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NATIONAL INSTITUTE OF AEROSPACE

2015 ANNUAL REPORT

RESEARCH
GRADUATE EDUCATION
OUTREACH

National Institute of Aerospace

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Front Cover Photo Credit: NASA

President's Message

In 2015, NIA and our employees received many awards and performed an array of innovative research, education, and outreach activities as you will discover in exploring this Annual Report. Perhaps the most exciting research award we received was being selected by NASA to manage the new Advanced Composites Consortium. The consortium is a unique public-private partnership whose purpose is to "reduce the timeline for development and certification of innovative composite materials and structures, which will help American industry retain their global competitive advantage in aircraft manufacturing." Initial members include NASA, FAA, Boeing, United Technologies/Pratt & Whitney, General Electric, Lockheed Martin and NIA. The funding for this consortium is expected to exceed $40M over 5 years, which will represent the largest research activity in NIA history!

Our six Langley Professors in residence at NIA from our member universities have all continued to excel in 2015. Five of the six are now Fellows in their respective professional societies. In this Annual Report you will find a feature on one of them, Prof. James Hubbard of the University of Maryland. Prof. Hubbard had an exceptional year. He is an internationally recognized leader in the fields of smart materials and adaptive structures, with recent innovative applications to unmanned aerial vehicles. In 2015, Prof. Hubbard was named a Fellow of the American Society of Mechanical Engineers (ASME) and won the ASME 2015 Best Paper in Structures Award. He was given the Smart Structures and Materials Lifetime Achievement Award from SPIE. Finally, he ended the year by being accepted into the National Academy of Engineering – the highest honor offered to a U.S. engineer! He joins only 2,200 other members from all engineering fields, including only 6 other members from NASA.

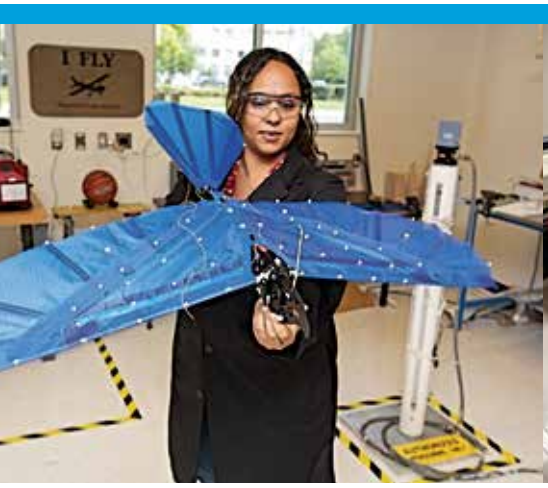
Our world-class Research Centers continued continued to flourish in 2015. Our Center for High-Performance Aerospace Computations (HiPAC) under the leadership of NIA Fellow, Dr. Boris Diskin, completed $1.5M in research in 2015 involving 25 different research projects. Our HiPAC Team also conducted 11 seminars, published 17 peer-reviewed papers, and developed 10 new university collaborations. Our Center for Planetary Atmospheres and Flight Sciences (CPAFS), led by Dr. Jared Bell, continued growing and includes collaborators from 15 different universities and government labs. The CPAFS Team completed a Saturn thermosphere model and won funding for a Venus thermosphere model.

In 2015, NIA researchers had many accomplishments and awards. We now have the largest number of researchers in NIA history! NIA Associate Fellow Dr. Ron Krueger was selected as AIAA Hampton Roads Section (HRS) Engineer of the Year (EoY) and was also selected as Peninsula Engineers Council (PEC) Engineer of the Year. This is the second year in a row an NIA Researcher has won the prestigious HRS EoY award. In addition, NIA's Dr. Nelson De Carvalho won 1st place in the AIAA Hampton Roads Section Laurence J. Bement Young Professional Paper Competition. NIA's unique Boron Nitride Nano-Tube (BNNT) Manufacturing and Science Lab continued active operation in 2015, including collaborative research with NASA Langley using state-of-the-art spectroscopy equipment. The BNNT NIA group also won two new external research awards and received a NASA Langley Group Achievement Award.

Our unique graduate education program reached a milestone of 170 cumulative Masters and Ph.D. graduates in 2015. Our students can earn degrees from any of our nine member universities and take up to half of their classes from other universities. We also sponsored a record 78 seminars at NIA from distinguished faculty and researchers from all over the world, as well as 4 workshops and 5 short courses in FY15, including a short course series on Autonomy and Special Seminar Series on Big Data Analytics, Autonomy, CFD, and Formal Methods. Finally, our world-class educational and public outreach programs continued to garner new customers, audiences, and awards. In 2015, we broadcast 260 episodes of our Innovation Now radio program, which features exciting innovations in aerospace, and its audience increased from 7 million to over 12 million daily listeners. We also produced and distributed 22 new video episodes for our flagship NASA 360 television program. Its Facebook followers increased from 3.1 to 4.5 million, and it was recognized with three national broadcast awards. Our Center for Integrative STEM Education (CISE) also continued to provide unique and exciting teacher training, curriculum development, student competitions, and a variety of educational outreach activities. CISE was selected for a $2.4M NASA Science Mission Directorate award to continue and expand the successful NASA eClips program, which had 845,000 views/downloads in FY15 and 6.5 million total.

I look forward to working with each of you and all of our stakeholders in 2016 as we continue to create a unique research, education, and outreach capability at NIA.

Research



Message from Bo Walkley

As 2015 drew to a close, I could not help but reflect on my almost 12 years of service to the NIA. It has been a wonderful journey enabled by a host of colleagues at NIA who have supported me through the years. And with my impending retirement on February 1, 2016, I could not help but feel grateful and thankful to those colleagues, and to the faculty and leaders at our member universities, and to our customers. It's all about the effort of teams, and I am very proud to have been part of many such teams at NIA!

Although my retirement means I will no longer be involved in the day-to-day NIA activities, I have tremendous confidence in the new Vice President for Research - my friend and colleague of more than 40 years – David Throckmorton. David and I first met when we were both Cooperative Education Students at NASA Langley Research Center. In addition to 34 years spent at Langley, David's NASA career also included service in senior leadership positions at the NASA Marshall Space Flight Center, and the Stennis Space Center. I am confident that his leadership and executive management experience, coupled with his broad network of aerospace professionals, will contribute in a highly significant way to the continued success of the NIA research program.

Bo Walkley
Vice President of Research

Bo Walkley,
VP of Research, received an AIAA Section Award for continued outstanding support of the AIAA Hampton Roads Section working with Corporate Sponsors and their contributions.

NIA's outgoing VP for Research, Bo Walkley (left) and the new VP for Research, David Throckmorton (right), congratulate NIA's Dr. Ronald Krueger (center) on his selection as the AIAA Hampton Roads Section Engineer of the Year at the annual Axel T. Mattson Lecture.

Centers of Excellence

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. Langley Professors have their own NIA-based research Centers for which they serve as Directors. In addition, two members of NIA's research staff also lead Centers. The Center for High Performance Aerospace Computations (HiPAC), directed by Dr. Boris Diskin, was founded to advance the technology for numerical simulations, and support work at NASA Langley Research Center and in industries. The Center for Planetary Atmospheric and Flight Sciences, led by Dr. Jared Bell, offers a robust series of coursework in atmospheric flight, including atmospheric characterization, aerobraking and entry, descent, and landing (EDL); and space flight mechanics, including orbit and trajectory analysis, and spacecraft dynamics and control. 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.

NIA Research staff numbered just above **50** in **2015** an all-time high!

Samuel P. Langley Distinguished Professor, Dr. James E. Hubbard, Jr. University of Maryland

Dr. Hubbard began his professional career in the early 1970's as a United States Coast Guard licensed Marine Engineer with an unlimited horsepower rating to operate steam and diesel plants on ships. Over the next 30 years, he established himself as a key pioneer in developing piezo-film sensors and piezo-electric actuation systems for smart structures and materials applications, and has made extensive contributions to aerospace engineering in the field of smart structures. He is an internationally recognized leader in the fields of smart materials and adaptive structures as well as controls research for unmanned aerial systems. His work has resulted in multiple patents which have demonstrated the efficacy and practicality of the techniques that he and his students have developed over the years. These techniques have been viewed as innovative and revolutionary by his colleagues. In recognition of these accomplishments, the University of Maryland named Dr. Hubbard the University of Maryland Samuel P. Langley Distinguished Professor at the National Institute of Aerospace in 2003.

Dr. Hubbard has more than 100 technical publications, 24 U.S. and Worldwide patents, has served on numerous technical Boards and Committees and received several prestigious awards. In recognition of his leadership, Prof. Hubbard was named a Fellow of the American Institute of Aeronautics and Astronautics. Building on that recognition, this year he was named a Fellow of the American Society of Mechanical Engineers as well.

Professor Hubbard has designed a new course that will be offered at NIA beginning in Spring 2016. The course, which will be run by Dr. Hubbard, Dr. William Moore, Hampton University's Professor-in-Residence at NIA, and David North, NASA Langley Research Center, will provide NASA engineers and students from NIA's member universities opportunities to interact in the classroom. Participants will design a flight-worthy risk reduction prototype vehicle and include a detailed systems analysis as their final project.

Prof. Hubbard is Director of the Morpheus Lab at NIA whose mission is four-fold:

1. To offer rigorous, graduate level, experiment-centric training in the fields of adaptive aerospace structures, smart materials, and flight testing.
2. To benefit society through the generation of scholarship in the fields of adaptive aerospace structures, smart materials, and flight testing.
3. To develop disruptive flight-worthy aerospace technologies based on innovative applications of smart materials.
4. To inspire the children of today to become the scientific and engineering innovators of tomorrow through ongoing outreach efforts in the surrounding community.

Dr. Hubbard mentors and serves as a research advisor for a cadre of graduate students who comprise the Morpheus Lab Team and matriculate to graduation over a five year period. Because 2015 marked the tenth year for the Lab, it was a transition year for the Morpheus Team. As the second cadre of students were leaving, the process of interviewing and hiring a new compliment of students began. The year proved productive and helped launch the latest Morpheus team into new areas of research and broad collaboration.

Focused on improving the performance and agility of flapping wing vehicles through passive morphing using custom designed and optimized compliant mechanisms, the Lab has pioneered the implementation of passive morphing devices that reduce the drag penalty on the wing's upstroke without compromising the power output of the wing's down stroke or thrust performance.

Research also focused on investigating and validating design principles for an integrated, variable-autonomy, control system and the development of a user interface that enables effective cooperative control between a small, highly-automated unmanned aerial system (SUAS) and a human operator.

This year, the Morpheus Lab worked to expand its research base to include Small Unmanned Vehicle or SUAV Autonomy. The team plans to include international collaborations while exploring SUAV operations in an urban environment.

In addition, Dr. Hubbard was selected for a $500K AFOSR DURIP award for a 40 camera VICON lab for motion capture called StarLab. The vision of the University of Maryland StarLab is to promote excellence in our Nation's Aerospace field through academic research and education using modern state of the art motion capture technology. It is the long term goal of StarLab to become a nationally recognized Center of Academic Excellence helping to create advanced technological solutions in autonomy for SUAVs in support of our Nation's future and prosperity in this arena.

Dr. Hubbard and his former graduate student, Dr. Aimy Wissa,

won the ASME 2015 Best Paper in Structures Award for " Design and Optimization of a Contact-Aided Compliant Mechanism for Passive Bending."

Modeling and Simulation of Robotic Manipulation and Operations using the Tendon-Actuated Lightweight In-Space MANipulator (TALISMAN)

Dr. Cornelia Altenbuchner,
NIA Research Engineer

Figure 1. Artist's conception of a TALISMAN applied for servicing of the Hubble Space Telescope.

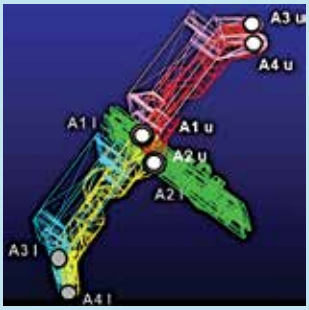
Devices for maneuvering and precisely placing payloads are critical for efficient space operations involving reusable assets or in-space assembly and construction. Key to the success of many of the space activities for NASA has been the availability of long-reach manipulators, such as the Shuttle Remote Manipulation System (SRMS) and the Space Station Remote Manipulation System (SSRMS). These devices have been used for many operations including berthing spacecraft, space station assembly, astronaut positioning, payload transfer, satellite deployment and spacecraft inspection prior to re-entry. New missions and applications are being considered, such as asteroid retrieval and redirection, asteroid mining, and satellite servicing, that will all benefit from long reach manipulator capabilities.

Figure 2. Prototype TALISMAN Hardware posed to grapple a free-flying asteroid.

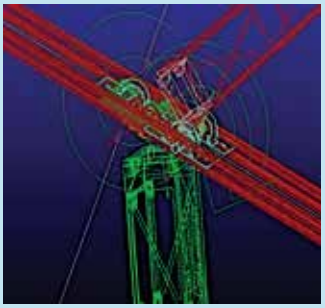
The Tendon Actuated Lightweight In-Space MANipulator (TALISMAN) is an invention of a new robotic manipulator architecture that incorporates a tendon-actuated joint with a novel hinge that allows a full 360-degree rotation between connecting links, and the capability to incorporate auxiliary and passive tension stiffening. Tendon actuation employs spreaders to achieve longer moment arms between the applied force and the joint rotation axis, thus gaining mechanical advantage for generating moments and actuating the joints.

Complexity in the system dynamics are induced by the continuous changes in relative system geometry that occur during manipulation operations (changes in the TALISMAN pose). The TALISMAN is actuated by tendons which introduce system complexity due to nonlinear behavior under load, and changes in length of the tendon structural members. Thus, a flexible multi-body dynamics model is required to accurately predict and assess TALISMAN system performance during mission operations.

Figure 3. Model image of TALISMAN Joint.



a) Revolute Joint Attachment.



b) Joint with Truss Links and Spreader attached.

This activity comprised modeling and simulation, and analyses of the flexible, multi-body structural dynamics of the TALISMAN system. Example simulations modeled the effect of operational tip-load conditions into TALISMAN joint loads to investigate and optimize the structural integrity of the lightweight in-space structure. This modeling and simulation was performed for a Satellite Servicing Mission. Joints are modeled using four revolute joint attachment points that emulate the 360-degree rotational capability of the actual TALISMAN joint (Figure 3). Assessed joint load conditions for one considered satellite servicing operational case are shown in Figure 4. The joint load conditions serve as inputs for a Finite Element structural optimization of the joint for the specific application.

Notably, in 2015, the TALISMAN concept won the NASA Tech Briefs' award for Best New Technology of the Year in Automation and Robotics.

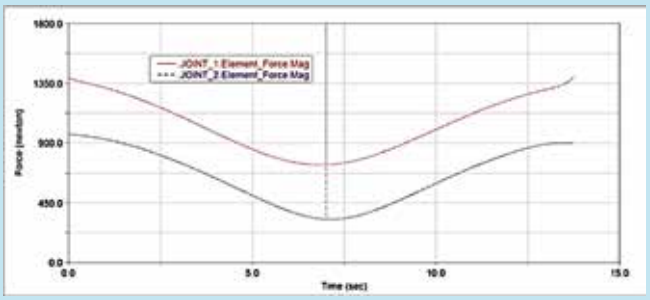
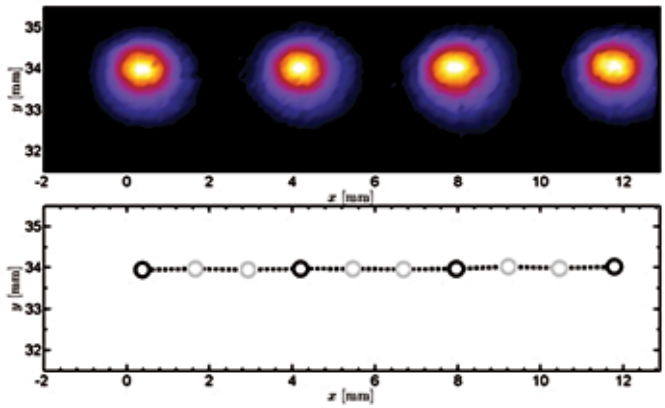


Figure 4. Example Joint Load conditions.

Unseeded Velocimetry in High-Pressure, Cryogenic Environments Using FLEET

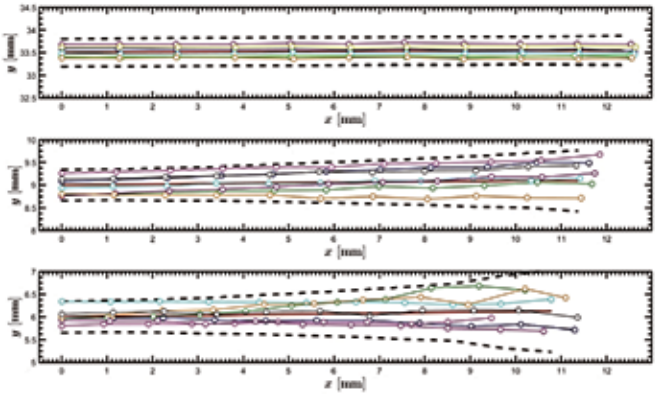
Dr. Ross Burns, NIA Research Engineer

The development and refinement of large-scale, cryogenic, transonic wind tunnel facilities have greatly advanced the ground-testing capabilities available to researchers. By utilizing very low-temperature, high-density gas as the working fluid, extremely high test Reynolds numbers are attainable, approaching or equaling those encountered in the flight of full-scale aircraft. Performing optical flow measurements within transonic cryogenic tunnels (TCTs) has proven challenging historically; the reasons for this are several. These test facilities often have limited optical access due to the rugged construction needed to accommodate the high operating pressures. Condensation of water vapor on facility surfaces, optical distortions caused by density fluctuations in and around the facilities, and strong vibrations that can compromise the alignment of optical components are among the other challenges researchers face. Consequently, optical flowfield measurements that have been implemented in this type of facility have been limited in scope and quantity.



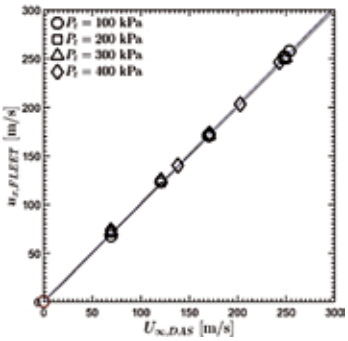
Sample burst of FLEET image data and measured trajectory. (top) Sample FLEET images (1 of 3 images shown for clarity) and (bottom) trajectory measured from image sequence in top pane

A new velocimetry technique that could be applied reliably in these high-pressure, cryogenic facilities originates in the field of ultrafast laser technology. Femtosecond laser electronic excitation and tagging, or FLEET, velocimetry belongs to a class of techniques known as molecular tagging velocimetry, in which a laser at an appropriate wavelength is used to mark specific molecules in a flow. Sequential imaging of the tagged molecules can reveal information about flowfield velocities and trajectory. Unlike other velocimetry techniques, FLEET uses an extremely short-duration, high-intensity laser pulse to directly excite and dissociate molecular nitrogen and consequently does not require the seeding of toxic gases or particles. Furthermore, FLEET is experimentally simple to set up and execute, requiring only a single laser and camera, making the system compact and resistant to facility-induced vibrations.



Measured pathlines at different locations in tunnel boundary layer; the boundary layer thickness (δ) is 12 mm. (top) freestream, (middle) $y/\delta = 0.75$, and (bottom) $y/\delta = 0.5$.

The FLEET technique has been implemented in the NASA Langley 0.3-m Transonic Cryogenic Tunnel, representing the first application of FLEET in both a large-scale wind tunnel facility and a high-pressure, cryogenic test facility. FLEET images were collected in a triggered burst mode using a high-speed camera and image intensifier, allowing for the collection of long time series of FLEET data. A custom, high-precision, surface-fitting algorithm was used to analytically model the intensity and centroid information in the raw FLEET data, allowing the calculation of flow velocity and trajectory. Measured FLEET pathlines revealed information about the flow structure and temporal unsteadiness within the facility boundary layer. Comparison of the measured velocity statistics with the facility data acquisition system indicated a measurement accuracy within one percent (standard error), while the measured velocity precisions were as low as 0.5 percent of the freestream velocity across the full envelope of facility operating conditions. These measurements suggest that FLEET could potentially serve as a viable optical measurement tool in many of the NASA Aeronautics Evaluation and Test Capabilities (AETC) facilities where other measurement techniques are prohibited by facility protocol or simple practicality.



Comparison of FLEET-measured velocities with 0.3-m TCT facility data acquisition system

Dr. Nelson Carvalho

won 1st place in the 2015 Hampton Roads Section AIAA Laurence J. Bement Young Professional paper competition with his paper titled, "Modeling delamination migration in cross-ply tape laminates."

Analyzing Facesheet/Core Disbond Growth in Honeycomb Sandwich Panels

Dr. Ronald Krueger, NIA Associate Research Fellow

A typical damage mode in light honeycomb sandwich structures is face sheet/core disbonding which can pose a threat to the structural integrity of a component. This damage mode is of particular interest to aviation certification authorities since several in-service occurrences, such as rudder structural failure and other control surface malfunctions, have been attributed to face sheet/core disbonding.

For the present study a fracture mechanics based approach was used to evaluate the loading at the disbond front caused by ground-air-ground pressurization. A flat sandwich panel, consisting of laminated composite face sheets and a honeycomb core with an initial circular disbond at the upper face sheet/core interface was considered, as shown in Figure 1.

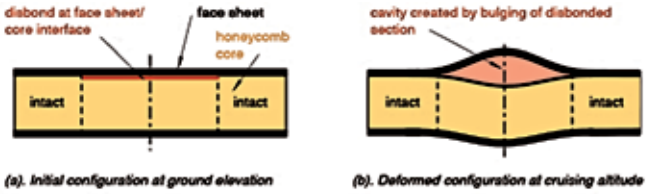


Fig. 1: Deformation behavior of a sandwich panel with disbond

It is assumed rapid pressure equalization inside the sandwich can only occur between the honeycomb cells in the disbonded section. For this reason, the pressure is initially assumed equal inside and outside the sandwich and thus the sandwich structure is not loaded (and is undeformed) as shown in Figure 1(a).

When the ambient pressure decreases rapidly, for instance during the launch of a spacecraft or the ascent of an aircraft, the resulting pressure difference between the entrapped air and the ambient surrounding air causes the sandwich to expand. In the disbonded section, the thin face sheets with low bending stiffness can easily be deformed by the pressure load and bulge the sandwich as shown in Figure 1(b). The out-of-plane deformation results in an increased volume, creating a cavity and a resulting decrease in internal pressure. At the same time, the decreasing ambient temperature cools the entrapped air, causing the honeycomb sandwich to shrink.

Therefore, for the disbonded section, a coupled pressure-deformation problem has to be solved and a non-linear finite element analysis was performed which coupled the ideal gas law for the air filled cavity with the deformation analysis of the sandwich. The Virtual Crack Closure Technique (VCCT) was used to calculate the energy release rate along the disbond front and assess the propensity of disbond growth. A typical 3D model of the flat panel used for the current study is shown in Figure 2.

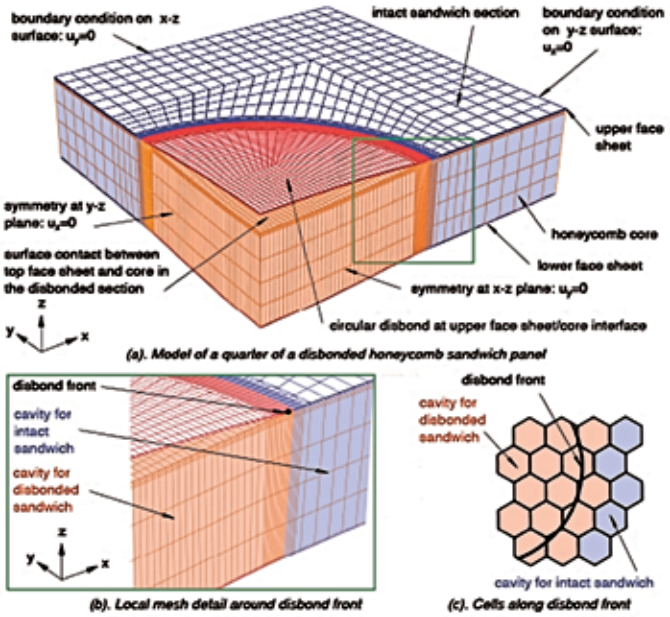


Fig. 2: Finite element model of disbonded honeycomb sandwich panel.

The following observations were made:

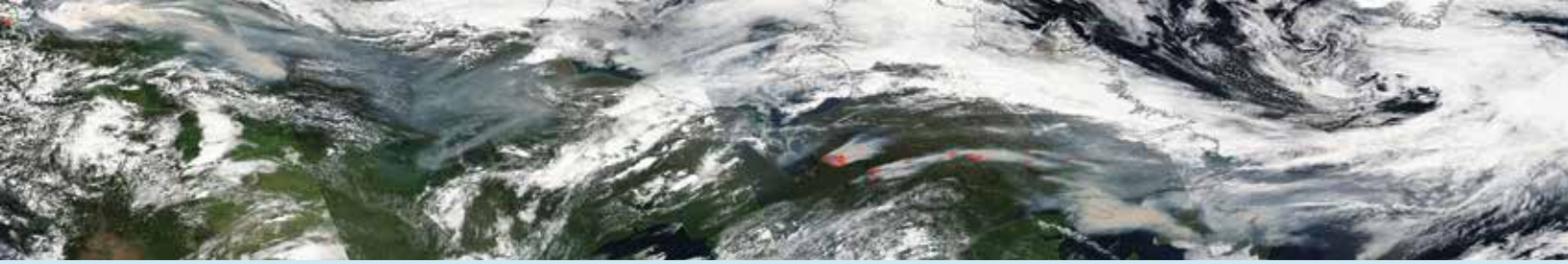
- Overall, the finite element analysis with fluid cavities performs well and is capable of capturing the pressure-deformation coupling in the disbonded section of the panel
- Sandwich panels with a large disbond, thin face sheet, and thick core are the most critical configuration for disbond growth

Future studies will include a comparison of the computed local deformation field of the disbonded face sheet with far field measurements and a comparison of the computed pressure inside the cavity with measured values.

NIA Researchers were involved in approximately

165

individual research projects



"River of smoke" as seen by MODIS onboard Aqua, July 4, 2013. Fire detections are shown in red. A plume of smoke from wildland fires crosses the boreal zone from Alaska through Canada to the Atlantic. The eastern portion of this smoke plume is transported south, below the Greenland Ice Sheet; but the western portion of this plume intersects with the field sites in northeastern Greenland. Credit: Amber Soja using NASA WOLDVIEW.

"River of Smoke"
Transported to the Greenland Ice Sheet

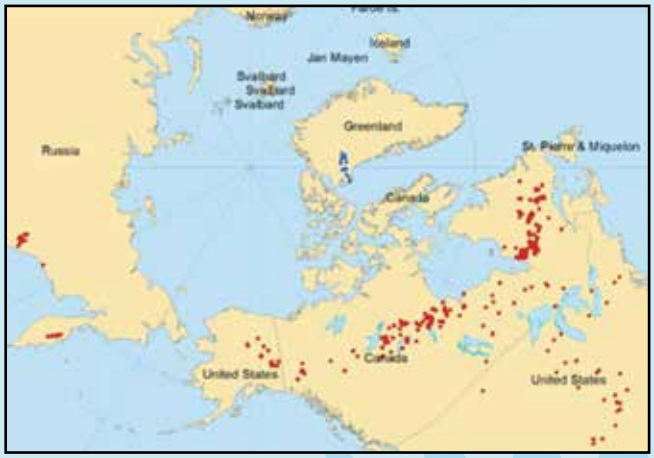
Dr. Amber J. Soja, NIA Associate Research Fellow and
Dr. Hyun Deok Choi, NIA Senior Research Scientist

The Greenland Ice Sheet is undergoing profound transformations, triggered by the impact of global sea level rise and climate. In 2012, the Greenland Ice Sheet (GIS) experienced a massive melt event, where 98.6% of the GIS experienced melting -- which was similar to an event last reported in 1889. Soja and Choi used a novel method, developed by Soja, to define and quantify the impact of smoke from wildland fires that was transported over huge distances and deposited on the Greenland Ice Sheet (GIS).

Specifically, a variety of NASA remote sensing products and the NASA Langley Research Center Trajectory Model (LaTM) were used to identify and quantify, or exclude, the transport of smoke plumes and black carbon deposition leading to or enhancing the unusually large 2012 GIS melt, and to quantify deposition found in ice core samples in 2013. NASA Moderate Resolution Imaging Spectoradiometer (MODIS) observations were used to identify active fires, and MERRA (Modern Era-Retrospective analysis for Research and Applications) meteorology was used to drive the LaTM simulations. Data from the Cloud Aerosol Lidar Orthogonal Polarization (CALIOP) instrument onboard the CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) satellite provided the crucial information necessary for verifying the transported plumes and identifying the height to which the smoke plumes are injected into the atmosphere.

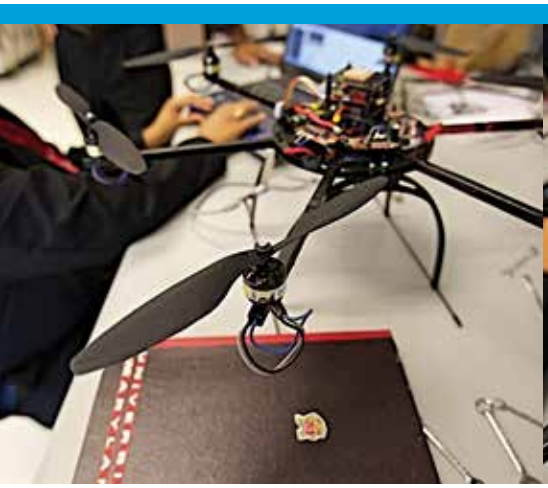
Transport paths differ substantially depending upon the height the smoke is injected in the atmosphere.

Soja and Choi are currently working with an interdisciplinary team of scientists from NASA Langley, Cold Regions Research and Engineering Laboratory, the Universities of New Hampshire and Michigan, and the Université Pierre et Marie Curie to synthesize a new, quantitative understanding of fire emissions, transport, deposition, and the radiative impact of black carbon from large biomass burning events on the Greenland Ice Sheet. This work has implications for the scientific understanding of altered patterns of snow and ice melt, climate, and air quality.



Smoke from the fires, burning on July 5th 2013 (shown in red), is transported to the GIS field sites (shown in blue), where ice core samples were analyzed, showing biomass burning signatures.

Research Publications



Aeronautical Sciences

R. Burns, P.M. Danehy, S.B. Jones, B.R. Halls, and N. Jiang, "Application of FLEET Velocimetry in the NASA Langley 0.3-Meter Transonic Cryogenic Tunnel," Paper AIAA 2015-2566, in the *Proceedings of the 31st AIAA Aerodynamic Measurement Technology and Ground Testing Conference,* AIAA Aviation, 22-26 June 2015, Dallas TX, doi:10.2514/6.2015-2566

K. Mitchell, C.R. Fuller, and M. Jones, "Design Optimization of Broadband Metamaterial Acoustic Liners through Finite Element Efficacy Studies," Paper AIAA 2015-2694, in the *Proceedings of the 21st AIAA/CEAS Aeroacoustics Conference,* AIAA Aviation, 22-26 June 2015, Dallas, TX, doi:10.2514/6.2015-2694

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peer-reviewed journal articles, conference papers, etc.

PENINSULA TECHNOLOGY INCUBATOR

NIA's Peninsula Technology Incubator (PTI).

The Peninsula Technology Incubator is dedicated to nourishing ideas into small businesses that are prepared to change the world. Our vision is to be the leader in development, implementation and business in technology commercialization for the future of Hampton Roads and to be recognized as a leader in technology-based businesses in the Commonwealth and international communities.

We provide our member companies business training, counseling and mentorship, technology transfer resources and information, and educational resources on the fundamentals of business development and growth. PTI was incorporated in April 2012, by NIA as a subsidiary 501(c)3 Virginia Corporation and received an initial grant from the City of Hampton Industrial Development in March 2012. PTI is led by Daniel Morris, J.D., seasoned entrepreneur with a history of successful startup and exits and deep domain knowledge in aspects of company formation and funding. Since Mr. Morris took over in the Summer of 2015, PTI has already attracted six (6) new clients who have agreed to locate in the City of Hampton to grow their business and create jobs and two (2) new virtual clients.

PTI is also committed to the mission of economic development in the City of Hampton and strongly believes that entrepreneurship can and should play a more significant role in job creation, wealth creation, and retention of the best and brightest graduates of the regional universities. PTI is a member in good standing with the National Business Incubator Association (NBIA) and follows NBIA's established best practices.

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Recent recognition of PTI companies has been significant:

- **Hottest Tech Startup in the Nation** – HIS Energy (now MicroNergy)
- **Hottest Tech Startup in D.C.** – HIS Energy (now MicroNergy)
- **Hottest Tech Startup in Baltimore** – FreePing
- **Top Five Emerging Entrepreneurs in the Nation (White House)** – Aazia Mickens Dessaso of FreePing
- **Winner Get Started NOVA (Inc. Magazine/Cox Business Network)** – Feedback Enterprises
- **Winner Babson College/Goldman Sachs 10,000 Small Businesses** – Crossrope
- **Winner Phase II SBIR** – SMD Corp
- **Winner Phase I SBIR** – Pancopia

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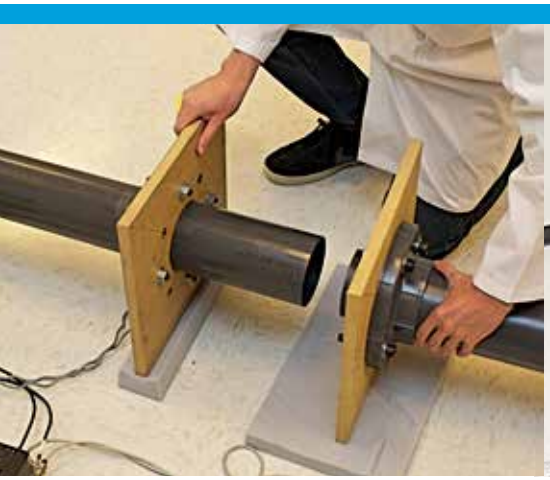
2015 NIA Visitor Program



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 2015 NIA hosted 20 visiting student, researchers and professors.

Visiting Researchers:

Ayala-Rincon, Mauricio
University of Brazil, Brazil
"Formal Methods"

Campi, Marco
University of Brescia, Italy
"Experience-Based Optimization: The Scenario Approach/An Intro to Scenario Optimization"

Darmofal, David
Massachusetts Institute of Technology, United States
"Strategy of CFD Vision 2013 Implementation"

Jansen, Kenneth
University of Colorado, Boulder, United States
"CFD of High Lift Systems"

Masci, Paolo
Queen Mary University of London, United Kingdom
"Modeling and Analysis of Avionics Systems"

Nordstrom, Jan
Linkoping University, Sweden
"Computational Mathematics"

Ritter, Markus
German Aerospace Center, Germany
"Aeroelasticity"

Svard, Magnus
University of Bergen, Norway
"Non-linear Numerical Analysis/CFD"

Wang, Qiqi
Massachusetts Institute of Technology, United States
"Computational Fluid Dynamics; High Fidelity Design Optimization"

Yamaleev, Nail
North Carolina A&T University, United States
"High-Order Entropy Stable Spectral Collocation Schemes"

Visiting Students:

Blonigan, Patrick
Massachusetts Institute of Technology, United States
"Computational Fluid Dynamics, High Fidelity Design Optimization"

Gilbert, Frederic
French Institute for Research in Computer Science and Automation, France
"Formal Methods"

Groh, Rainer
University of Bristol, United Kingdom
"Application of the Refined Zigzag Theory to Damage Modeling of Laminated Composites"

Hyun, Sangwon
Carnegie-Mellon University, United States
"Statistics and Optimization"

Jaloyan, Georges-Axel
École Normale Supérieure, France
"Computer Science"

Mallozzi, Piergiuseppe
Universita di Pisa, Italy
"Development of Formal Methods – PVS Research"

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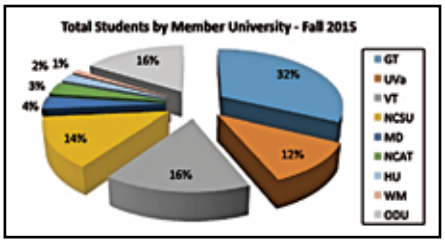
of NIA's researchers have become US citizens!

Graduate Education



The NIA Graduate Program offers a range of 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 the on-site research staff. In the Fall of 2015, 32 full-time students enrolled in our graduate education program were resident either at NASA or NIA, with an additional 23 part-time students from member institutions. In addition, 49 students from member and non-member schools were resident at home campuses, but receiving support through NIA. Of the on-site complement, 11% (6) were female; 2/3 were Ph.D. students; and 1/3 were working towards an M.S. degree. Students are technically and geographically diverse.



NIA Students by Member University; Fall 2015

The distribution of our students among member institutions (on-campus and on-site students combined) is: Georgia Tech (28), Virginia (10), Virginia Tech (14), NC State (12), Maryland (3), North Carolina A&T (3), Hampton (2), William & Mary (1), Old Dominion (14).

Table 5.1 – Graduate Degrees Available at NIA, 2015

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, Mechanical Engineering, Engineering Management and Systems 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 currently maintains 4 distance learning classrooms with capacities ranging from 2-15 students. All are equipped with a range of technology (monitors, SMART Boards, VCRs, cameras, microphones, Elmo document projectors, electronic screens, and projectors) to support live, transmitted, or online classes. In the spring 2015 semester, NIA offered 124 classes to students; 96 classes were available during the fall 2015 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 169 graduates, comprised of 52 Ph.D. degrees and 117 M.S./M.E. degrees.

Graduates:

Donato Girolamo
North Carolina State University, December 2015
Degree/Advisor: M.S., Mechanical and Aerospace Engineering, Dr. Fuh-Gwo Yuan **Thesis Topic:** "Design and Development of a Contactless Laser-based Automated Nondestructive Evaluation (CLANDE) System for Metallic and Composite Structures" **Present Position:** Blade Integrity Engineer, Siemens Wind Power in Denmark

Mohammad Said Harb
North Carolina State University, August, 2015
Degree/Advisor: Ph.D., Mechanical Engineering, Dr. Fuh-Gwo Yuan **Dissertation Topic:** Damage Imaging in Metallic and Composite Structures using Scanning Air-coupled and Laser Ultrasound **Present Position:** Material and Processing Engineer, Mooney International

Jiaze He
North Carolina State University, August 2015
Degree/Advisor: Ph.D., Mechanical and Aerospace Engineering, Dr. Fuh-Gwo Yuan **Dissertation Topic:** "Time-reversal Based Array Damage Imaging in Structural Health Monitoring"

Duncan Alexander McGillivray
University of Virginia, May, 2015
Degree/Advisor: Ph.D., Electrical Engineering, Dr. Mool Gupta **Dissertation Topic:** Metamaterials for 2-D Microwave Imaging

Kelsey Mitchell
Virginia Tech, May, 2015
Degree/Advisor: M.S., Aerospace Engineering, Dr. Christopher Fuller **Thesis Topic:** Broadband Acoustic Liner Optimization Study Using Novel Metamaterials **Present Position:** Control Systems Engineer at Controls and Data Services, subgroup of Rolls-Royce Aero Engines

Nicole Ogden
North Carolina A&T University, December 2015
Degree/Advisor: M.S., Electrical and Computer Engineering, Dr. William Edmonson **Thesis Topic:** non-thesis **Present Position:** Internship with JPL, Pasadena, California then applying to PhD programs

Juliette Kelly Pardue
University/Date: Old Dominion University, May, 2015
Degree/Advisor: MS, Computer Science, Dr. Andrey Chernikov **Thesis Topic:** non-thesis **Present Position:** pursue Ph.D. in Computer Science at Old Dominion University/NASA LaRC

Jesse Quinlan
University of Virginia, August 2015
Degree/Advisor: Ph.D., Mechanical & Aerospace Engineering, Dr. James McDaniel **Thesis Topic:** "Flamelet/Progress Variable Modeling for a Dual-Mode Scramjet Combustor" **Present Position:** Civil Servant, NASA/LaRC, Aeronautics Systems Analysis Branch

Mathew Thomas
Old Dominion University, May, 2015
Degree/Advisor: M.S., Aerospace Engineering, Dr. Drew Landman **Thesis Topic:** Thrust Prediction for a Rotor Operating in a Ship Airwake **Present Position:** Engineer, Aviation Applied Technology Directorate – Fort Eustis

Amy Thornhill
Georgia Institute of Technology, May, 2015
Degree/Advisor: M.S., Aerospace Engineering, Dr. Alan Wilhite **Thesis Topic:** Attitude Determination Using the Miniature Inertial Measurement Unit on SAGE III ISS **Present Position:** NASA Civil Servant, Flight Software Systems Branch

Kenneth Toro
Old Dominion University, December 2015
Degree/Advisor: Ph.D., Aerospace Engineering, Dr. Drew Landman **Dissertation Topic:** "Uncertainty Estimates and Prediction Interval Development for Internal Strain Gage Balance Calibration Systems" **Present Position:** NASA/LaRC, Civil Servant, System Engineering and Engineering Methods Branch

Craig Ungaro
University of Virginia, August 2015
Degree/Advisor: Ph.D., Mechanical & Aerospace Engineering, Dr. James McDaniel **Dissertation Topic:** "Flamelet/Progress Variable Modeling for a Dual-Mode Scramjet Combustor" **Present Position:** Civil Servant, NASA/LaRC, Aeronautics Systems Analysis Branch

Erik Viken
Georgia Tech, December 2015
Degree/Advisor: M.S., Aerospace Engineering, Dr. Dmitri Mavris **Thesis Topic:** "Learn to Fly (L2F) Efficient Wind Tunnel Testing Methods" **Present Position:** Seeking a position at NASA Langley Research Center

Samuel Wald
Georgia Institute of Technology, August, 2015
Degree/Advisor: M.S., Aerospace Engineering, Dr. Alan Wilhite **Thesis Topic:** A Parametric Model of Integrated Advanced Technology Applications for Long Duration Transit Habitats **Present Position:** Pursing PhD at Massachusetts Institute of Technology

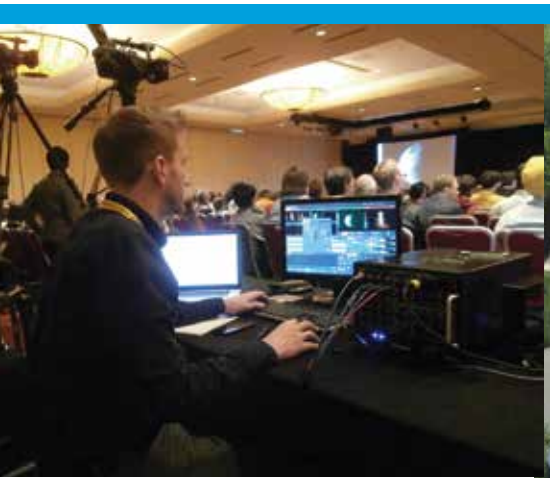
Dennis L. Waldron
University of Virginia, May, 2015
Degree/Advisor: Ph.D., Electrical and Computer Engineering, Dr. Mool Gupta **Dissertation Topic:** Quantum dot luminescent solar concentrators **Present Position:** Engineer, Naval Air Station Patuxent River

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 offers programs of short courses, workshops, conferences, seminars and colloquia. In 2015, NIA offered more than 60 seminars, 1 workshop, 1 public forum, and 2 short courses. A number of our short courses are open to NASA and the general public, and many of the seminars are video recorded and web-archived on the NIA web site.

The 2015 Martin L. Drews Memorial Scholarship *was awarded to Duminda Kankanamge, Ph.D. candidate from Hampton University, Department of Atmospheric and Planetary Sciences. Mr. Kankanamge is studying Hadean era heat transport in the Earth's mantle (early in the planet's history) with advisor Dr. Bill Moore, and plans to use the Drews scholarship funds to travel to the American Geophysical Union meeting in December 2015. The supplemental scholarship is awarded each year to a student engaged in research related to the exploration of space.*

Outreach



Educational Outreach

NIA partners with NASA, universities, and the national STEM education community to deliver award-winning inspirational and educational outreach programs, products, and services for K-12 and higher education. Our goals are to improve STEM literacy, advance understanding and opportunities in Science, Technology, Engineering, and Mathematics (STEM) and to improve teacher competence and confidence in STEM pedagogies. We do this by developing and delivering programs and training in collaboration with federal, state and local governments, industry and non-profits that reach learners in both formal and informal learning environments for people of all ages.

NIA's on-going relationships with NASA, NOAA, Department of Education, science centers, museums, after-school and extended school programs and clubs around the country contribute to our success. We make significant efforts to serve minorities and other under-represented populations in our programs.

The diverse portfolio of programs and activities, led by an award winning team of STEM education specialists, program managers and media producers include: pre- and in-service teacher training and graduate course work, web-based programs for elementary, middle and high school, university-level engineering and mission architecture design competitions, virtual world modeling and simulation programs, video production, classroom science and engineering resources.

CENTER FOR INTEGRATIVE STEM EDUCATION
NATIONAL INSTITUTE OF AEROSPACE

NIA's Center for Integrative STEM Education (CISE)

NIA's Center for Integrative STEM Education (CISE) prepares educators to facilitate learning that empowers students to use STEM knowledge and practices to ask "why" and design solutions on their way to becoming STEM-literate citizens. CISE offers a diverse portfolio of products, services, and training that meets the unique needs of K-12 educators who seek methods that provoke and inspire students' natural curiosities, foster higher order thinking, and develop problem solving skills within formal and informal learning environments.
http://www.nia-cise.org/

NIA Educational Outreach and Programs by the numbers:	9 federally funded programs	7 non-government funded programs	320 teachers trained in STEM pedagogies and research-based best practices	2.5m educational resource downloads or video views	35 student learning events reaching 851 students

Figure 1Elementary STEM Instructional Leaders Cohort—McDaniel College

Graduate Courses in Elementary and Secondary STEM

NIA has developed and is delivering six graduate courses in partnership with McDaniel College. These courses comprise the Elementary and Secondary STEM Instructional Leader program. The program is approved by the Maryland Higher Education Commission and the Maryland State Department of Education. Completion of the ESIL program and a final digital portfolio satisfies Maryland State Department of Education's 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 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™ videos and educator resources are aligned with current national curriculum standards as identified by the National Council of Teachers of Mathematics, the National Science Teachers Association (NSTA) and the International Society for Technology in Education.

Addressing the new engineering standards, NASA eClips™ provides materials for teachers to integrate engineering practices into core subjects. The websites continue to be a popular resource, receiving nearly 845,000 webhits this year, bringing the lifetime visits to over 6.5 million.

http://nasaeclips.arc.nasa.gov

http://www.youtube.com/nasaeclips

OPTIMUS PRIME Spinoff InWorld Challenge

NIA partnered with NASA Goddard Tech Transfer, James Webb Space Telescope, and NASA Langley's Office of Education to develop the OPTIMUS PRIME Spinoff InWorld Challenge. Students in grades 6 – 12 worked with college engineering students to develop their video spinoff ideas within a 3D multi-user virtual world 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. This Challenge was a spinoff of the RealWorld-InWorld NASA Engineering Design Challenge. All virtual communications were housed within the NIAUniverse, a protected 3D protected 3D modeling and simulation virtual world 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 K-5 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

SpaceMath@NASA introduces students to the use of mathematics in today's scientific discoveries. Through press releases and other articles, we explore how many kinds of mathematics skills come together in exploring the universe.

SpaceMath@NASA has attracted over 300,000 unique visitors to its website. More than 2.5 million problem files were downloaded in FY15, demonstrating that this NASA resources continues to be a very active vehicle for teachers and students to access innovative math resources based upon NASA press releases and STEM activities.

SpaceMath@NASA completed a number of specific mathematics projects in support of the Mars InSight mission and the New Horizons Pluto fly-by. This included new math problems, integrative STEM modules, and innovative interactive Excelets that facilitate hands-on mathematics modeling.

http://spacemath.gsfc.nasa.gov

Higher Education Programs

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

NIA manages RASC-AL, a NASA Advanced Exploration Systems undergraduate and graduate level systems architecture design competition, which received a record number of abstracts in FY15. 16 universities were selected to advance to the RASC-AL Forum Competition held in Cocoa Beach, Florida in June, 2015. Design teams must include one faculty or industry advisor and two or more students. Participation in RASC-AL includes an oral presentation/design review, poster presentation, and technical paper.

The FY15 RASC-AL Steering community included NASA civil servants and senior management representatives from industry, including Boeing, Optimum Technologies, SpaceX, SpaceWorks, and Aerojet Rocketdyne.

The University of Maryland's Asimov City placed first and Embry Riddle Aeronautical University's Mankind's Advancement of Resources and Verification of Extraterrestrial Landing (MARVEL), placed 2nd.

http://rascal.nianet.org/

The 2015 RASC-AL themes were:

- *Earth-Independent Mars Pioneering Architecture*
- *Earth-Independent Lunar Pioneering Architecture*
- *Mars Moons Prospector Mission*
- *Large-Scale Mars Entry, Descent, and Landing (EDL) Pathfinder Mission*

RASC-AL Exploration Robo-Ops

NIA manages Robo-Ops, a NASA Advanced Exploration Systems university level engineering design competition focused on robotics system, which was held at NASA Johnson Space Center's (JSC) Rock Yard in June 2015. University teams are challenged to design, build and demonstrate a planetary rover's capabilities by performing a series of tasks on-field tests. 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 tele-operated 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 2015, University of Maryland won first place, and the West Virginia University claimed second place.

http://robo-ops.nianet.org/

RASC-AL Exploration Robo-Ops

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 valuable support for marketing and media, outreach and communications.

NASA 360

NASA 360 is a premiere NASA outreach program that 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, hosted on NASA.gov and other broadcast platforms such as YouTube and Facebook, expanded in 2015 and now has three video formats: (1) the traditional full length (30 minute) broadcast; (2) NASA 360 PRESENTS, which are 3-5 minute videos focusing on a single topic and designed to provide an understanding of the work NASA is currently conducting; and (3) NASA 360 TALKS, which are 1-3 minute videos that inform the public about leading-edge research presented at national conferences, events and workshops.

NASA 360 has over 15 million views from NASA.gov and has more than 4 million Facebook and Twitter followers. NASA 360 is available on **www.NASA.gov/nasa360**

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

The NIA Media Communications Group received two 2015 Communicator Awards of Distinction for:

NASA 360: *The Future of Human Space Exploration* and ***NASA 360:*** *From Science Fiction to Science Fact. The Communicator is a leading international media award honoring creative excellence for communication professionals.*

NASA 360: *Rise of the Rovers received the 2015 Bronze Telly Award for best film and video production and groundbreaking online video content.*

Innovation Now

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 interstitials 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 ~10.5 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, the Philippine Islands, Guam, and New Zealand.

www.innovationnow.us

Live Streaming and Event Support

The NIA Media Communications Group provides live web broadcast and public engagement support for identified conferences, events, and workshops to broaden public exposure to some of the most exciting new developments in the aerospace industry, and to stimulate an interest in science, engineering, and technology relevant to NASA.

2015 Livestream webcasts included:

- Early Stage Development Workshop
- AIAA SCITech 2015
- Hubble 25th Anniversary
- 46th Annual Lunar Planetary Science Conference
- 2015 NIAC Symposium
- Humans 2 Mars Summit
- AIAA Aviation 2015
- MESSENGER
- AIAA Propulsion and Energy 2015

NIA's web broadcasting efforts in 2015 surpassed more than 3.7 million viewer minutes with viewers from around the globe.

www.livestream.com/viewnow

NIA team members Robin Alford, Scott Bednar and Harla Sherwood were recognized with a NASA Group Achievement Award *presented to the Hubble 25th Anniversary Team for "Making the Hubble Space Telescope 25th Anniversary Events Extraordinary."*

Hubble Space Telescope 25th Anniversary

NIA provided support for the Hubble Space Telescope 25th Anniversary Celebrations including a live web broadcast of the Anniversary Ceremony on April 24 from the Smithsonian National Air and Space Museum and featuring NASA Administrator Bolden, ESA Director General Dordain, and Dr. Holdren, Assistant to the President for Science and Technology. On April 25, NIA supported Family Day at the National Air and Space Museum Steven F. Udvar-Hazy Center with a live web broadcast of Astronaut panels. NASA 360 Facebook posts featuring Hubble resulted in 7.8M impressions in 2015.

NIA broadcast and outreach support for public engagement events resulted in

641k

video views, reaching ~4M people.

The Orion Outreach Program received the prestigious Douglas S. Morrow Public Outreach Award *for significant contributions to public awareness of space programs. For their roles in the development and implementation of the very successful NASA Exploration Design Challenge, which reached more than 163,000 students, and coverage of the EFT-1 launch, NIA recipients for the Award included: Scott Bednar, Sharon Bowers, Rebecca Jaramillo, Harla Sherwood, and Caleb Stern.*

Our People:

The National Institute of Aerospace (NIA) is a 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 we understand that a quality team is essential to the success of NIA's research and educational programs. The NIA team consists of just under 200 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 and senior principal engineers. Among the research staff, 88% 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 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.

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

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