

NIA

NATIONAL INSTITUTE OF AEROSPACE

RESEARCH • GRADUATE EDUCATION • OUTREACH

2012 Annual Report



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Dr. Fuh-Gwo Yuan

NIA Langley Professor
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Center for Smart Structures and Materials

President's Message

2012 marked a year of great change at the National Institute of Aerospace (NIA). Two of NIA's "Founding Fathers" left after a decade of service. In April, Dr. Bernard Grossman retired as Vice-President of Education and Outreach, and in July, Dr. Robert Lindberg stepped down as President and Executive Director. Bernie and Bob were two of the original executive team members that founded NIA a decade ago. We are grateful for their exceptional leadership and service and wish them both well in their future endeavors.

I was extremely honored to be selected by the Board of Directors to serve as the new President and Executive Director, after having served as Vice-President of Research and Program Development since October of 2011. In prior positions I served on the faculty of Georgia Tech, as a Program Manager at Orbital Sciences, and as a civil servant with NASA Headquarters and NASA Langley. I am looking forward to using my experience in government, industry, and academia to build NIA into a world-class research and educational institute over the next decade with the help of our University and NASA partners.

We are also pleased to welcome Dr. Sivaram Arepalli as our new Vice-President of Education and Outreach, and Mr. Bo Walkley as Interim Vice-President of Research and Program Development. Sivaram has decades of experience in academia and industry leading research in lasers, aerothermodynamics, energy, and nanomaterials; and Bo has been ably serving NIA as Director of Research Programs for many years.

Langley Professor Robert Tolson of North Carolina State University also retired in 2012 and was replaced by Professor Fuh-Gwo Yuan who has a distinguished career of research in integrated structural health monitoring, embedded sensors, smart materials, and energy harvesting.

Another great change that occurred in 2012 was the much-anticipated opening of our new NIA Research and Innovation Laboratories (NIA Labs) across the street from our current headquarters in Hampton, Virginia. We have established individual labs for each of our Langley Professors, as well as lab facilities for our research staff and small companies. You will read more about NIA Labs elsewhere in this Annual Report.

2012 also marked the beginning of our new Peninsula Technology Incubator (PTI), which is housed in our new NIA Labs. PTI was founded through a grant from the City of Hampton and will nurture small technology companies that could commercialize NIA intellectual property or serve as strategic partners for NIA or our universities.

In 2012 we celebrated our 10th anniversary with a number of events, including a 10th Anniversary Distinguished Lecture

Series, which is archived on our web site. We also welcomed back a number of NIA's founders, including key university and NASA Langley leaders for an evening of celebration and reflection. The panel discussion from this event, which describes many of the events surrounding NIA's founding and early years, is also archived on our web site.

2012 was also a year of many awards for NIA and our faculty and staff. NIA was named as one of the "50 Best Non-Profits to Work for in 2012" and one of the "Best Places to Work in Virginia." Members of our research staff won the NASA Exceptional Engineering Achievement Medal, several NASA Group Achievement Awards, the IDTechEx Energy Harvesting & Wireless Sensor Networks Award for Best Technology Development of Energy Harvesting, the 2012 Robert A. Mitcheltree Young Engineer of the Year Award from AIAA Hampton Roads Section, the Peninsula Engineering Council's 2012 Doug Ensor Award, the AIAA Hampton Roads Section 2012 Laurence Bement Young Professionals Paper Competition award, as well as the Best Annual Paper Award presented by Society of Experimental Mechanics in the area of Model Validation and Uncertainty Quantification. In addition, Prof. James Hubbard, our Langley Professor from the University of Maryland, was elevated to an AIAA Fellow.

Finally, our world-class educational and public outreach programs continued to garner new customers, audiences, and awards. In 2012, we established the Center for Integrative STEM Education to provide teacher training, curriculum development, student competitions, and a variety of educational outreach activities. NASA eClips, an NIA-based STEM education program, had nearly one million downloads this past year and was recognized by the National Science Teachers Association as an exemplary inquiry based classroom resource. In 2012, we also produced 260 radio episodes of "Innovation Now" which were distributed to more than 400 radio stations around the globe. Programs of our flagship TV series, "NASA 360" were downloaded more than 4.5 million times in 2012, doubling the audience of previous years!

I look forward to working with each of you and all of our stakeholders to make NIA's next decade even more exciting than the previous one.



Dr. Douglas O. Stanley

Research



Peninsula Technology Incubator

NIA is committed to the mission of economic development in the City of Hampton and the Virginia Peninsula 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. Toward this effort, the Peninsula Technology Incubator (PTI) was incorporated in April 2012 by NIA as a subsidiary 501(c)3 Virginia Corporation. Funded by the City of Hampton, Virginia, PTI provides startups with the resources they need to position themselves as they implement their business plan and work towards raising capital.

PTI's programs focus on providing a space to collaborate and access to area business leaders that help mentor young companies. The Incubator also builds relationships with local business, which can offer their products and services at a reduced rate. The Peninsula Technology Incubator is located on the third floor of NIA's new Research & Innovation Laboratories facility and has already recruited a number of tenants.



Bo Walkley
Vice President, Research & Program Development

It has been an unexpected honor and privilege for me to serve as NIA's Interim Vice President for Research and Program Development. I am surrounded by a very capable executive team, program and administrative staff, and more than four dozen of the finest research engineers, scientists, and research scholars to be found anywhere. Our success in both the ongoing technical research and the identification and capture of new funded research is a team effort, which continues to make significant

contributions to the aerospace body of knowledge while seeking even more challenging technology opportunities. Our core research with NASA, the FAA and other government and commercial customers continues to expand as NIA collaborates and supports research initiatives on a global basis.

Several examples of NIA's research thrusts are presented below along with a summary of significant awards honoring several of our researchers in 2012. These examples point again this year to the truly exceptional character and capabilities of the NIA research team.

University of Virginia/National Institute of Aerospace Samuel P. Langley Professor Dr. Mool Gupta



Professor Gupta is the founding Director of a multi-university National Science Foundation Industry/University Cooperative Research Center for Laser and Plasma Applications, and the Editor-in-Chief of the CRC Handbook of Photonics. His group is active in solar energy, high power lasers and optical sensors/devices research. During his tenure as a Langley Professor at the National Institute of Aerospace, he has developed strong

collaborative ties with researchers at NASA Langley Research Center. Currently, Gupta advises four NIA Graduate Research Assistants, who each conduct work at both NASA Langley Research Center and Gupta's Laboratory for Photonics, Sensors, and Solar Energy within NIA's Research and Innovation Laboratories. In addition to those four, Gupta also advises six graduate students and one Postdoctoral Fellow, who are supported by external grants, and are working at their home campus: the University of Virginia. Gupta teaches courses on Photonics and Photovoltaics at NIA and UVA. NASA, NSF, DARPA, Army, Navy, DOE and private industry support his work.

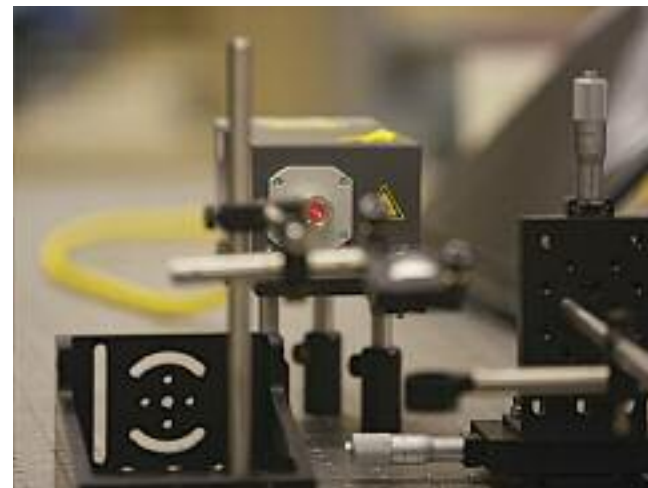
Gupta has established two research laboratories within the NIA Research and Innovation Laboratories facility:



Laboratory for Photonics, Sensors and Solar Energy –

This laboratory focuses on research related to: the design, fabrication and evaluation of solar thermal energy receivers; quantum dots based solar concentrators; and microwave metamaterials for subsurface imaging. The laboratory has various high power lasers and optical measurement equipment for fabrication and characterization of materials. The four NIA/UVA Graduate Research Assistants working in this laboratory are currently hard at work participating in the National Disabilities Innovation Contest, for which they are putting their academic and technical backgrounds to the test to design a solar powered wheel chair.

Laser and Plasma Technologies Laboratory – This laboratory belongs to a "spin-off" company founded by Gupta, of which he is the current Chair. A research and development company, it specializes in advanced technologies based on laser applications and sensor devices. The company's current efforts are supported by the U.S. Navy Small Business Innovation Research program's phase two funding, and is conducting work regarding early corrosion detection at the surface and below the surface of various paint coatings on military aircraft.



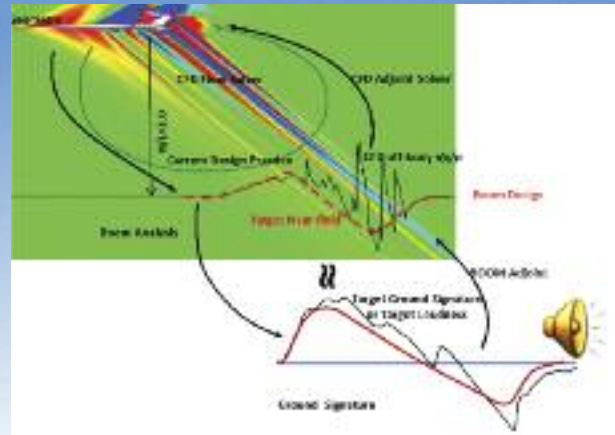
Sonic Boom

Propagation Tools and Methods for Low Sonic Boom Design

– Dr. Sriram Rallabhandi

In 2012, several advances were made in the area of supersonic aircraft design for sonic boom mitigation. An advanced boom propagation tool (sBOOM) was developed and is now widely used by academic and industry partners. During sBOOM development, a novel and unique approach to design of the supersonic aircraft outer mold line by optimizing the A-weighted loudness of sonic boom signature predicted on the ground. A formal Computational Fluid Dynamics and boom propagation (sBOOM) coupling, through the use of discrete adjoint methodology, allows the sensitivity of the ground signature loudness to be directly linked to the aircraft geometry changes thus allowing efficient shape optimization for the purpose of minimizing the impact of loudness. This is a change from the current state of the art and represents a new leading edge in sonic boom related research as it attempts to directly optimize integrated ground objectives rather than

near-field targets. An additional benefit of using this new approach is that target specification is not tedious; rather it is an intuitive loudness value in case of a single azimuth (under-track) optimization, or a target loudness vector if designing for multiple azimuths.



Uncertainty-Based Methods for the Analysis and Design of Dynamic Systems – Dr. Luis G. Crespo



The AirSTAR flight testing facility and the Generic Transport Model developed by NASA Langley

Uncertainty-based methods (UBM) aim to develop, implement, and demonstrate strategies that enable the efficient analysis and design of systems subject to varying operating conditions and uncertainty. Effective uncertainty quantification begins at the conceptual design phase and continues tightly integrated to the analysis and design cycles of the vehicle as the refinement of the models and the fidelity of the tools increase. Given the harsh, uncertain, and largely varying operating conditions of many aerospace applications the experimental data required to validate their mathematical models is often insufficient, difficult or expensive to collect. UBM provide the framework and the

means to account for the effect of uncertainties when analyzing and designing such systems. Scientists from NIA and NASA Langley Research Center have been working on the development of new and efficient technologies for uncertainty quantification for the last 10 years.

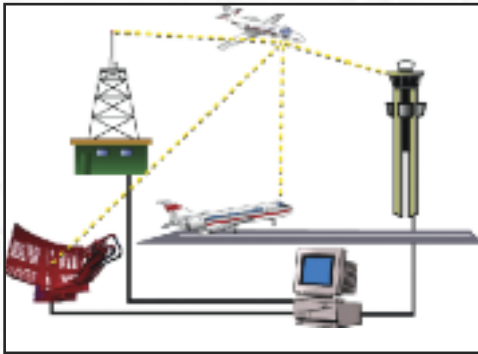
UBM focus on the development of strategies for uncertainty characterization, uncertainty propagation, global sensitivity analysis, reliability analysis, and robust design of aerospace systems. The scope of UBM is general, and as such, they are applicable to multi-disciplinary, variable-fidelity models.



Scientists from NIA have conceived and implemented UQTOOLS, a matlab-based toolbox for uncertainty quantification. This toolbox, which is publically available through NASA Langley Research Center, compiles new technologies developed in-house. These strategies have been successfully applied to the analysis and synthesis of flight control systems for the Generic Transport Model (GTM) developed by NASA Langley Research Center. Flight tests were used to validate the effectiveness of the resulting control design.

Formal Methods Research of Complex Aerospace Systems –

Dr. Natasha Neogi, Dr. Radu Siminiceanu, and Dr. Heber Herencia-Zapania



The NIA Formal Methods Team conducts research in Formal Methods for the specification, design and verification of safety-critical Air Traffic Management (ATM) and avionics systems. Formal methods are mathematically based techniques relying on logic for mechanical reasoning about emergent system properties.

In general, the Formal Methods research conducted at NIA focuses on applying formal methods to the challenges posed by the real-time, distributed and embedded aspects of these systems, and the barriers posed by the unique critical-infrastructure of the National Airspace System (NAS). The broad goal of this research is to develop technologies that aid in verification and validation of software intensive systems, thereby making aviation systems safer and increasing overall capacity in the NAS.

Areas of specific interest and research include:

- Specification and verification of the algorithmic correctness of new operational concepts (i.e. paired parallel landings, interval management etc.), using theorem proving, model checking and hybrid system verification;
- Creation of formal avionics and control theoretic models that are executable and analyzable through automated/interactive tools (i.e. PVS theorem prover, SMT solvers etc.)
- Probabilistic simulation and analysis at the code level of enabling avionics technologies
- “Green” techniques for software change management based on directed symbolic execution focused on improving the energy efficiency of software.

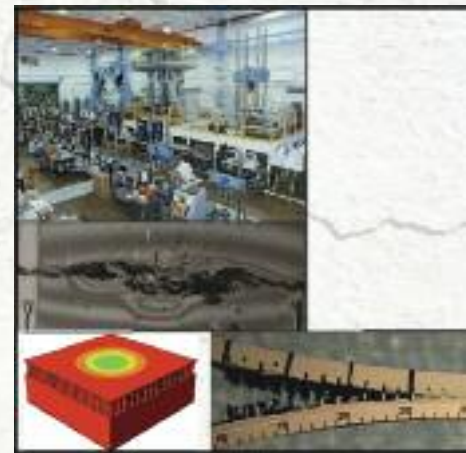
Damage Tolerance Capabilities/Delamination Fatigue Methodology of

Advanced Composite Structures – Dr. James Ratcliffe and Dr. Ronald Krueger

NIA engineers are performing research towards the development of methodologies for characterizing and simulating initiation and progression of damage in composite aircraft and rotorcraft structures in collaboration with researchers at NASA Langley Research Center.

The purpose of the research is to apply methodologies based on interlaminar fracture and progressive damage mechanics to large-scale components containing delaminations and disbonds. This research includes the generation of experimental data and the development of analytical methods. The modeling efforts are directed

towards the prediction of the damage evolution in composite materials, including delaminations, matrix cracking, delamination migration and fiber failure.



Implementation of a damage tolerance methodology requires modeling of an assumed initial flaw either from manufacturing, handling during assembly, or in-service impact. In addition, delamination growth prediction from impact is particularly challenging due to progressive damage and multiple delamination paths interacting with matrix cracking and branching as observed in real components.

In collaboration with industry partners, coupon, sub-components and structural test articles are defined. Experimental data generated during the tests are compared to the modeling results to provide model verification or validation. Once validated, the methodologies and analysis methods will be able to replace the traditional building block approach by replacing tests with substantiated analysis methods and reducing the test matrix required for certification.



Aviation Safety Data Generation and Analysis Using Serious Gaming Methods – Dr. Ersin Ancel

2012 Doug Ensor Award

Dr. Natasha Neogi, a Senior Research Engineer at the National Institute of Aerospace (NIA), has been named the winner of the 2012 Doug Ensor Award. The award is given in recognition of an individual's contribution to the profession for significant technical accomplishments and community involvement.

Dr. Neogi conducts research projects to develop formal verification methods for the analysis, design, validation and implementation of complex software-intensive systems of interest to NASA.

NIA is supporting NASA's Aviation Safety Program (AvSP) by developing models of current and future aviation accidents. Loss of control (LOC) is the leading cause of fatal aircraft accidents in the U.S. The first model developed, the LOC accident framework (LOCAF), encapsulates multiple interdependent causal factors such as environmental effects and crew performance within an Object-Oriented Bayesian Network. In addition to predicting the likelihood of an LOC accident occurrence, LOCAF can also be used to evaluate the impact of AvSP research products on reducing the future risk of an LOC accident. This provides valuable information to decision makers in strategizing the AvSP technology portfolio.

A parallel modeling effort is also underway, focusing on flight deck automation issues. In an effort to increase safety, timeliness and efficiency of routine procedures, modern airliners have become highly complex and automated. However, this increased automation has resulted in additional training requirements, more cognitive workload to the crew and new failure modes. In addition, recent aircraft incidents and accidents often involve factors tied to breakdowns in communication and coordination between humans and machines. NIA is working to include the automation model, will also be used as a part of AvSP's portfolio assessment process.



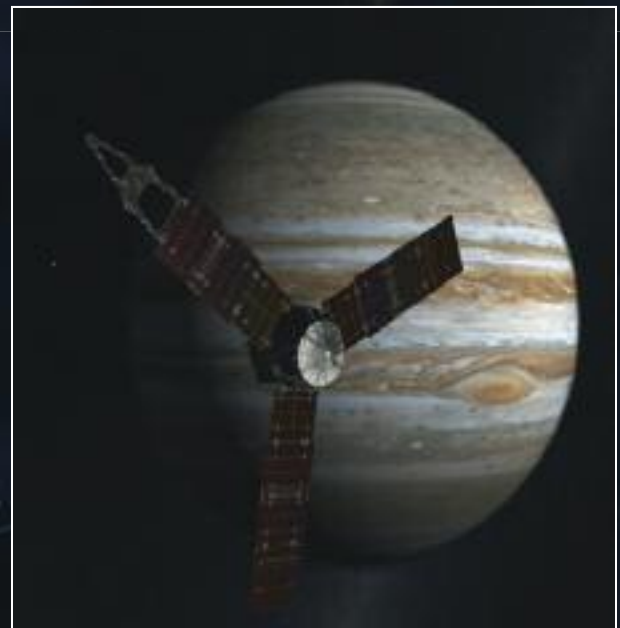
2012 Laurence J. Bement Young Professional Paper Competition 1st Place Winners

Dr. Lin Duan, Research Scientist at the National Institute of Aerospace (NIA) and former NIA Graduate Research Student, **Jared Grauer** tied for 1st Place in the 2012 Laurence J. Bement Young Professional Paper Competition, AIAA.

Dr. Duan won top honors for his paper entitled, "Direct numerical simulation of hypersonic turbulent boundary layers. Part 3. Effect of Mach number" which was published in the Journal of Fluid Mechanics in April 2011. Grauer's 1st place paper, "Testing and System Identification of an Ornithopter in Longitudinal Flight" was written while he was a graduate student under Dr. James Hubbard at NIA and was published in the Mar-Apr 2011 issue of the Journal of Aircraft.

Development of a Non-Hydrostatic Global Circulation Model for Jupiter's Ionosphere-Thermosphere System with Applications for Juno – Dr. Jared Bell

As you read this, NASA's Juno mission is en route to Jupiter with 2016 set as the estimated time of arrival. Juno carries a suite of instruments to explore Jupiter's giant interior, the upper atmosphere and the dense plasma environment surrounding the "king of the planets." NIA Research Scientist, Dr. Jared Bell, is developing the world's first non-hydrostatic, three-dimensional Global Circulation Model (GCM) for the Jovian upper atmosphere. This GCM is based upon the Global Ionosphere-Thermosphere Model (GITM) developed at the University of Michigan, and has been adapted for the specific physics of Jupiter, creating a new model known as J-GITM. Dr. Bell's work currently focuses on predicting the thermal, chemical and dynamical state of Jupiter's upper atmosphere before Juno's arrival at Jupiter. This will allow Dr. Bell to provide a theoretical context within which to interpret incoming data from the upper atmospheric remote sensing instrument. In particular, Dr. Bell is exploring how the magnetosphere of Jupiter can affect and modify the global temperatures and winds in the ionosphere and thermosphere.



30th International Modal Analysis Conference Best Paper

On September 13, 2012, the Society for Experimental Mechanics, Inc., selected the paper entitled, "Robust Control Design for Uncertain Nonlinear Dynamic Systems," by S.P. Kenny, L.G. Crespo, L. Andrews, and D.P. Giesy as the best paper presented in the area of Model Validation and Uncertainty Quantification.

Publications

Atmospheric Science

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Computation, Modeling, & Simulation

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Bolton, M., Bass, E., and Siminiceanu, R., "Generating Phenotypical Erroneous Human Behavior to Evaluate Human-Automation Interaction Using Model Checking," *Inter. J. of Human-Computer Studies*, 70 (2012): 888-906, doi:10.1016/j.ijhcs.2012.05.010

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Crespo, L.G., Kenny, S., and Giesy, D., "Uncertainty Quantification for Polynomial Systems via Bernstein Expansions," AIAA Paper 2012-1851, in Proceedings of the 53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 23-26 April 2012, Honolulu, HI, doi:10.2514/6.2012-1851

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Jobredeaux, R., Herencia-Zapana, H., Neogi, N., and Feron, E., "Developing Proof Carrying Code to Formally Assure Termination in Fault Tolerant Distributed Control Systems," in Proceedings of the 51st IEEE Conference on Decision and Control, 10-12 December 2012, New Orleans, LA, doi:10.1109/CDC.2012.6425966

Liao, W., Mujeeb, M., Lee-Rausch, E.M., Li, F., Nielsen, E.J., Buning, P., Chang, C.L., and Choudhari, M., "Boundary-Layer Stability Analysis of the Mean Flows Obtained Using Unstructured Grids," AIAA Paper 2012-2690, in Proceedings of the 42nd AIAA Fluid Dynamics Conference and Exhibit, 25-28 June 2012, New Orleans, LA, doi:10.2514/6.2012-2690

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2012 Exceptional Engineering Achievement Medal

NIA Senior Research Engineer, Dr. Sriram Rallabhandi, was awarded the Exceptional Engineering Achievement Medal by NASA Langley Research Center for his research in sonic boom mitigation and tool development.

His research is funded by the Aeronautics Systems Analysis Branch.

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NIA Research and Innovation Laboratories

The dedication of the **NIA Research and Innovation Laboratories** in April 2012 represented a major step toward enabling both technology and economic development. This new facility fosters innovation and strengthens Virginia's economic future as it provides opportunities for academic, industry and government partners to co-locate on collaborative research and development projects.



As NIA's first dedicated laboratory building for faculty, student and staff research, the NIA Research and Innovation Laboratories enable NIA to conduct research in its own laboratories as well as collaborate with NASA and other partners on NIA-led research with facilities complementary to those at NASA Langley. This facilitates world-class scientific and engineering research for NASA, other government agencies and NIA's industry and academia partners.



The facility is unique in the region, having been constructed from the outset to facilitate collaboration between research staff, faculty, students, and industry with its shared-use facilities.



The first floor of the building is dedicated to laboratory research facilities. Expansion space for offices and five additional laboratories on the second floor can accommodate companies interested in co-location and collaboration with NIA. The third floor houses the new Peninsula Technology Incubator (PTI), a computer lab and offices. Inaugural tenants include the Virginia Tech College of Engineering, Tao Systems and the Technology Commercialization Center (TeCC).

Construction of the approximately 58,000 square foot building was funded by a Commonwealth of Virginia bond initiative on land provided by the City of Hampton Industrial Development Authority.

Visitors at NIA

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, visas for our international guests, and access badges for NASA Langley Research Center. Participants usually conclude their stay with a seminar for our resident faculty, research staff, students and researchers from the NASA Langley Research Center community.



Visiting Scholars

Gilles Dowek

INRIA, France; Formal Methods

Jeman Juang

National Cheng Kung University, Taiwan; Dynamics of a Spinning Membrane

Alicia H. Kim

University of Bath, United Kingdom; Optimization of Two Steered Fiber Panels

Jiayue Huang

China; Tropospheric Ozone over China

Masahikio Miyauchi

Kaneka Corporation, Japan; High Temperature Composite Matrix Resins

Michael Smart

University of Queensland, Australia; Hypersonics

Gary Coleman

University of Southampton, United Kingdom; Turbulence Simulation and Modeling

Jing Liao

University of New Hampshire, New Hampshire study

Florent Kirchner

CEA, France; Source Code Analysis and Verification

Mark Sheplak

University of Florida, Florida; Investigations of Drag Due to Flow

Sudip Sen

Lancaster University, United Kingdom; Nowcast of Atmospheric Ionizing Radiation for Aviation Safety

Nail Yamaleev

North Carolina A&T State University, North Carolina; Adjoint-Based Grid Adaptation and Stability of Adjoint Solutions for Large-Eddy Simulations



Young-Ju Lee

Rutgers University; Upscaling of Vortical Flows

Joseph Blandino

VMI, Virginia; Thermal Mechanical Behavior of Very Large, Flexible-Substrate Solar Arrays

Marco Gherlone

Politecnico di Torino, Italy; Further Enhancements of the Inverse Finite Element Method

Marco Disciua

Politecnico di Torino, Italy; Further Enhancements of the Inverse Finite Element Method

Mauricio Ayala-Rincon

University of Brasilia, Brazil; Formal Methods and Applications

Axel Schwoeppe

DLR, Germany; Computational Fluid Dynamics

Juergen Garloff

HTWG, Konstanz; Global Optimization and Reliable Computing

Hector Cadavid-Rengifo

Columbia School of Engineering, New York; Autonomy for In-Space Operations

Jason Cohen

National University of Singapore, Japan; Inverse Analysis/Modeling of Absorbing Aerosols



Visiting Students

Camilo Rocha-Nino

University of Illinois, France; Software Verification Algorithms

Pierre Neron

Ecole Polytechnique, France; Formal Methods

Anton Lapatsin

University of Sciences and Technology, France; Atmospheric Optics

Chris Swin

Drexel University, Pennsylvania; Progressive Damage Modeling in Penetration of Composite Materials

Joel Belvin

California Polytechnical State University, California

Eugene Song

Norfolk State University, Virginia; Future Intelligent Transportation Systems

Joshua Branchaud

University of Nebraska-Lincoln, Nebraska; Formal Methods

Brady Garvin

University of Nebraska, Nebraska; Formal Methods

Chris Brampton

University of Bath, United Kingdom

Kevin Berry

Hampton University, Virginia; Space Weather Research

Guowei Yang

University of Texas-Austin, Texas; Software Verification

Antonio Franco Espin

University of Seville, Spain; Formal Methods

David Bilyeu

Ohio State University, Ohio; Sonic Boom Mitigation Using Counterflowing Jet (CFD)

Theodorus Ooijevaar

University of Twente, The Netherlands; Structural Health Monitoring of Composite Structures

Alejandro Campos

Stanford University, California; Turbulence Modeling for Separated Flows

Jessica Maloy

University of Florida, Florida; Investigations of Drag Due to Flow

Casey Barnard

University of Florida, Florida; Investigations of Drag Due to Flow

Han-Hsun Lu

National Cheng Kung University, Taiwan; Dynamics and System Identification of Spinning Membrane

Priscilla Cerracchio

Politecnico di Torino, Italy; Further Enhancements of the Inverse Finite Element Method

Yuniong Liao

University of Puerto Rico, Puerto Rico; Synthesis and Characterization of Boron Nitride Nanomaterials

Erik Martin-Dorel

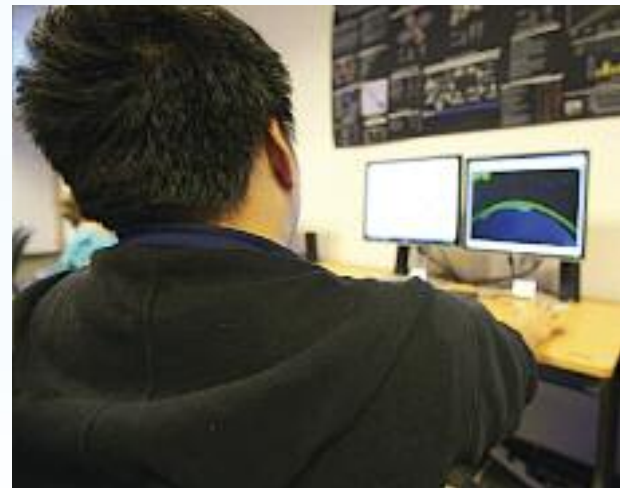
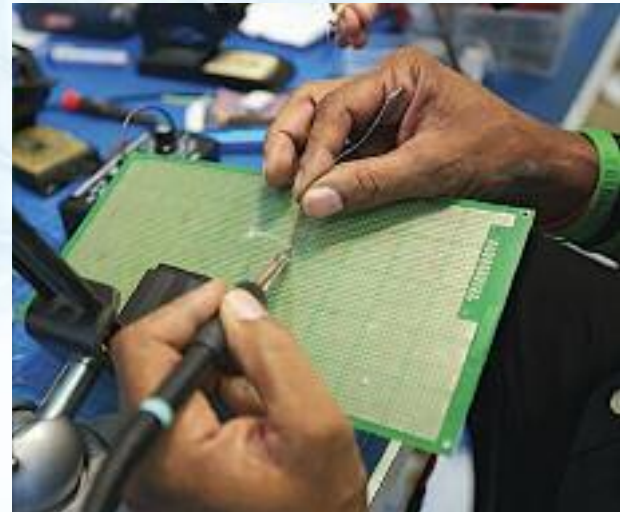
ENS, France; Formal Methods

Pierre Neron

Ecole Polytechnique, France; Formal Methods

Andreia Borges Avelar

University of Brazil, Brazil; Formal Methods



Graduate Education:

In 2012, our graduate program had 36 full-time graduate students in the spring semester and 38 full-time graduate students in the fall semester. Of the 38 students in the fall semester, 50% were Ph.D. candidates. Sixteen percent were female and 84% were male. In addition to the full-time graduate students, NIA had 40 part-time graduate students in the program. In 2012 we had 17 students graduate from the program in 2012, for a total of 126 graduates since the first graduate in December of 2004. By years end, the total has reached 36 Ph.D. degrees awarded and 90 Masters degrees.



NIA students have been recruited from:
United States:

Alabama 1	Montana 2
Arizona 5	North Carolina 22
California 3	New York 9
Florida 1	Ohio 4
Georgia 12	Oklahoma 3
Iowa 2	Pennsylvania 8
Illinois 1	Puerto Rico 1
Indiana 2	Rhode Island 1
Kentucky 1	South Carolina 4
Massachusetts 2	Tennessee 6
Maryland 9	Texas 2
Michigan 1	Virginia 35
Minnesota 2	Wisconsin 1

International:

Austria 1	Korea 1
China 5	Morocco 1
India 1	Taiwan 1
Israel 1	United Kingdom 1

Graduates



Vincent Adams

Old Dominion University/May 2012
M.S., Dr. Thomas Alberts



Matthew Allen

Virginia Tech/May 2012
M.S. Mechanical Engineering,
Dr. Ricardo Burdizzo
Thesis Topic: Analysis and Synthesis of
Aircraft Engine Fan Noise for Use in Psychoacoustic Studies
Present Position: Research Engineer at Raytheon BBN Technologies,
Virginia



Denisse Aranda

Virginia Tech/December 2012
ME, Material Science Engineering,
Dr. Michael Kelley
Thesis Topic: Contamination Control Engineering
and its Application to NASA Langley Research Present Position:
NASA/LaRC Aeronautics System Integration and Test Branch



Dale Arney

Georgia Tech/August 2012
Ph.D., Aerospace Engineering,
Dr. Alan Wilhite
Thesis Topic: Rule-Based Graph Theory to Enable
Exploration of the Space System Architecture Design Space
Present Position: Research Engineer at Georgia Tech



Lindsey Barr

North Carolina State University/May 2012
M.S. Mechanical and Aerospace
Engineering, Dr. Robert Tolson

Sean Commo

Old Dominion University/August 2012
Ph.D., Mechanical and Aerospace
Engineering, Dr. Drew Landman
Thesis Topic: Measurement System Characterization in the
Presence of Measurement Errors Present Position: NASA/LaRC
Aeronautics Systems Engineering Branch



Taumi Daniels

Hampton University/May 2012
Ph.D., Atmospheric Science,
Dr. William Smith
Thesis Topic: On the Analysis of an Imaging
Passive Fourier Transform Spectrometer for the Airborne Detection
of Wake Vortices Present Position: Continuing full time at NASA as
a civil servant



Matthew Fischer

Georgia Tech/May 2012
M.S., Aerospace Engineering, Dr. Alan Wilhite
Thesis Topic: Magnetohydrodynamic
Acceleration of a Thermal Air Rocket Utilizing
Low Energy Present Position: Boeing, Alabama

Christie Funk

Old Dominion University/December 2012
M.S., Aerospace Engineering,
Dr. Brett Newman
Thesis/Topic: Analysis of Turbulence Response Characteristics of
Flexible Aircraft Present Position: NASA/LaRC Aerelasticity
Branch



Justin Green

University of Virginia/December 2012
M.S., Aerospace Engineering, Dr. Robert Lindberg
Thesis Topic: Morphing Hypersonic Inflatable
Decelerator Present Position: Continuing in NIA
Ph.D. with University of Virginia



Lynn Huh

North Carolina State University/December
2012 Ph.D., Aerospace Engineering,
Dr. Robert Tolson
Thesis Topic: Statistical Analysis of the
Uncertainty in Pre-Flight Aerodynamic Database of a Hypersonic
Vehicle

Karol Koller

Old Dominion University/May 2012
ME, Dr. Colin Britcher



Marina Mazur Moen

North Carolina State University/December 2012
M.S., Aerospace Engineering, Dr. DeJarnette
Present Position: NASA/LaRC

Christopher Northrup

Old Dominion University/December 2012
M.S., Aerospace Engineering, Dr. Colin Britcher
Present Position: NASA Ames in California



Nicole Pothier

Hampton University/May 2012
M.S. Atmospheric and Planetary Science,
Dr. William Moore
Thesis Topic: Earth's Ground-Based Geomagnetic
Perturbations in Response to Substorms Present Position: Pursing
Ph.D. at the University of Michigan



Devin Pugh-Thomas

University of Virginia/May 2012
Ph.D. Electrical Engineering, Dr. Mool Gupta
Thesis Topic: Luminescent Quantum Dots for High
Temperature Sensing Present Position: NASA LaRC

Thomas (T.J.) Wignall

Old Dominion University/December 2012
M.S., Aerospace Engineering, Dr. Drew Landman
Thesis Topic: Design Proposals of HITL Experiments to Test NextGen
Flight Deck Based Interval Management Tools Present Position:
LARSS Intern, Applying to Ph.D. programs



Martin L. Drews Memorial Scholarship

The 2012 Martin L. Drews Memorial Scholarship has been awarded to Ankit Shah, who is a University of Virginia Ph.D. candidate studying at the National Institute of Aerospace.

Geographic Diversity of NIA graduates

Industry and Non-profits

a.i. solutions
Lanham, MD

The Aerospace Corporation
El Segundo, CA

Analytic Mechanics Associates
Hampton, VA

Applied Biomathematics
Seatauket, NY

Applied Materials Inc.
Santa Clara, CA

Bettis Atomic Labs
Pittsburg, PA

Boeing
Huntsville, AL

Cessna
Wichita, KS

Charles Stark Draper Laboratory
Cambridge, MA

Dynamic Concepts
Huntsville, AL

Exxon Mobil Research and Engineering
Fairfax, VA

General Electric Aircraft Engines
Evendale, OH

Integrity Applications, Inc.
Chantilly, VA

Johns Hopkins University/Applied Physics Lab
Laurel, MD

Knolls Atomic Power
Saratoga Springs, NY

National Institute of Aerospace
Hampton, VA

Orbital Sciences Corp
Dulles, VA

Raytheon Missile Systems
Tucson, AZ

Raytheon BBN Technologies
Arlington, VA

United Technologies Research Corp
East Hartford, CT

Government

Air Force Research Laboratory
Dayton, OH

Army Research, Development and Engineering Command
Fort Eustis, VA

Army Research Laboratory
Hampton, VA

NASA Ames
Moffett Field, CA

NASA Goddard Space Flight Center
Greenbelt, MD

NASA Langley Research Center
Hampton, VA

Naval Research Laboratory
Washington, D.C.

NIA graduates have continued their studies at NIA-member and non-member universities

National Institute of Aerospace
Columbia University
Georgia Tech
North Carolina State University
University of Maryland
University of Massachusetts
University of Michigan
University of Virginia

NIA/UMD Graduate Research Assistant Aimy Wissa traveled to Wright Patterson Air Force base in August 2012 to conduct an AFOSR funded flight test of a student built ornithopter.

Testing took place in the AFOSR indoor MAV laboratory – the largest Vicon motion capture system in the U.S. The ornithopter was designed and built in the NIA/UMD “Morpheus” laboratory under the direction of Dr. James Hubbard, UMD’s NIA Langley Professor.

NIA/UVa Graduate Research Assistant Ankit Shah was invited to attend the 11th IUVSTA School on Lasers in Materials Science - SLIMS, held in July 2012 in Venice, Italy.

Travel funding was provided by the National Science Foundation. Ankit presented a poster “Low Cost Efficient Solar Thermal Collectors by Laser Sintering.” Ankit’s advisor is Dr. Mool Gupta, UVA’s NIA Langley Professor.

Educational

Center for Integrative STEM Education

Through its Center for Integrative STEM Education (CISE), NIA provides a platform for collaboration and research of highly skilled leaders and practitioners in the field of integrative STEM education. CISE's areas of focus include: preservice and in-service teacher training and courses at the Continuing Education Units (CEU) and graduate degree level; distance learning for elementary, middle, and high school students and teachers; virtual world learning environments and programs for middle and high school students; and an Educator In Residence program. In 2012, NIA worked closely with NASA, school districts, and other STEM partners to develop new, and expand existing, innovative and relevant K-12 educational programs that are research-based and reflect best practices in integrative STEM pedagogy.

Education and Public Outreach

Central to NIA's multi-faceted educational and public outreach endeavors is a collaborative team of Educators-in-Residence (EIR), subject matter experts, program managers and media producers who deliver award-winning science, technology, engineering and mathematical (STEM) educational programs and classroom resources across the K-12 spectrum and beyond.

To advance opportunities in STEM, NIA resources are designed to capture an early fascination with science, technology, engineering and mathematics and then feed that interest throughout the formative years. Key to this effort is providing training

opportunities for in-service and pre-service teachers to develop and strengthen their confidence and competence to effectively teach STEM concepts and improve STEM literacy. Opportunities to further stimulate and sustain the development of the STEM workforce are provided to collegiate students through internship programs and rigorous engineering design competitions. NIA also serves the public through continuing education programs, as well as video and radio programming that informs the public on exciting new scientific discoveries and innovations in engineering that improve the understanding of our universe and the human condition.

Educator Programs and Classroom Resources

STEM Pre-Service Teacher Institute



NIA educators developed and delivered the 2012 Pre-Service Teacher Institute to 21 university students preparing for teaching careers in the K-8 classroom. During the week-long 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. 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 (NSTA) and the International Society for Technology in Education.

Addressing the new engineering standards, NASA eClips provides material for teachers to integrate engineering principles

into core subjects. New production during 2012 was sponsored by NASA's Jet Propulsion Laboratory and the Hypersonic Inflatable Aerodynamic Decelerator project. A total of nine new video segments were produced and added to the NASA eClips website, bringing the suite to a total of 240 segments. Related NASA resources are continuously aligned with video segments and posted on the NASA eClips website and social media outlets.

This year, NASA eClips joined with Alleyoop and Promethean Planet to provide STEM resources to their audiences. It was also recognized by NSTA as an exemplary digital resource in its February 2012 issue of Science Scope. It also garnered a 2012 Silver Davey Award in the educational category for the episode, "Real World: NASA Harnesses Half-Life." www.nasa.gov/nasaecclips

RealWorld-InWorld NASA Engineering Design Challenge

The RealWorld-InWorld NASA Engineering Design Challenge is a unique education initiative for students to explore and to build skills essential for successful STEM careers through two phases of project-based learning and team competition. In the RealWorld phase, teams of 8-12 grade students and teachers/coaches work face-to-face collaboratively as engineers and scientists. After exploring and designing solutions in the RealWorld phase, participants move InWorld to continue working in a 3D virtual universe. In this virtual environment, each newly-formed team uses 21st Century tools to refine designs and to create 3D models related to a specific NASA real-world challenge. The Challenge is a collaboration between NASA, NIA, and USA TODAY Education.



During Spring 2012, participating students completed the second year's challenges focusing on Robonaut-2 and the James Webb Space Telescope. In Fall 2012, the third challenge was launched focusing solely on the James Webb Space Telescope. Webb engineers will visit and "chat" InWorld with participants throughout the challenge. Over 207 students registered for this challenge and up to 20 teams will be accepted into the InWorld phase. The winning team will get to visit NASA's Goddard Space Flight Center and present to James Webb Space Telescope researchers. <http://www.nasarealworldinworld.org>

Educational and Public Awareness of HIAD

During 2012, NIA's Educational Outreach team worked with NASA Langley's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) team to develop a national public and educational awareness program. NIA managed, produced, and delivered a portfolio of activities to inform, engage, and excite the public about the technology and innovations coming out of the HIAD project. The portfolio included: a NASA 360 episode, six NASA eClips™ video segments, a NASA eClips educator guide, three Innovation Now radio interstitials, creation of the HIAD project website on the NASA portal, and filming, interviewing the team, and streaming of the IRVE-3 launch from NASA Wallops Flight Facility. www.nasa.gov/hiad

Public and Education Media

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.

With internationally recognized work in radio, web, live broadcasts, conferences, and events, NIA provides multi-layered support and world-class creative for marketing and media, outreach and communications.



NASA 360™

Designed to air on public television and on NASA.gov, NASA 360 is a premiere NASA outreach program that engages an adult (18-35) audience. The program highlights NASA's current research projects and informs and educates us on ways to conserve and sustain life on Earth, while looking ahead to life beyond Earth. NASA 360 was reinvigorated and enhanced in 2012 with a new website, program format, hosts and production team. Episodes produced in 2012 won two Telly Awards and a Capital Chesapeake Bay Emmy Award.

In 2012, NASA 360 had over 4.5 million downloads on NASA.gov and the brand doubled its presence on Facebook and Twitter to more than 60,000 social media fans and followers. NASA 360 is available on public and commercials broadcast stations including NASA Television and airs on Hulu and international airline flights. Three (3) new episodes were released in 2012. www.nasa.gov/nasa360



Innovation Now™

Each 90-second episode of the Innovation Now radio program features compelling stories of revolutionary ideas, emerging technologies and the people behind the concepts that are shaping the future. In collaboration with NASA's Space Technology Mission Directorate, NIA produced and distributed 260 episodes of "Innovation Now" in 2012. The series airs as daily weekday programming on ~400 public, college and commercial broadcast radio stations across the U.S. and the world. WHRO/WHRV 89.5 FM, in Norfolk, Virginia serves as our primary broadcast distribution partner for the series. <http://innovationnow.us>



Live Web Streaming and Events

In 2012 NIA collaborated with NASA, the commercial aerospace industry and non-profit organizations to increase awareness and participation of the public for numerous high-profile events, series and conferences including:

- NASA Technology Days
- 43rd Lunar and Planetary Science Conference
- Mars Concepts 2012
- Venus Transit
- NASA's Mars Science Laboratory Landing from Times Square
- NASA Innovative Advanced Concepts - 2012 Fall Symposium
- Science Cafes
- SpaceUp Houston 2012
- 50th AIAA Aerospace Sciences Meeting
- Airborne Wind Energy Conference 2012
- "START! Peninsula"
- NIA 10th Anniversary Lecture Series

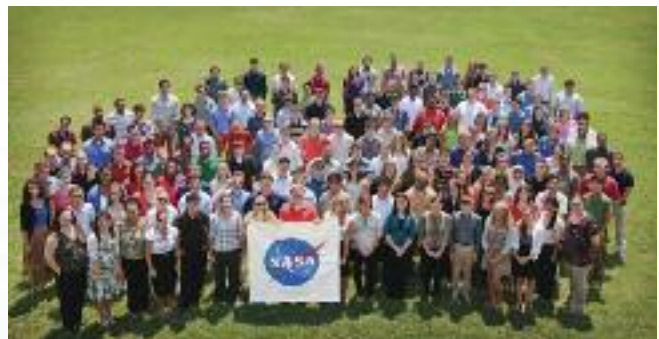
NIA's web broadcasting efforts in 2012 surpassed more than 3.2 million viewer minutes with viewers from around the globe.

Internships and Design Competitions

Langley Aerospace Research Student Scholars (LARSS) Program

The LARSS Program celebrated its 26th Anniversary in 2012, giving it the distinction of NASA's longest running internship. This paid, unique and highly competitive research internship program targets undergraduate and graduate students pursuing degrees in science, technology, engineering, and math (STEM), as well as fields relevant to work conducted at NASA Langley Research Center. Designed to bridge the gap between academic concepts and real-world experience, LARSS offers students studying STEM disciplines the opportunity for research, academic engagement and collaboration with NASA's professional STEM work force. LARSS helps students become "work ready" by emphasizing STEM competencies and building 21st century skills. LARSS is a year-round paid internship program with 3 sessions – fall and spring (15 weeks) and summer (10 weeks).

The LARSS Program is managed for NASA by NIA and implemented by the Virginia Space Grant Consortium under a sub-award.



2012 Summer LARSS Participants

FY12 marked the highest number of approved applicants (1,000+), and boasted a record number of annual total participants in LARSS history (220).



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, which focuses on human scale architecture and systems. This competition is an example of the “university reach back” that NIA is well-poised to conduct, creating an avenue for NASA to gain access to fresh, innovative concepts from the top-minds at America’s best engineering schools, while students have the opportunity to become involved in high-level relevant aerospace research.



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 constraints and criteria announced at the onset of each year. Each university design team must include one faculty or industry advisor and two or more students. Top winning teams are awarded with a secured presentation slot at the annual AIAA Space Conference, where they present a condensed version of their RASC-AL concept.



RASC-AL Exploration Robo-Ops

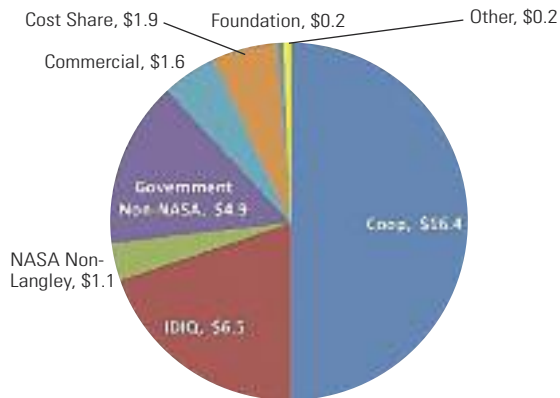
Robo-Ops is a university level engineering design competition managed by NIA for NASA, focused on robotics systems. Participating teams build a planetary rover prototype and demonstrate its capabilities to perform a series of tasks in field tests at NASA Johnson Space Center’s (JSC) Rock Yard. Rovers are operated remotely from the mission control center of their home universities, while remaining team members join the rover at the JSC Rock yard to serve as the team’s on-site pit crew. This robotic manipulation (complete with communication delays), replicates how robots and astronauts will work together in the near future on human space exploration missions. Student teams are also required to submit a technical paper and poster, as well as conduct a robust and dynamic Education & Public Outreach (EPO) component that demonstrates participatory exploration approaches for future NASA missions. Winning teams are awarded cash prizes.

Fourteen teams (Five graduate and nine undergraduate) were selected to compete at the 2012 RASC-AL Forum held in Cocoa Beach, Florida from June, 2012.

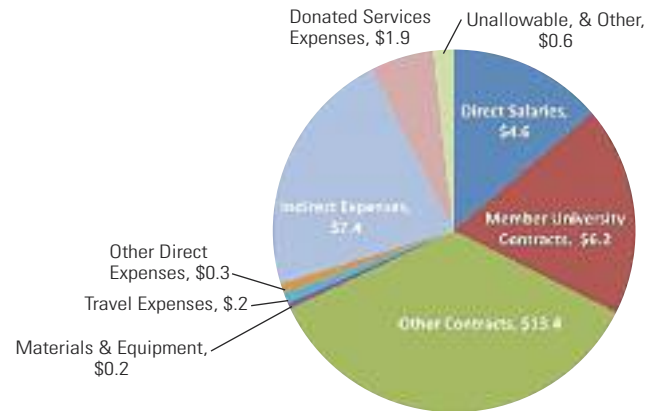
In 2012, eight (8) teams were selected to participate in the RASC-AL Robo-Ops Competition held May 31 – June 1, 2012 in Houston, Texas.

Financials

2012 Revenue Sources



2012 Revenue Uses



	Base Program	Discretionary Programs	Earned Revenue	Cost Sharing	Total
2003	2.5	3.7	6.2	0.8	7.0
2004	3.7	8.3	12.0	1.1	13.1
2005	5.1	17.2	22.3	1.6	23.9
2006	5.3	20.2	25.5	1.5	27.0
2007	6.2	22.2	28.4	1.0	29.4
2008	-	28.4	28.4	1.1	29.5
2009	-	29.9	30.1	0.8	30.9
2010	-	29.9	29.9	0.9	30.8
2011	-	33.6	33.6	1.7	35.3
2012	-	30.9	30.9	1.9	32.8

Earned Revenue	
2009	30064497
2010	29867377
2011	33560096
2012	



Mission

- **Conduct** research and foster collaboration among national laboratories, academia, and commercial partners that stimulates innovation and creativity.
- **Provide** comprehensive graduate and continuing education in science and engineering via local campus presence and distance learning technologies.
- **Incubate** and stimulate the commercialization of new intellectual property developed through NIA's research activities.
- **Promote** aerospace science and engineering and provide outreach to the region and the nation.

100 Exploration Way
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