CUTTING-EDGE RESEARCH, INNOVATIVE TECHNOLOGY DEVELOPMENT AND EXTRAORDINARY EDUCATION

NATIONAL INSTITUTE OF AEROSPACE

2009 ANNUAL REPORT

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On the Cover:
NASA. NIA, Virginia Tech and Georgia Tech are collaboratively researching strut- and truss-braced wing concepts capable of meeting the Agency's aggressive N+3 environmental targets. Results suggest an SBW can reduce fuel weight by at least 15% and a TBW by 20%.

President's Message

Dr. Robert E. Lindberg, Jr.

> *Change can be disruptive, but disruption exposes new opportunities. NIA is ready to seize the opportunities.*

By any measure, 2009 was a year of change. The inauguration of President Barack Obama, and the attendant transfer of power in Washington, brought with it a new direction for NASA. In the spring, the White House called for an independent assessment of NASA's program in human space exploration. In the resulting report, released to great anticipation in October, the committee concluded that NASA's Constellation Program was seriously underfunded, and that returning humans to the Moon by 2020 within the constrained NASA budget plan was not achievable. The report provides a range of alternatives for NASA, the White House and Congress to consider; the White House is expected to propose a new plan for NASA as part of the President's budget which will be submitted to Congress in February 2010.

The cost of the Constellation program over the last several years has led to cuts in other NASA programs – including aeronautics research, Earth science, investments in NASA's space exploration technology portfolio and in education - and there is reason to expect that these cuts will be reversed in the President's new plan. The research and education foundation we have built at the National Institute of Aerospace positions the institute to be ready to respond if NASA shifts their emphasis (and increases funding) in these areas. The new NASA Administrator, Charlie Bolden, has already announced that an increased focus on education at all levels will be one of his key objectives for the agency. Since NIA is NASA Langley Research Center's strategic partner in graduate education and educational outreach, NIA's programs in these areas could see substantial growth over the course of the Obama administration.

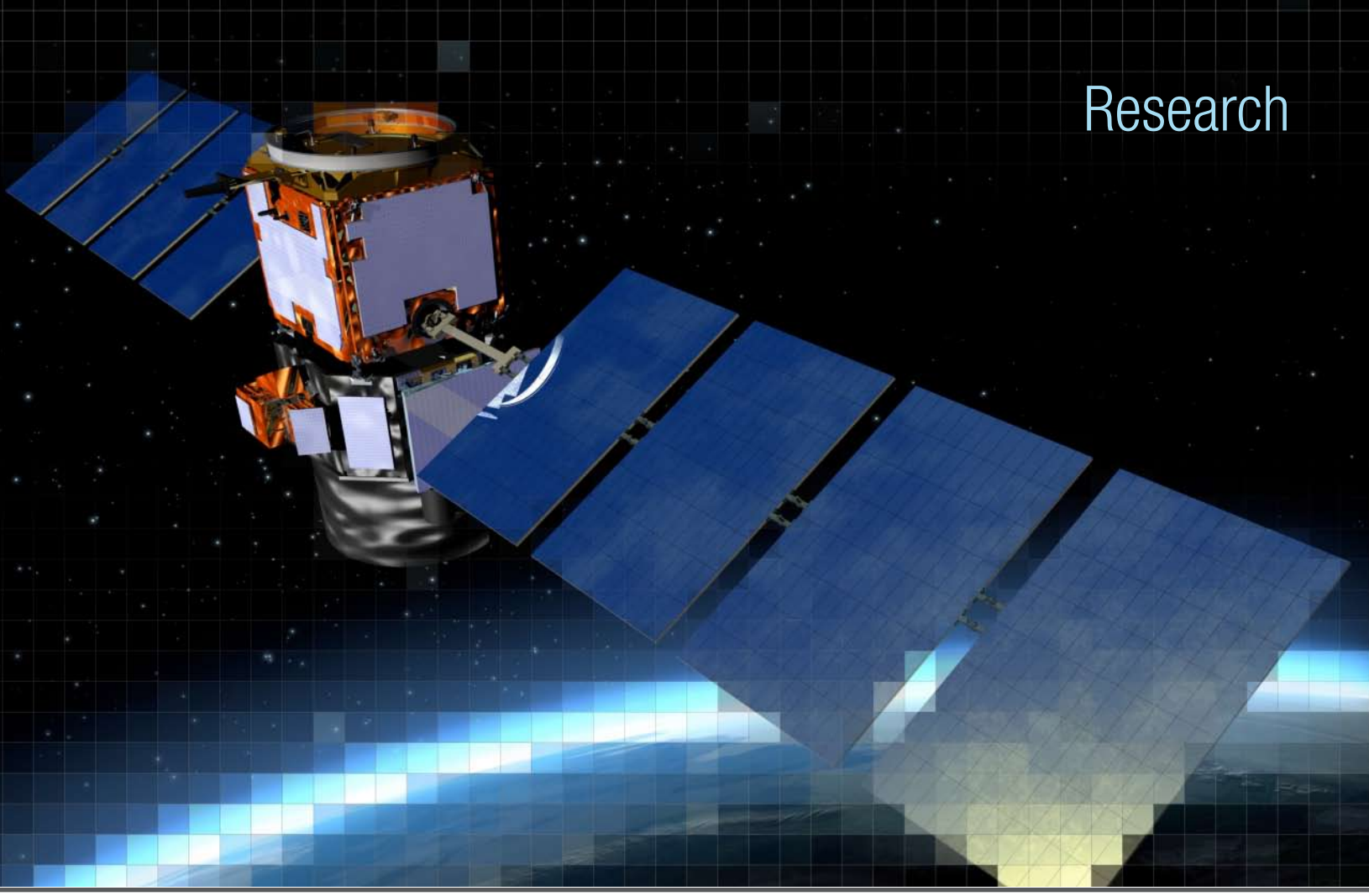
Other less dramatic changes in 2009 can be found in the evolving makeup of NIA's research portfolio. While research projects supported by Langley stayed roughly stable, we continued to win new competitive awards from other NASA sources, and our new work for the Federal Aviation Administration continued to grow. Our diverse research portfolio now includes about 10% that is supported by the aerospace industry and other non-government sources.

NIA's international collaborations continued to expand in 2009. Working with the faculty of Aerospace Engineering at Delft University of Technology, we hosted four graduate students on international internships at Langley Research Center during the summer. A senior member of our research staff, Dr. Boris Diskin, initiated an extended collaborative research project with colleagues from the German Aerospace Center, DLR. We expect these and other international collaborations to expand in 2010 and beyond.

In 2009, we continued to make progress with Virginia Tech and the City of Hampton in planning the new laboratories building on NIA's campus. The new research capabilities of this building will be a significant asset as we prepare to respond to a new era of increased investment in aviation research, space technology development and Earth science at NASA.

Change can be disruptive, but disruption exposes new opportunities. NIA is ready to seize the opportunities.

Table of Contents



Research

The scope of NIA's

research enterprise increased in several important ways in 2009. Supporting the work of our Strategic Partner, NASA Langley Research Center (LaRC), remained one of the major foci of our efforts. To this end, our researchers and resident faculty again this year published numerous outstanding papers on science and engineering and invented some potentially valuable new technology. The ongoing goal of broadening the funding base received a significant boost from a new relationship with the Federal Aviation Administration that focuses on human factors associated with increased flight deck workload as next generation airspace technology enters service. We also started a new thrust on flexible airframes with our largest corporate partner, Airbus North America. Our research infrastructure plans also advanced this year with the selection of the construction team for our new laboratory building and preparations to begin work next year.

Space Technology Innovation

is one of NIA's Focused Research Areas. It is led by NIA Langley Professor from Georgia Tech, Dr. Alan Wilhite. Professor Wilhite and one of his graduate students, Christopher Jones, are working to help NASA realize innovative methods of fueling spacecraft by determining the feasibility of utilizing the Earth's atmosphere as propellant for space exploration missions. Systems engineering methodology is used to define the air collection vehicle, propellant depot, and the exploration transportation systems. Emphasis is placed on determining the performance, cost, and safety benefits of such a system as compared to the current NASA exploration architectures.

Prof. Alan Wilhite

The initial research for Propellant Harvesting of Atmospheric Resources in Orbit (PHARO) was to establish the requirements, initial feasibility, and technology requirements for a complete system. One possible concept of operations, shown in Figure 1, is 1) orbit the collector at an optimum circular orbit, 2) liquefy and separate the air for storage into propellant tanks, 3) continue collection using a fraction of the collected propellant energized with beamed power until the collector storage tanks are full, 4) reboost collector to a stable orbit to offload the collected propellant into a orbital propellant storage depot, 5) continue operation until the propellant depot tanks are full and 6) transfer propellant to the space exploration transportation system.

Christopher Jones

An analytical method was developed to determine the performance requirements of the PHARO Atmosphere Collector. Drag in the upper atmosphere at free-molecular conditions was estimated with the Aerodynamic Preliminary Analysis System. However, because of the complexity of inlet flow, initial drag estimates were computed using Direct Simulation Monte Carlo (DSMC) with the help of Dr. Christopher Glass at LaRC. Initial results showed that a truncated cone collector allows 50% of the air to spill around the opening (Figure 2). However, mass capture was greatly improved by placing a diffuser element in the conical collector as shown in Figure 3. Optimizing the geometry is essential because collection rate and atmospheric drag are critical parameters for PHARO's operation. Results from the trajectory analysis using the 100N of drag from the DSMC resulted in a required propulsion specific impulse of 1500 seconds. The initial collection scheme is based on a Mars mission as defined in NASA's Design Reference Architecture 5.0 report in 2009. The resulting architecture is a 5 meter diameter/15 meter long Collector.

The engine selected for the system is a magnetohydrodynamic ramjet requiring 2 MW of power. Several power sources are being considered including solar power collection with laser or microwave beamed power, thermal beaming, and internal power from nuclear fission. Technology show-stoppers identified are MHD propulsion on air, power, cryogenic fluid long-term storage, and cryogenic fluid transfer. Research is continuing to determine the technology status and risk of developing these technologies.

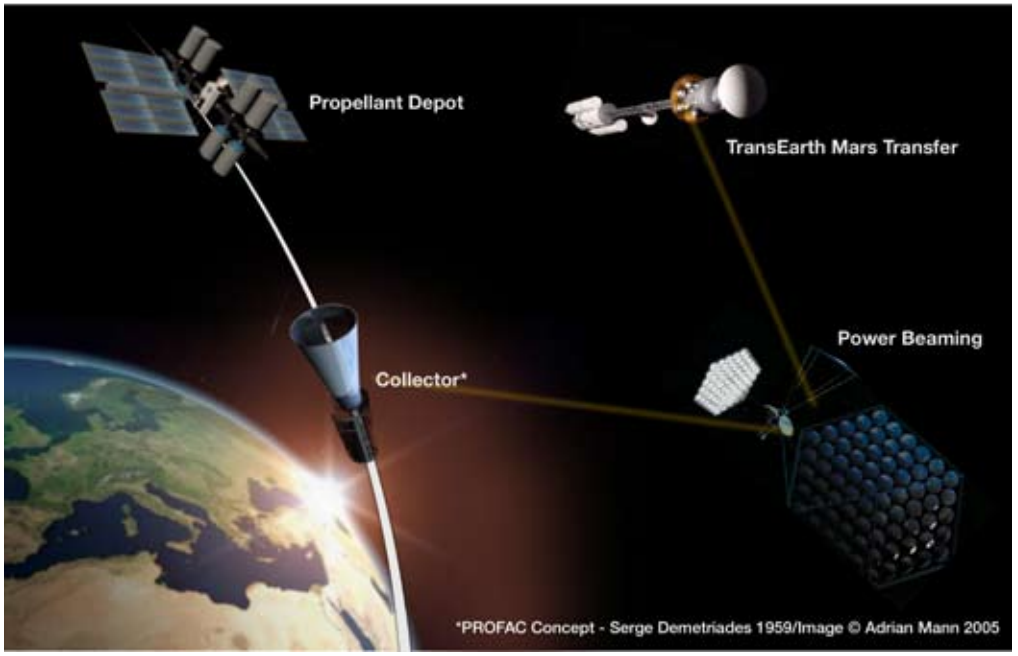


Fig. 1. PHARO Operational Concept

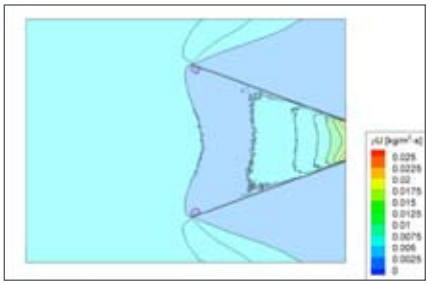


Fig. 2. Truncated Cone Collector

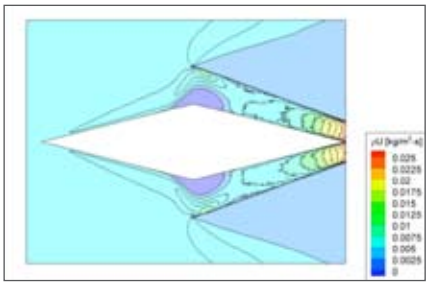
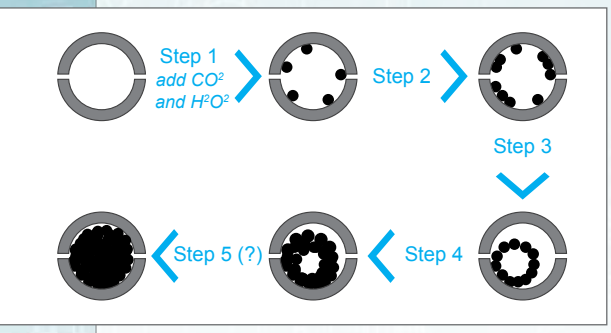


Fig. 3. Collector with External Diffuser

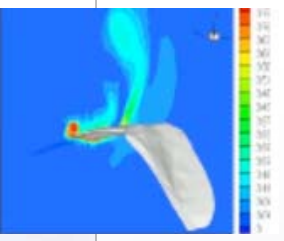
Energy Generation and Storage for Aerospace Applications



Dr. Jae-Woo Kim

is one of NIA's Focused Research Areas. NIA Research Staff Member, Dr. Jae-Woo Kim, is one of several researchers whose work contributes in this area. Some of Dr. Kim's recent work on multifunctional nano-structured materials in collaboration with colleagues at NASA Langley Research Center focuses on creating bio-inspired materials and other nano-materials that may find use in batteries and sensors. Horse Spleen Ferritin (HoSF) is one of the more unusual materials that can be used to create metallic nano-particles for both batteries and biosensors. Ferritin is a naturally occurring iron storage bio-molecule that ensures iron is available for cellular metabolism. It also traps excessive free iron to prevent harmful radical compounds from forming in the cells. These nearly spherical shell molecules have several porous channels that allow their internal contents to exchange with their surrounding fluids thus providing a pathway to exchange their iron mineral cores with other minerals containing metals such as cobalt, nickel, chromium, manganese, and even gold. Cadmium Sulfide, a semiconductor used in solar cells, can also be place inside ferritin thus leading to the possibility of nano sized energy generation devices. The process for "growing" a cobalt nano-particle inside a previously emptied ferritin molecule is shown in the schematic diagram.

Unmanned Autonomous Systems for Extreme Environments



Professor James Hubbard

is also a Focused Research Area at NIA. This area includes broadly machines that operate on or beneath land and water and those that fly. It is led by Professor James Hubbard, NIA Langley Professor from the the University of Maryland. Among his research interest are avian-inspired unmanned aerial vehicles. These machines fly low and slow by flapping their wings much like birds. Only rotorcraft are able to operate in this flight regime presently. Rotorcraft are energy intensive and noisy which make them unsuitable for many applications. Wing-flapping is highly energy efficient as expected given the large variety of birds that use this strategy for flight. The flapping-wing, low and slow flight regime is not well understood. To investigate this, Professor Hubbard and his graduate students recorded high speed video of mechanical birds in flight. The wings were tagged with reflective dots in order to follow their flexing behavior as the device flew. This is similar to the methods used by video game makers to get realistic motion in computer games. Computer codes for fluid and structural dynamics then allow prediction of air velocities and pressures around the device as well as stresses on its airframe.

NIA Research Lab

NIA and Virginia Tech have selected Concorde Eastridge, Inc. to construct a 60,000 sq. ft. laboratory building on a site near NIA's office and classroom building in Hampton, VA. This facility will provide laboratory space for work on robotic devices, advanced nano-materials, and modeling and simulations on the first floor. The second floor will house some common auxiliary facilities such as a kitchen and dining/collaboration area. It will also have some unfinished shell space to accommodate future needs. The third floor will house the Hampton Roads Technology Innovation Center for high tech startup companies. We expect construction to begin in late spring and to require about 16 months to complete.

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Fischer, M., and Wilhite, A., "Earth to Moon Transportation Optimization," AIAA Paper 2009-6564, AIAA Space 2009 Conference and Exposition, 14-17 Sep. 2009, Pasadena, CA.

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Grauer, J., and Hubbard, J.E., "A Multibody Model of an Ornithopter", J. Guidance, Control, and Dynamics, 32 (2009): 1675-1679.

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Hubbard, J.E., "Dynamic Shape Control of a Morphing Airfoil Using Spatially Distributed Transducers," J. Guidance, Control, and Dynamics, 29 (2009): 612-616.

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Wilson, M., Wilhite, A., and Komar, D.R., "Bimodal Nuclear Thermal Rocket Propulsion Systems for Human Exploration of Mars," AIAA Paper 2009-5311, 45th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 2-5 Aug. 2009, Denver, CO.

Crespo, Giesy, Kenny Win 2009 Outstanding Publication Award

Each year NIA chooses an outstanding publication example from among the many research papers published by our technical staff to receive the "Best Research Publication Award". The recipients for 2009 are Dr. Luis Crespo, Dr. Daniel P. Giesy, and Dr. Sean P. Kenny for their paper entitled, ""Reliability-based Analysis and Design via Failure Domain Bounding" published in 2009. The paper proposes an optimization-based strategy for the analyses and design of systems that are subject to uncertainty. The proposed framework enables the identification of the worst-case uncertainty combination for the particular system architecture and systematically searches for designs with improved reliability characteristics.This paper has a wide impact due to the methodology that is applicable to the vast majority of mathematical models used in engineering, e.g., structures, fluids, controls, materials. This methodology can also be used without incurring the heavy computational burden required by Monte Carlo sampling.

Visitors @ NIA

Visiting Scholars

Prof. Kenneth Brentner; Pennsylvania State University; Prediction of Acoustic Scattering and Interaction for Shrouded Rotors

Prof. Hector Cadavid-Rengifo; Colombia School of Engineering; Spacecraft Autonomy for In-Space Operations

Prof. Gilles Dowek; Ecole Polytechnic, France; Formal Methods and Spacecraft Autonomy for In-Space Operations

Dr. Jean-Christophe Filliatre; CNRS,INRA, France; Spacecraft Autonomy for In-Space Operations

Dr. Rowan Gollan; University of Queensland, Australia; Design System for Three-Dimensional Inlet Compression Systems

Dr. Heber Herencia-Zapana; Old Dominion University; Formal Methods – Safety Buffers for Conflict Detection and Resolution

Dr. Hyun Jung Kim; Korea Advanced Institute of Science & Technology; Advanced Materials for Energy Harvesting

Mr. Matthew Lythgoe; self; Aeroelastic Rotor Experimental System Data Acquisition System Development

Prof. Natasha Neogi; University of Illinois, Urbana-Champaign; Spacecraft Autonomy for In-Space Operations

Dr. Adrian Orifici; Royal Melbourne Institute of Technology, Australia; Benchmarking Delamination Propagation and Growth Capabilities in Commercial Finite Element Codes

Dr. Parag Patre; NASA Postdoctoral Program; Adaptive Control Methods for Uncertain Systems under Anomaly

Prof. Andre Platzer; Carnegie Mellon University; Formal Analysis and Verification for Hybrid Systems in Aviation Safety

Prof. Michael Smart; University of Queensland, Australia; Design System for Three-Dimensional Inlet Compression Systems

Prof. Eli Turkel; Tel-Aviv University, Israel; Numerical Algorithms for Navier-Stokes Equations, Steady & Unsteady Flows

Dr. Paul Weaver; University of Bristol, UK; Shell Buckling Design Technology

Prof. Deonna Woolard; Randolph-Macon College, Applicability of Scanning Infrared Thermography as a Large Area Inspection Technique for Composite Structures

Prof. Dong Wu; Ocean University of China; Atmospheric & Ocean Science

Visiting Students

Ananyo Bandyopadhyay; Michigan Technological University; Multiscale Modeling of the Effects of Physical, Chemical, and Hydrothermal Aging on Failure of Graphite/Epoxy Composites

Scott Belcourt; Virginia Tech; Multifunctional Aerospace Materials

Matthew Bolton; University of Virginia; Spacecraft Autonomy for In-Space Operations

Chase Brown; Georgia Tech; Advanced Space Architectures

Fernand Clermont; Delft University of Technology, The Netherlands; Air Traffic Management and Aviation Safety

Matthew Fischer; Georgia Tech; Lunar Architecture Optimization

Paolo Gradassi; University of Rome Three, Italy; Time Domain Prediction of the Broadband Noise Generation by Airfoils and Rotating Blades

Julius Ha; Governor's School Mentorship, Atomic Force Microscopy Study of Adhesion between Carbon Nanotube and Biomolecules

Lyndell Hockersmith; Virginia Tech; Solar Wind-Magnetosphere

Scott Hopkins; Virginia Tech; Multifunctional Aerospace Materials

Dana Ionita; Georgia Tech; Quantifying the Performance of Real-Time Wake Vortex Computational Models

Leonard Lensink; University of Nijmegen, The Netherlands; Spacecraft Autonomy for In-Space Operations

Alexander Maas; Delft University of Technology, The Netherlands; Advanced Earth-to-Orbit Concept Development

Joseph Macon; Virginia Tech; Space Weather

Megumi Matsutani; Massachusetts Institute of Technology; Adaptive Control Technology for Safe High-Performance Aircraft

Alessandro Migliaccio; Delft University of Technology; Aerospace Structural Dynamics

Michael Okyen; Virginia Tech; Multifunctional Aerospace Materials

Ami Patel; University of Virginia; High Power Laser Texturing of Surfaces for Aerospace Applications

M. Brett Pearce; North Carolina State University; Planetary Atmospheric Flight

Joshua Rice; Governor's School Mentorship; Multifunctional Space Materials for Solar Energy Harvesting

Pierre Roux; Ecoles Normales Superieures, France; Formal Verification & Automated Testing for Diagnostic and Monitoring Systems Using Hybrid Abstraction

Mark van der Steen; Delft Universityof Technology, The Netherlands; Operator State Estimation and Management through Haptic-Multimodal Interaction

Vivek Vittaldev; Delft University of Technology, The Netherlands; Technology Assessment Tools/Methods Development

Timothy Wang; Georgia Tech, Formal Verification of Adaptive Controllers

Yiquiang Zhang; Sun Yat-sen University, China; Vertical Distribution of Tropospheric Ozone over China

Graduate Education

In 2009, NIA continued our robust graduate program, with 60 full-time graduate students in Spring Semester 2009 and 58 full-time graduate students in the Fall Semester 2009. Of the 58 students in the Fall Semester, 26 were M.S. candidates and 32 were Ph.D. candidates. In addition to the full-time graduate students, we had 31 part-time graduate students in the program.

GRADUATES:

Alan J. Fletcher
University of Virginia
December 2009
M.S. in Materials Science and Engineering
Dr. Mool Gupta, advisor
"Elastomeric Nanocomposites for Electromagnetic Shielding"
Ken Dudley, NASA Mentor

John Fuller
North Carolina State University
December 2009
M.S. in Aerospace engineering
Dr. Robert Tolson, advisor
"Methods to Alleviate Processing Requirements of High-Fidelity Multibody Parachute Simulations Involving a Cofluent Mass"
Daniel Litton, NASA Mentor

John Gaebler
North Carolina State University
November 2009
M.S. in Mechanical and Aerospace Engineering,
Dr. Robert Tolson, advisor
"Failure Bounding and Sensitivity Analysis Applied to Monte Carlo Entry, Descent and Landing Simulations"
Juan Cruz, NASA Mentor

David Kuhl
University of Maryland
November 2009
Ph.D. in Atmospheric and Oceanic Science
Dr. Istvan Szunyogh, advisor
"Assimilation of Trace Gas Retrievals with the Local Ensemble Transform Kalman Filter"
Robert Bradley Pierce, NASA Mentor

Conrad Lovell
University of Virginia
October 2009
Ph.D. October 2009,
Prof. James Fitz-Gerald, advisor
M.S. August 2007 in Mechanical Engineering/Materials Science and Engineering
"The Effects of Polymer Morphology and Single-Wall Carbon Nanotubes on Biopolymer Shear Piezoelectricity"

Eric Lundgren
Virginia Tech
September 2009
M.S. in Aerospace Engineering
Dr. Rakesh Kapania, advisor
"Durable Joining Technology for NASA's Ares V Launch Vehicle"
Dr. Stanley St. Clair Smeltzer, III, NASA Mentor

Sarvjit Lota
University of Virginia
August, 2009
M.E. in Mechanical and Aerospace Engineering
Dr. James McDaniel, advisor
Dr. Ajay Kumar, NASA Mentor

Matthew Aitken
North Carolina State University
July 2009
M.S. in Aerospace Engineering
Dr. Robert Tolson, advisor
"Lidar-Aided Inertial Navigation with Extended Kalman Filtering for Pinpoint Landing"
Dr. Farzin Amzajerdian, NASA Mentor

Emmanuel Winston Okraku
University of Virginia
June 2009
M.S. in Electrical Engineering
Dr. Mool Gupta, advisor
"Laser Annealing of P3HT/PCBM Organic Solar Cells"
Kenneth Wright, NASA Mentor

Khary Tatum
North Carolina A&T State University, May 2009
M.S. in Electrical Engineering
Dr. Abdollah Homaifar, advisor

Alex Stramel
University of Virginia, May 2009
M.S. in Electrical Engineering
Dr. Mool Gupta, advisor
"Resonant Pulsed Laser Deposition of Carbon Nanotube Thin Films"
Dr. Jirong Yu, NASA Mentor

Daniel Le
University of Virginia, May 2009
Ph.D. in Mechanical and Aerospace Engineering
"Robust Design of Low Sonic Boom Concepts"
Dr. James McDaniel, advisor

Michael Hunt
Virginia Tech, May 2009
M.S. in Materials Science and Engineering
Dr. Kathryn Logan, advisor
"Pressureless Densification of SHS produced Alumina-Titanium Diboride Ceramic Matrix Composites"

Adam Cowling
Virginia Tech, May 2009
M.S. in Aerospace Engineering
Dr. Christopher Hall, advisor
"Pitch-Control Predictor-Corrector and Neural Network Ascent Guidance"
Jeff Robinson, NASA Mentor

INTERNSHIPS

NIA continues to manage and grow the Langley Aerospace Research Summer Scholars (LARSS) program with administrative support from the Virginia Space Grant Consortium. LARSS is designed to inspire the next generation of explorers by providing research internships for college students on NASA's aeronautics and space-related missions and to maintain and increase the cadre of high-caliber college students who are pursuing undergraduate and advanced degrees in disciplines compatible with NASA Langley Research Center programs. 2009 saw 212 students participating in the LARSS program drawing from majority universities, HBCUs, HSIs and TCUs nationally.

RASC-AL DESIGN COMPETITION

In September 2008, NIA assumed responsibility for NASA's Revolutionary Aerospace Systems Concepts (RASC-AL) Engineering Design Competition. RASC-AL is a design program targeted at engineering students, managed by NIA and sponsored by NASA ESMD.

The 2009 RASC-AL Forum competition was held in Cocoa Beach, Florida June 1-3. There were 15 teams competing from 16 universities. Ten graduate teams competed against each other and five undergraduate teams competed against each other. There were 94 students and faculty members involved. The graduate winning team was the Georgia Tech/NC State team for "Reusable Lunar Transportation Architecture Utilizing Orbital Propellant Depots."The undergraduate winning team was from UMd for "Project Alshain: A Lunar Flying Vehicle for Rapid Universal Surface Access."

Martin L. Drews Scholarship

The 2009 Martin L. Drews Scholarship has been awarded to Mr. Dale Arney, a Georgia Institute of Technology Ph.D. candidate studying at the National Institute of Aerospace.

North Carolina A&T State University

University of Maryland

University of Virginia

VirginiaTech

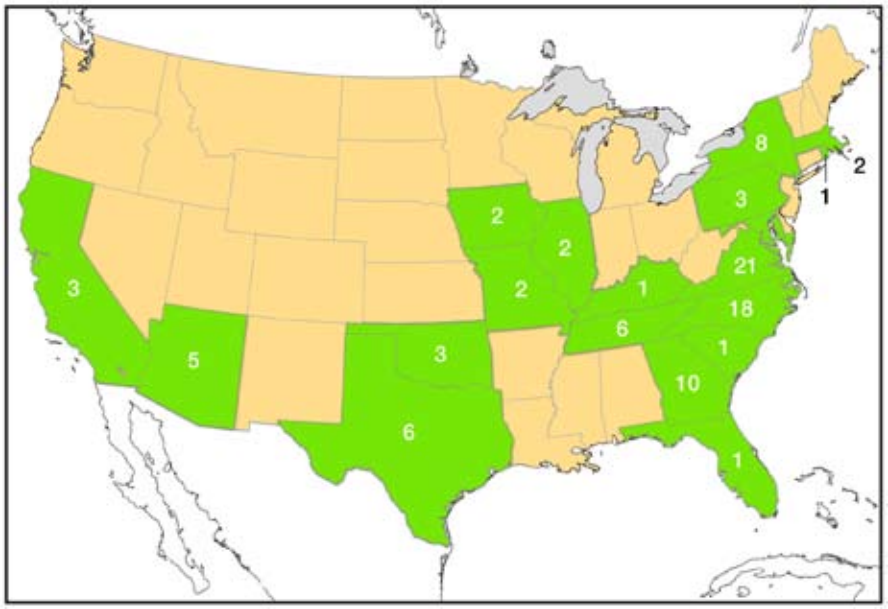
NC STATE UNIVERSITY

Georgia Tech

Hampton University

Geographic Diversity of NIA Graduate Students

NIA STUDENTS HAVE BEEN RECRUITED FROM…



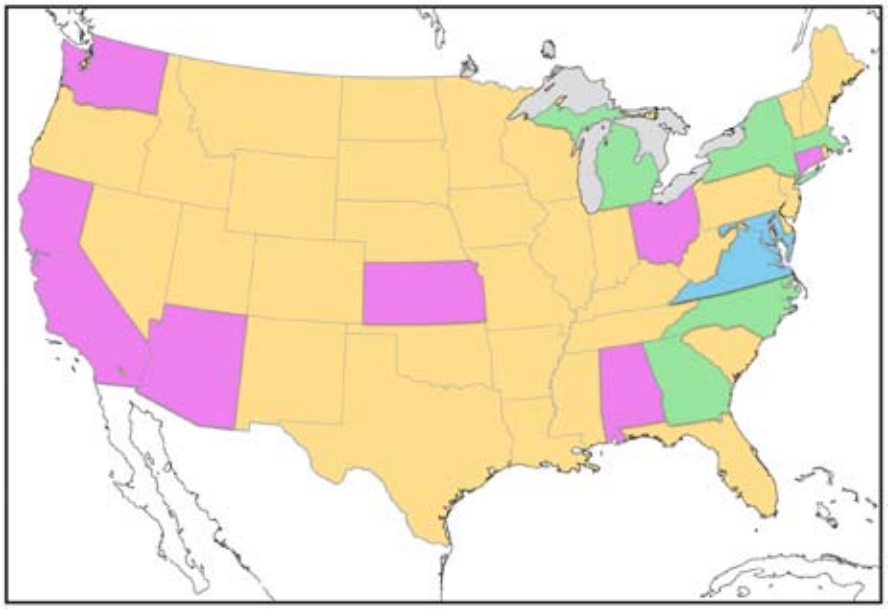
United States

Arizona	5	South Carolina	3
California	3	Tennessee	6
Florida	1	Texas	2
Georgia	10	Virginia	21
Iowa	2		
Illinois	1		
Indiana	2		
Kentucky	1		
Maryland	8		
Minnesota	2		
Montana	2		
North Carolina	18		
New York	8		
Ohio	4		
Oklahoma	3		
Pennsylvania	6		
Puerto Rico	1		
Rhode Island	1		

International

China	10
India	1
Israel	1
Korea	1
Morocco	1
Taiwan	1
United Kingdom	1

GEOGRAPHIC DIVERSITY OF NIA GRADUATES



Graduates have been employed by...

Government

NASA Langley Research Center
Hampton VA

NASA Goddard Space Flight Center
Greenbelt MD

Army Research Laboratory
Hampton VA

Army Research, Development and Engineering Command
Fort Eustis VA

Naval Research Laboratory
Washington DC

Industry and Non-profits

Boeing
Renton WA and Mesa AZ

Orbital Sciences Corp
Dulles VA

Raytheon Missile Systems
Tucson AZ

The Aerospace Corporation
El Segundo CA

Johns Hopkins Univ / Applied Physics Lab
Laurel MD

General Electric Aircraft Engines
Evendale OH

National Institute of Aerospace
Hampton VA

a.i. solutions
Lanham MD

Integrity Applications, Inc.
Chantilly VA

Analytic Mechanics Associates
Hampton VA

Cessna
Wichita KS

Dynamic Concepts
Huntsville AL

United Technologies Research Corp
East Hartford CT

Exxon Mobil Research and Engineering
Fairfax VA

Applied Materials Inc.
Santa Clara, CA

NIA graduates have continued their studies at...

Member and Non-member Universities

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

Outreach

NIA offers best-in-class, leading edge pre-service and in-service teacher's workshops/activities. These efforts, developed and led by NIA's award winning Educators in Residence (EIR), deliver a pioneering approach to STEM pedagogy.

Based on the Principles of 21st Century e-Teaching and 21st Century Skills our EIRs train teachers across the country on how to effectively apply and integrate instructional technology and STEM content into the classroom within core academic subjects. NIA's Educators draw heavily from NASA eClips™ content and other NASA and NIA unique resources.

NASA Pre-Service Teacher STEM Program (PSTSP)

PSTSP supports grades 4-8 pre-service teachers from underserved populations, particularly Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs) and selected majority institutions. The program includes professional development, external partnerships and systemic reform. In 2009, the program included a virtual STEM lesson plan development contest for 750 participants, and a 2 week residential intensive Pre-Service Teacher Institute.

NASA eClips

NASA eClips are short, relevant educational video segments designed to inspire and engage students, helping them see real-world connections with STEM education. Produced weekly, The programs target elementary, middle, and high school students and are augmented by teacher resources and training to support the use of best practices and effective implementation in a 21st Century classroom. Educational material for this program is selected based on national curriculum standards identified by NCTM, NSTA and ISTE.

Since the project began in 2008, 120 videos have been produced and made available through YouTube and the NASA.gov websites – 38 Our World (grades K-5), 40 Real World (grades 6-8), and 42 NASA Launchpad (grades 9-12).The program has received several awards including the prestigious iParenting Media Award for Outstanding Television Product of 2009.
www.nasa.gov/education/nasaeclips
www.youtube.com/nasaeclips

Modeling and Simulation

In 2009, NIA took a leadership role in delivering Modeling and Simulation (MODSIM) instructional technology and best practices into core academic subjects through partnerships with NASA LaRC and area schools. MODSIM has been cited by prominent state and federal committees and panels as an essential tool set to successfully compete in today's global economy. It allows for the economical continuation of innovation and advancement of engineering, science, research and technology.

MODSIM is used in diverse disciplines and applications such as defense, education, engineering, science, training, transportation and urban planning. Because of its pervasiveness across a wide range of industries, it is considered to be an integral part of the 21stCentury laboratory and is a "must have" skill set for the next generation of engineers, scientists and technicians.

21st Century Physics FlexBook

The 21st Century Physics FlexBook is a collaborative effort of the Virginia Secretaries of Education and Technology, and the Virginia Department of Education that seeks to elevate the quality of physics instruction across the Commonwealth of Virginia.

Chapter 12, Modeling and Simulation in the Physics Classroom, was written by Mark Clemente, an NIA Educator in Residence, in collaboration with a retired physics professor from Christopher Newport University and a software engineer at isee systems, publishers of STELLA® Systems Dynamics/Systems Thinking modeling software.

Virtual Exploration Sustainability Challenge (VESC)

The Virtual Exploration Sustainability Challenge is a MODSIM Challenge sponsored by NASA LaRC, GSFC and NIA. The competition teams undergraduate engineering students and high school students to collaboratively solve a NASA-inspired design problem within a virtual environment.

In 2009, NIA ran a beta-test of VESC pairing three regional high school teams with MODSIM undergraduate students from Old Dominion University. The challenge focused on a servicing mission for the Hubble Space Telescope. Access to the VESC virtual world laboratory spaces is available through NIA Universe.
www.nianet.org/VESC

21eTeacher Graduate Studies Certificate

In March, 2009 NIA, with its partner Nortel LearniT, initiated an alliance of Virginia government, non-profit, education and business community to support a new Certification, Virginia's 21st Century eTeacher Certificate program, which aims to lead systemic change towards 21st century teaching and learning throughout the Commonwealth. NIA's EIR's contributed to the development of the courses with Nortel LearniT.

NASA 360

This thirty-minute magazine style program was created in collaboration with the Langley Office of Strategic Communications and Planning. Designed to air on public television, NASA 360 targets an adult or general population audience and highlights NASA's current research and projects that will take us back to the moon, this time for more than just a short visit. NASA 360 informs and educates us on ways to conserve and sustain life on Earth, while looking ahead to life beyond Earth. In 2009, NASA 360 had over 1 million downloads and has won numerous awards, including the coveted Emmy award for excellence in film making, and a special 30th anniversary gold Telly award given for outstanding local, regional, and cable TV commercials and programs, film and video.
www.nasa.gov/nasa360

Discovery Now

NIA, through a generous grant from the American Institute of Aeronautics and Astronautics (AIAA), initiated the development and distribution of a daily radio program, in September 2006. Discovery Now represents an economical method of circulating information on aeronautics and astronautics technology, science, history, innovations, research, and inventions worldwide. In 2009, Discovered Now was honored with a International Davey Award for excellence in non-profit radio programming; increased its station base from 37 to 155; received 1.1 million unique downloads of its program; and was picked up by Armed Forces Network, distributing programming content to over 170 countries.
www.discoverynow.us

NASA 101, NASA CITY and NASA @ Home 3D Interactive Websites

NIA, in collaboration with Woodpile Studios, worked with NASA HQ ESMD to develop two 3D interactive websites – NASA 101 and NASA City and NASA @ Home. This year, Phase 2 of the development and rollout was completed with the inclusion of voice-overs on all videos.

NASA 101 focuses on NASA's innovation, discovery and inspiration. Information on the Science, Exploration, Operations, Aeronautics and Education mission directorates is featured as well as information on NASA's Vision, Constellation, Centers and Facilities, and Top Stories.
www.nasa.gov/externalflash/nasa101

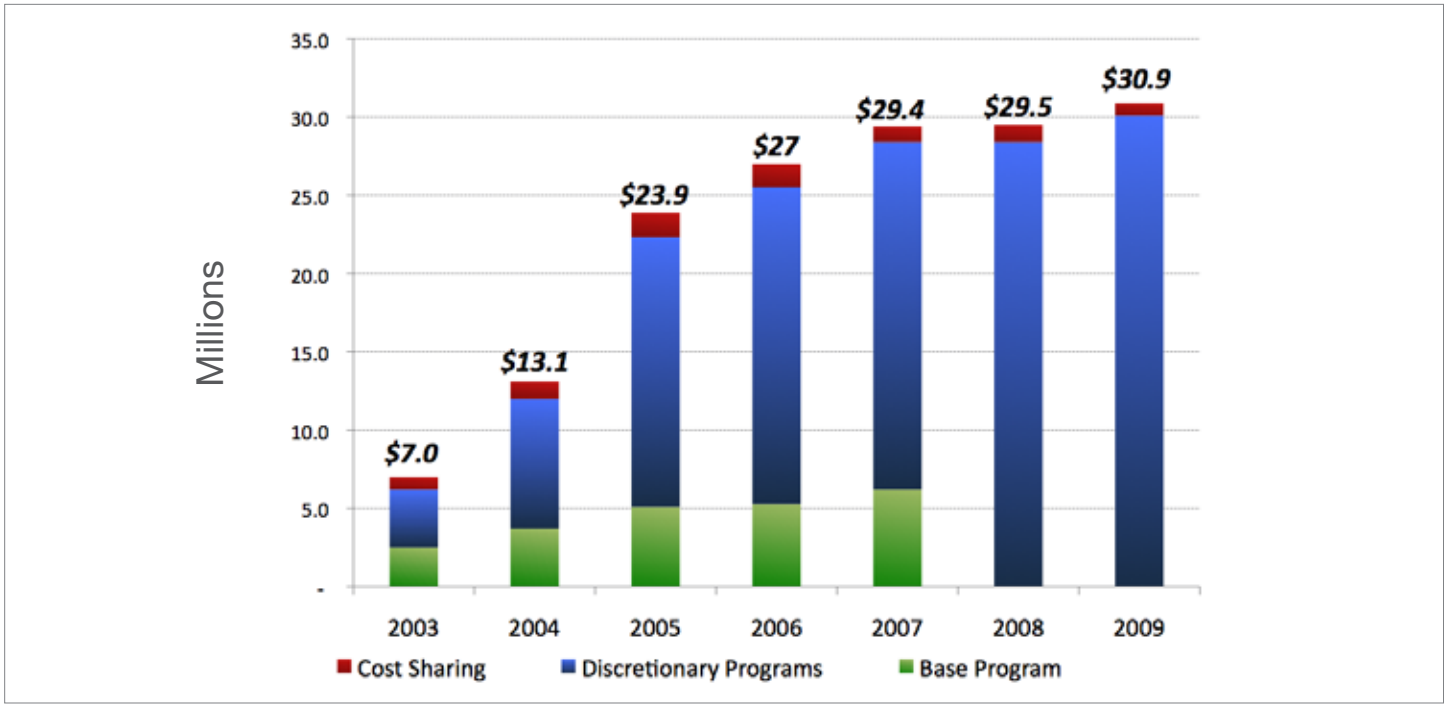
NASA's 40th Anniversary of Apollo Lunar Landing

NIA partnered with NASA in the celebration of the 40th anniversary of the Apollo Lunar landing. Events and activities included: a reception in Washington, DC for 2,500 NASA and government officials, industry and non-profit leaders; advocating for the establishment of the Congressional Medal of Honor for the Apollo crew; and professional development workshops and student events to advance public awareness of the success of the Apollo missions.

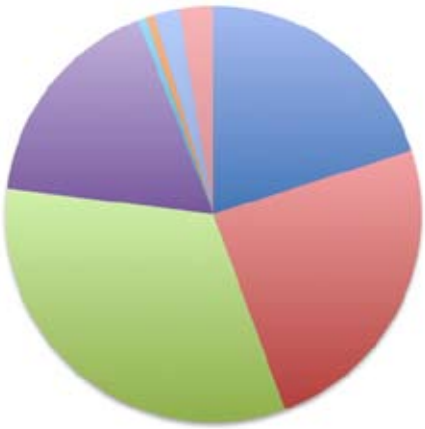
Moon-Mars Forum

The Moon-Mars Forum, part of the Distinguished Lecture Series started in 2006 and is supported by NASA Langley's Systems Analysis and Concepts Directorate (SACD) and features presentations by experts from academia, industry, and government on the conception, design, engineering, analysis, and operation of vehicles and systems to continue mankind's exploration of the solar system. The forum was held on March 17, 2009 at the Virginia Air and Space Center with over 300 attendees. The entire event has been video archived and is available on the NIA website.
www.nianet.org

Financials



2009 Revenue Uses



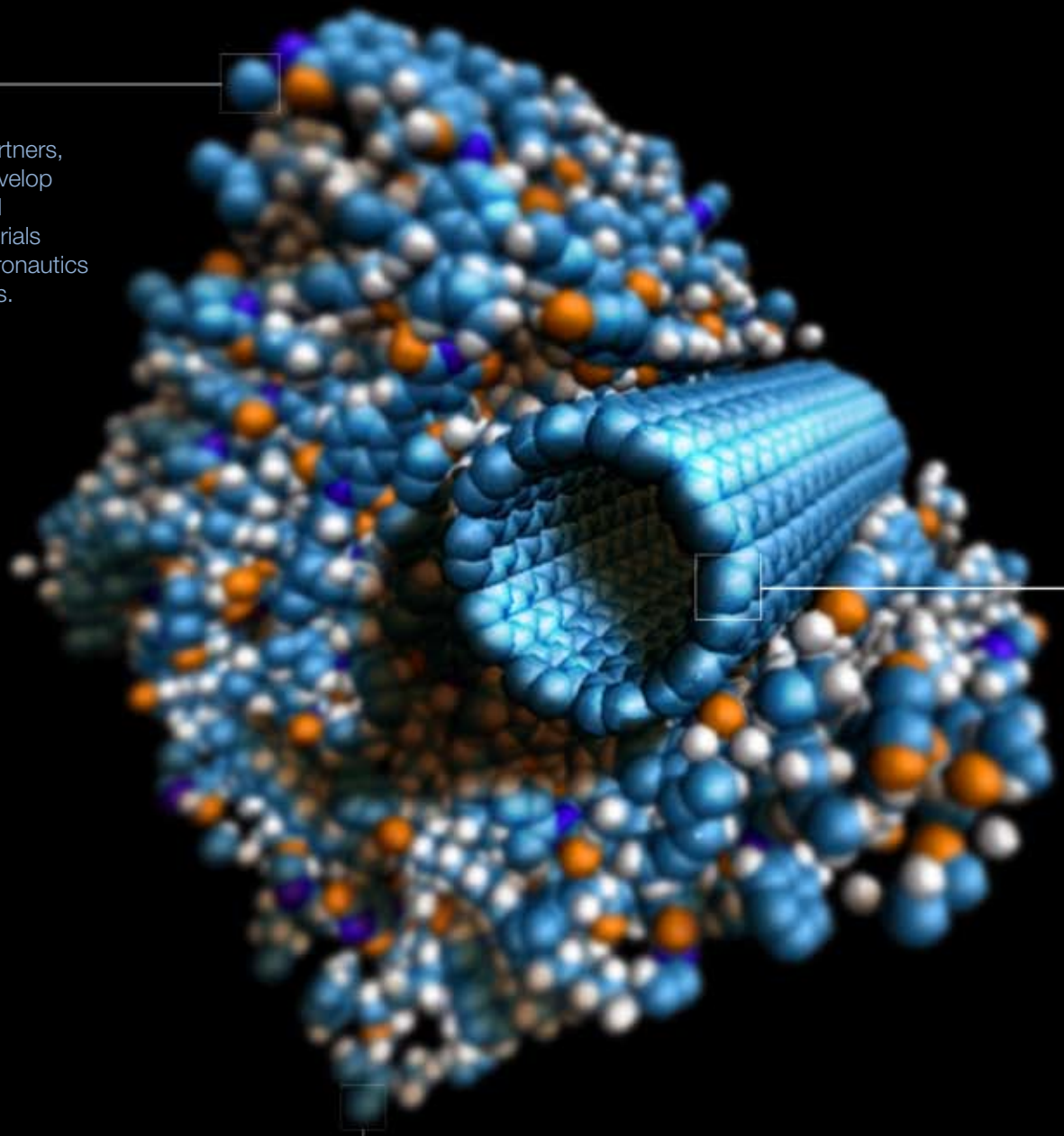
- $6.1 - Direct Salaries
- $7.4 - Member University Contracts
- $9.9 - Non-Member Contracts
- $5.2 - Indirect Expenses
- $0.2 - Materials and Equipment
- $0.2 - Travel
- $0.6 - Other Expenses
- $0.8 - Donated Services

2009 Revenue Resources

- $13.3 - Coop
- $1.8 - IDIQ 1
- $9.1 - IDIQ 2
- $1.6 - NASA Non-Langley
- $1.3 - Government Non-NASA
- $2.8 - Commercial
- $1.2 - Univ. Cost Share
- $0.2 - Foundation

COOP: NASA Cooperative Agreement
IDIQ: NASA Task Order Contract

Image: With our partners, NIA continues to develop novel multifuncitonal structures and materials for application in aeronautics and space industries.



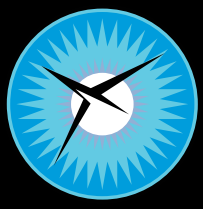
MISSION

...Foster *research collaboration among national laboratories, academia and industrial partners to stimulate 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 nation.*



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