 8 slots to demonstrate their rover's capabilities by performing a series of tasks in field tests at NASA Johnson Space Center's (JSC) Rock Yard. Rovers were operated remotely from the mission control center of their home universities, while remaining team members joined the rover at the JSC Rock Yard to serve as the team's on-site pit crew. This robotic manipulation, complete with communication delays, tests Mars-forward capabilities to reduce mass and lunar and Mars surfaces, simulates crew assisted return of samples, and demonstrates teleoperated robotic asset work on lunar and Mars surfaces. Student teams were also required to submit a technical paper and poster, as well as conduct a robust and dynamic public engagement component that demonstrates participatory exploration approaches for future NASA missions. In 2014, West Virginia University claimed first place, and the Massachusetts Institute of Technology claimed second place.

Media Communications and Public Outreach

NIA collaborates with government, industry, universities, professional societies, non-profits and others to develop and implement projects and campaigns that build excitement and support for NASA and the aerospace community.

NIA's multi-layered support and world-class creative services are crafted to deliver award-winning campaigns. With internationally recognized work in radio, web, live broadcasts, conferences, and events, NIA provides multi-layered support and world-class creativity for marketing and media, outreach and communications.

NASA 360

NASA 360 is a premiere NASA outreach program that engages an adult (18-35) audience. NASA 360 brings you the latest in NASA science, engineering and aeronautics. From understanding our changing Earth to preparing humans for a journey to Mars - this is YOUR space agency, get to know it. NASA 360 aired 2 full-length episodes in 2014: *The Rise of the Rovers and The Future of Human Space Exploration.*

The program was expanded this year to include shorter length videos designed to inform the public about leading-edge research presented at professional conferences, workshops and events. These videos air directly on nasa.gov and through social media outlets, reaching a broader audience in real-time.

NASA 360 has over 15 million views from NASA.gov and has more than 3 million Facebook and Twitter followers. NASA 360 is available on **www.NASA.gov/NASA360**

Follow NASA 360:

NASA 360 | Facebook
https://www.facebook.com/FollowNASA360

NASA - 2014 Patent Awards Ceremony- Issued US Patents:

Fabrication of Nanovoid-Imbedded Bismuth Telluride With Low Dimensional System LAR-16906-1; U.S. Patent Number 8,529,825 ***Sang-Hyon Chu, Jae-Woo Kim, Yeonjoon Park,*** *et.al.*

Conducting Nanotubes or Nanostructures Based Composites, Methods of Making Them and Applications LAR-17493-1; U.S. Patent Number 8,424,200, ***Mool Gupta***

Antenna With Dielectric Having Geometric Patterns LAR-17638-1: U.S. Patent Number 8,508,413, ***Sayata Ghose, Kent Watson***

Innovation Now was developed in collaboration with NASA Langley Research Center and launched in Sept. 2011. NIA produces and distributes ~260 radio segments annually. The 90-second intersticials are designed to air daily, Monday-Friday, for broadcast during programs like National Public Radio's "All Things Considered." WHRO/WHRV Hampton Roads is the public radio partner supporting online distribution of the program nationally to public radio stations.

Innovation Now is designed to promote advocacy for NASA research and technology programs while communicating the societal impact of NASA technology investments.

The series reaches ~7.5 million listeners daily via pubic, college and commercial broadcast radio stations, on the web and through mobile devices. Innovation Now's geographic footprint currently reaches every U.S. state, Australia, Thailand, Philippine Islands, and New Zealand. **www.innovationnow.us**

NASA Exploration Design Challenge

NASA EDC was developed in collaboration with Lockheed Martin and NASA and is an opportunity for K-12 students to chart their journey to deep space by tackling one of the major challenges of long-duration exploration – the dangers associated with radiation. The challenge launched on March 11, 2013 at Johnson Space Center and culminated with the launch of Orion's Exploration Flight Test–1 in December 2014.

The winning high school team, Team ARES – American Radiation Eradication in Space – from the Virginia Governor's School for Science and Technology in Hampton, Virginia, was announced at the USA Science and Engineering Festival, Washington DC, by NASA Administrator Charles Bolden and LM CEO Marillyn Hewson. The winning team flew a prototype of their shielding design on EFT-1 and participated in launch events.

NASA Administrator Charles Bolden and Lockheed Martin CEO Marilyn Hewson with Team ARES at USA Science and Engineering Festival

More than 163,200 students completed the Challenge, which ended June 30, 2014. All 50 states, the District of Columbia, Puerto Rico and 94 countries were represented. A list of 37,734 student names were flown on EFT-1 as the virtual crew.

NASA/U.S. Dept. of Education 21st Century Community Learning Centers

NIA, in collaboration with NASA and the U.S. Department of Education, supported a pilot to expand science, technology, engineering and mathematics (STEM) education within the 21st Century Community Learning Center (21CCLC) program. The pilot included three states (Michigan, Oregon and Virginia) using STEM challenge content including the NASA Exploration Design Challenge. NIA provided professional development for facilitators, student interactions, and media services throughout the pilot.

As a result of their work on the 21CCLC initiative, NIA's Director of Communications and Partnerships, **Harla Sherwood** and Senior Educator, **Becky Jaramillo** were awarded a *NASA Group Achievement Award* "For outstanding development of a groundbreaking model of interagency collaboration for the advancement of high quality STEM teaching and learning in afterschool settings."

21CCLC is being showcased as a model of a successful interagency effort under the President's vision of collaboration and efficiency in federal STEM education that is currently being advanced by the White House's Office of Science and Technology Policy and the Committee on STEM.

Challenger Center for Space Science Education Events

NIA in collaboration with NASA and the Challenger Center for Space Science Education hosted ten (10) public awareness events. Events were themed to 1) New Worlds - New Discoveries; 2) I'm the Mars Generation, and 3) Eyes on Earth. Events took place at Challenger Learning Centers across the US throughout May and June reaching ~2K individuals. This meant exposure for students and families from all walks of life including rural, underserved, and at-risk communities.

Live Streaming and Event Support

In 2014 … included:

- MAVEN Launch
- Mars Update at National Air and Space Museum
- AIAA SCITech 2014
- 45th Annual Lunar Planetary Science Conference
- Famelab
- Life Beyond Earth: A Celebration of Cassini's 10th Anniversary
- Mars Up Close
- Comet Workshop
- 2014 NIAC Symposium
- Announcement of Finalists for NASA Exploration Design Challenge
- Humans 2 Mars Summit
- AIAA Aviation 2014
- AIAA Propulsion and Energy 2014
- AIAA Space 2014
- EFT-1 Launch

NIA's web broadcasting efforts in 2014 surpassed more than 3 million viewer minutes with viewers from around the globe.

Our People:

The National Institute of Aerospace is a 501(c)3 non-profit research and graduate education institute created to conduct leading edge aerospace and atmospheric research, develop new technologies for the nation and help inspire the next generation of scientists and engineers. NIA values its people and in 2014 was ranked #12 in the top 50 best non-profit companies to work for in the United States. We understand that a quality team is essential to the success of NIA's research and educational programs. The NIA team consists of 201 employees, resident university professors, post-doctoral and graduate students, and consultants, who are highly educated and qualified research scientists and engineers, education specialists, students, and program and operational support staff. NIA's research staff includes research scientists and engineers ranging from post-doctoral to senior research fellows. Among the research staff, 83% hold doctoral level degrees in fields related to aerospace. Our researchers are sought-after experts in their fields and present their research to others through conferences, seminars, workshops, and publications.

Our Vision

(*To be a recognized leader in innovative aerospace research, exemplary education, and inspirational outreach.*)

Our Mission

Lead and conduct synergistic research with government, academia and industrial partners to stimulate innovation and creativity

- **Deliver** unique, collaborative, and comprehensive graduate and continuing education in science and engineering
- **Inspire** the next generation of aerospace engineers and scientists and provide outreach for the public good
- **Incubate** and commercialize new intellectual property developed through NIA's research activities

Our Values

- Our people are our strength
- Dedication to every stakeholder's success through excellent service
- Innovation in research and education that impacts future generations
- Trust and accountability in all relationships
- We share one vision and act as one Team
- We embrace change and reward innovation

Our Objectives

- **Establish** collaborative research and education centers that are internationally recognized for important intellectual contributions in aerospace-related engineering, science, and technology.
- **Remain** strategically aligned with NASA Langley and respond to NASA's research and development, education, and outreach priorities as they evolve.
- **Develop** and grow non-NASA support for research, education and outreach programs, including a robust collaborative research program with the global aerospace industry.
- **Collaborate** closely with university partners in fulfilling NIA's vision
- **Attract** the highest quality researchers, faculty, and students to conduct a collaborative, multi-disciplinary education and research program

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