ASTRONAUT SCHOLARSHIP FOUNDATION

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2008 Astronaut Scholar Meeting

2009 Astronaut Scholar Technical Conference Abstracts

May 2, 2009

Cocoa Beach, FL

Keynote Speaker

Charlie Duke

Apollo 16 Lunar Module Pilot

Charlie Duke was the Lunar Module Pilot of the Apollo 16 mission and the tenth man to walk on the moon. Together with Apollo 16 Commander John Young, he conducted three lunar EVAs totalling 20 hours and 15 minutes during his 71 hour and 14 minute stay on the moon.

Duke was born in Charlotte, North Carolina in 1935. He received a Bachelor of Science degree in naval sciences from the U.S. Naval Academy in 1957 and a Master of Science in aeronautics from the Massachusetts Institute of Technology in 1964. Following his graduation and commission from the Naval Academy, Duke entered the U.S. Air Force (USAF) and received flying training at Spence Air Base, Georgia and Webb Air Force Base, Texas. He completed advanced training in F-86L aircraft at Moody Air Force Base, Georgia. He served three years with the 526th Fighter Interceptor Squadron at Ramstein Air Base, Germany before transferring to the Aerospace Research Pilot School. Upon graduation from the school he remained on as an instructor, teaching control systems and flying F-101, F-104, and T-33 aircraft.

Duke was among 19 new astronauts selected by NASA in April 1966. After serving as a member of the astronaut support crew for the Apollo 10 flight, CAPCOM for Apollo 11, and backup lunar module pilot on Apollo 13, Duke was named Lunar Module Pilot for the Apollo 16 mission. Apollo 16 launched on April 16, 1972 and reached the moon three days later. While Command Module Pilot T. K. Mattingly orbited the moon in the command module *Casper,* Young and Duke landed their lunar ship *Orion* on the rugged Cayley Plain in the Descartes Highlands. During three outside excursions totalling 20 hours and 15 minutes over three days, they drove a lunar rover 16 miles and collected 213 pounds of lunar rock and soil. Duke later served as the backup Lunar Module Pilot for Apollo 17.

Duke is a retired U.S. Air Force Reserve Brigadier General. In 1975, he retired from NASA to enter private business. He is currently owner of Charlie Duke Enterprises and president of Duke Investments. He is an active speaker. Duke serves on the Board of Directors of the Astronaut Scholarship Foundation and was inducted into the U.S. Astronaut Hall of Fame on October 4, 1997.

Astronaut Scholar Presentations

Nadia Abuelezam

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2008–2009 Astronaut Scholar, Harvey Mudd College

Modeling HIV/AIDS: Preferential ART Treatment in Rural and Urban Uganda

HIV/AIDS is one of the largest health problems the world is currently facing. Even with anti-retroviral therapies (ART), many resource-constrained countries are unable to meet the treatment needs of their infected populations. ART-distribution methods need to be created that prevent the largest number of future HIV infections. We have developed a compartment model that tracks the spread of HIV in multiple two-sex populations over time in the presence of limited treatment. The model has been fit to represent the HIV epidemic in rural and urban areas in Uganda. With the model, we examine the spread of HIV among urban and rural regions and observe the effects of preferential treatment to rural areas on the spread of HIV in the country as a whole. We also investigate the effects of preferentially treating women on the spread of HIV. We find that preferentially treating urban women produces the most dramatic effect in reducing the number of infected male and females in rural and urban areas.

Nadia Abuelezam is currently a senior at Harvey Mudd College in Claremont CA earning her BS in mathematical biology. After graduating in May, she will be pursuing a Doctor of Science in Infectious Disease Epidemiology at Harvard University in the fall. Nadia spent six weeks in Uganda this past summer working with The AIDS Support Organization (TASO). She also traveled to Italy this past December to present her research at the first annual Workshop on the Analysis and Numerics of Population and Epidemic Models (WaNPE). She looks forward to working with an international health organization after attaining her degree from Harvard.

Larry Bradley, Ph.D.

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1993–1994 Astronaut Scholar, University of Central Florida
Assoc. Research Scientist, The Johns Hopkins University

The *Hubble Space Telescope* Ultra Deep Field '09: The Search for the First Generations of Galaxies in the Early Universe

The Hubble Ultra Deep Field (HUDF) is the deepest image of the universe ever taken at optical wavelengths. The HUDF contains approximately 10,000 galaxies, some observed just 750 million years after the Big Bang. So far, only about 12 galaxies have been reliably detected in the early universe (500-800 Myr after recombination). The Wide Field Camera 3 (WFC3), to be installed during the upcoming Hubble Servicing Mission 4 (STS-125), will allow a quantitative leap in the discovery of distant galaxies and our understanding of the early universe. I am part of a project (HUDF09) that will use WFC3 to obtain three of the deepest near-infrared fields, all of which leverage existing deep optical data including the HUDF and shallower HUDF05-01 and -02 fields. I will describe how we will use the combination of the ultra deep optical and near-infrared data to find young galaxies in the early universe.

Dr. Larry Bradley received the Astronaut Scholarship in 1993-1994 while completing Bachelors degrees in physics and mathematics at the University of Central Florida. He obtained a Ph.D. in astrophysics from The Johns Hopkins University, where he is currently an Assoc. Research Scientist with the *Hubble Space Telescope* Advanced Camera for Surveys Science Team. Larry serves on the Astronaut Scholarship Foundation Board of Directors and its Scholarship Committee and is Chair of the Scholar Alumni Committee.

Ben Corbin

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2007–2008 Astronaut Scholar, University of Central Florida
Massachusetts Institute of Technology

VeSpR – The Venus Spectral Rocket Project

The Venus Spectral Rocket Project is a joint mission between Boston University and the Massachusetts Institute of Technology. Project VeSpR will launch an ultraviolet telescope on a Terrier-Black Brant IX sounding rocket. The science objective is to use both a spectrograph and an imager to obtain a profile of Venus' deuterium/hydrogen ratio as a function of altitude along the limb, the first measurement of this kind that has ever been done on Venus. This information will help determine what happened to the water content on Venus over geologic time. This will also be the first image of Venus' corona in Lyman-alpha ever taken. This science will have applications for other studies of Venus, Earth and Mars as well. VeSpR is scheduled to launch in July 2010. The payload will be extensively upgraded from a previous flight in 1996. Payload testing is currently underway at Boston University, where two large vacuum chambers are being used to calibrate the detectors and optical surfaces. Integration testing will take place at Wallops AFB in Virginia, and the launch will take place at White Sands AFB.

Ben Corbin is a graduate student at MIT pursuing a double-master in Aerospace Engineering and Planetary Science. He graduated from the University of Central Florida in 2008 and earned the Astronaut Scholarship from his work in gas dynamics research. He is an active member of Students for the Exploration and Development of Space and is also working with the MIT/Georgia Tech Mars Gravity Biosatellite team.

Tim Duquette

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2008–2009 Astronaut Scholar, Purdue University
NASA Marshall Space Flight Center

STS-124 SSME Gimbal Position Visualization Tool

STS-124 saw an imbalance in thrust between its Solid Rocket Boosters shortly before separation. To compensate, the Space Shuttle Main Engines (SSME) gimbaled to an acceptable, but unusual orientation. The Marshall Space Flight Center (MSFC) SSME Systems Team could see the movement in flight data, but visualization of the relative engine positions was difficult. An Excel/VBA tool was developed to interface with MSFC's data analysis software and provide a near real-time visualization of the SSME positions at desired times in flight. The tool will be used to demonstrate the basics of SSME gimbal operations and the STS-124 response.

Tim Duquette is an undergraduate senior in Aeronautical & Astronautical Engineering at Purdue University and will graduate in December of this year. Tim has worked as an intern or co-operative education student with NASA Marshall Space Flight Center since the summer of 2006. Tim will pursue at least a graduate degree in engineering, but may work in industry for several years before returning to school. Tim is involved in a variety of intramural sports and student organizations. He also enjoys waterskiing, flying, and playing music.

Ryan East

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2006–2008 Astronaut Scholar, University of Oklahoma
The University of Texas at Austin

Ryan East has dreamed of becoming a flight controller in NASA's Mission Control Center (MCC) since he was ten years old. He received an internship to the Johnson Space Center (JSC) while a sophomore at the University of Oklahoma. He was accepted into JSC's Cooperative Education Program, allowing him to return for four additional tours. During his tours in both the Mission Operations and Engineering Directorates, he has worked on various projects including stowage safety constraints aboard the International Space Station (ISS), a database of optimal lunar descent trajectories, and determining contributions to a bias seen in past ISS drag predictions. Additionally, he has spent numerous hours in the MCC as an on-the-job trainee during various ISS and Shuttle missions.

Ryan considers Greenwood, Arkansas, to be his hometown and graduated from the University of Oklahoma with a B.S. in Aerospace Engineering in May 2008. He is currently pursuing a Master's degree at the University of Texas at Austin with plans to graduate in December.

Ashley Ewh

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2008–2009 Astronaut Scholar, University of Central Florida

Development of Low Enriched Uranium Based Metallic Nuclear Fuels for Research and Test Reactors

The Reduced Enrichment for Research and Test Reactors (RERTR) program was founded to convert test reactors to the use of low enriched uranium nuclear fuel alloys. U-Mo alloys were determined to be excellent due to their low enrichment and stability during irradiation. However, performance and service life of fuels can be drastically reduced due to volume expansion caused by a solid-state diffusional interaction between the U-Mo fuel alloy and the Al cladding material. In addition to reducing uranium enrichment, enhanced fuel alloys should maintain high density, mitigate the interaction, and remain stable under irradiation. It is suspected that ternary uranium fuel alloys may meet these requirements. Potential candidates for the alloying additions are Mo, Nb, Ti, and Zr. Some potential advantages of these additions are their low neutron absorption and high solubility. This study presents preliminary results of diffusion experiments using three such alloys. These observations will finally be used to assess the suitability of ternary uranium alloys as enhanced metallic nuclear fuels.

Ashley Ewh is a junior Mechanical Engineering major at the University of Central Florida. For the past three years, she has been and undergraduate research assistant in the Advanced Materials Processing and Analysis Center under Dr. Yongho Sohn. She will be doing an internship with the Nuclear Fuels and Materials Development Department at Idaho National Laboratory during the summer of 2009. She plans to attend graduate school to pursue a Ph.D. in Materials Science and Engineering.

Ryan Going

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2007–2009 Astronaut Scholar, North Carolina State University

Studies on Non-spherical Particles in an Optical Field

Optical trapping, mixing, and sorting of micro- and nano-scale particles of arbitrary shape (e.g., blood cells and nanorods) are but a few of the burgeoning applications of optical interference landscapes. Due to their non-invasive, non-contact manipulation potential, biologists and nanotechnologists alike are showing increased interest in this area and experimental results continue to be promising. A complete and reliable theoretical description of the particles' response within these fields will allow us to accurately predict their behavior and motion. This talk will convey my work to construct a simplified electrostatic model, which in many cases provides a good analytic approximation of this phenomenon.

Ryan is currently at North Carolina State University and will graduate in May with B.S. degrees in Electrical Engineering and Applied Math. He has spent three years doing an independent research project studying optical forces on non-spherical particles. This past summer he interned at the National Institute of Standards and Technology (NIST) studying GaN nanowires. He will attend Cambridge University in the fall with a Gates-Cambridge scholarship to study for an MPhil in Micro- and Nanotechnology. Upon returning to the US he will pursue a PhD in Electrical Engineering at UC Berkeley with an NSF Fellowship.

Avi Hameroff

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2008–2009 Astronaut Scholar, Syracuse University

Measuring Dose to Small Animals in Micro-CT

When the Syracuse Medical Imaging Research Group (SMIRG) acquired a Siemens Micro CAT II scanner, only theoretical predictions of dose existed which were based on computer models. Also included with the software of the scanner was a "dose calculator" provided by Siemens, but it was unclear what its dose predictions were based on.

It became necessary to perform a dosimetry study in order to empirically determine the dose to small animals during a scan. Utilizing materials and the method outlined by the SUNY Upstate Medical University, the study was successfully completed in May 2008. In order to measure exposure, thermoluminescent dosimeters were calibrated using an ionization chamber and then exposed in-air to obtain conversion factors. They were then exposed inside of a phantom. Post phantom exposure measurements were then converted into exposure measurements that were finally converted into dose.

The results of this study were mathematical equations that can predict dose to small animals during scanning. The equations, one for each of three filter thicknesses, allow the researcher to input their scan's technique (peak voltage and current applied to the tube, and exposure time) and obtain an empirically-derived prediction of dose to the subject. This project provided a powerful tool to researchers and also proved that dose to animals during micro-CT scanning, while small, is not insignificant.

A physics major in SU's College of Arts and Sciences, Hameroff's undergraduate research has focused on the area of biophysics. One of his research projects involved testing a micro-CT scanner under the direction of SU physics Professor Edward Lipson and Andrzej Krol, associate professor of radiology at SUNY

Upstate Medical University. This past summer Hameroff worked in the research laboratory of Brian Litt, assistant professor of neurology and bioengineering at the Mahoney Institute of Neurological Sciences, University of Pennsylvania, on a project to develop an implantable device that could be used to detect and prevent epileptic seizures. Hameroff's career goal is to become a physician and clinical researcher. In his spare time, he is a physics tutor at SU and provides supplemental science enrichment programs for a local elementary school. He also enjoys running, reading, and playing the piano and tuba.

Joseph Han, Ph.D.

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1999–2000 Astronaut Scholar, Texas A&M University
Director of Systems Engineering and Services, Penguin Computing

Recent Trends in Supercomputing

This presentation will provide a short history of the modern age of supercomputing from the largest systems in the world today to the workhorse systems which provide the computing platform for thousands of researchers and engineers around the world. Incorporating continuing advances in compute price/performance, density, power consumption, network bandwidth, and storage and memory architectures, we will also discuss modern design criteria and considerations for optimizing today's high performance Linux clusters as well as the challenges of management, administration, and workload scheduling and usage.

Joseph Han received the Astronaut Scholarship at Texas A&M in 1999-2000 while studying Chemical Engineering. Afterwards, he continued at Stanford University receiving a Ph.D. in Chemical Engineering in 2004. Joseph spent several years at Intel Corporation researching future generation chip manufacturing techniques prior to a move to Penguin Computing in 2006. Currently, he is the Director of Systems Engineering and Services and manages a team that architects solutions based on customer needs and implements the solutions based on the design.

Andrew Jones

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2008–2009 Astronaut Scholar, University of Minnesota

Processing of Renewable Fuels: A comparative study of various fuel options from renewable resources

The processing of renewable resources is critical to the future of transportation fuels and synthetic materials. A comparative study of the technology and economics behind the processing of renewable feedstocks to usable fuels has been completed. Aspen HYSYS modeling has been used to model the conversion of synthesis gases to DME, Methanol and gasoline from direct and indirect routes. An economic analysis has been completed to compare the methods. Typical synthesis gas compositions from NREL biomass gasification have been used, although the methods could be applied to MSW and other renewable feedstocks. The work has been supported by the University of Minnesota in collaboration with Professor Lanny D. Schmidt, Dr. Lloyd White and Rational Energies.

Donnie Keathley

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2008–2009 Astronaut Scholar, University of Kentucky

Enhanced Surface Plasmon Resonance Sensor Using Semi-Infinite Periodic Nano-Gaps

Surface Plasmon Resonance (SPR) sensors allow for a highly quantitative and label free detection of molecular binding and refractive index change. These sensors have many current and potential applications, including, but not limited to, drug discovery, basic chemistry research, and water quality testing. This project aims to enhance the performance of existing SPR sensors by creating enhanced electric fields within nano-sized gaps (on the order of 10 nm) along a thin gold film (on the order of 50 nm). It is proposed that this electric field enhancement will cause any binding occurrences or refractive index changes around the metal film to more greatly perturb a propagating plasmon, which will increase sensitivity and potentially improve the sensor's limit of detection (smallest amount of change detectable by the sensor).

Donnie Keathley is currently an electrical engineering senior at the University of Kentucky. He has been working in the area of surface plasmon resonance sensing as a research assistant in the lab of Dr. Todd Hastings since the summer of 2006. During this time he has studied the optical properties of materials, varying deposition and fabrication techniques, and the theoretical modeling and design of SPR sensors in order to improve upon current designs. He will be graduating with a Bachelor's degree in May and a Master's degree in August. He was recently awarded the National Defense Science and Engineering Graduate Fellowship, and plans to pursue research in the area of optics and photonics at the Massachusetts Institute of Technology in the fall.

Ryan Kennedy

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2008–2009 Astronaut Scholar, University of Colorado

Exploring Compositional Biases of RNA Sequences

Many functional RNA molecules are known to have distinct biases in their composition. Interestingly, we have found that artificially-selected RNAs share these same biases and that this does not depend on the RNA's function. Here, we explore the implication of these findings to our understanding of evolution and to the design of SELEX experiments.

Ryan Kennedy will be graduating with a degree in computer science and applied mathematics from the University of Colorado in May, 2009. As an undergraduate, Ryan has been performing research in bioinformatics and has developed a novel method for computing the probability of the occurrence of RNA motifs. He has also been involved in several machine learning research projects, including researching neural networks and applying machine learning concepts to both biology and finance. Ryan will continue his study of machine learning while pursuing a PhD at the University of Pennsylvania in the fall.

Capt. Trent Kingery

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1998–1999 Astronaut Scholar, North Carolina State University
Captain USMC, V-22 Interoperability Lead
PMA-275, NAVAIR

Past: FA-18 Pilot

Current: V-22 Osprey Interoperability and KPP Sustainment Lead

Future: UC-35 & C-12 (Cessna Citation Encore & Kingair 350) pilot at Andrew's AFB

Susan Koons

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2008–2009 Astronaut Scholar, Texas A&M University

Language Lateralization in Monolingual Children

Recent research with adults indicates that monolingual English speakers show significantly stronger left-hemisphere dominance than bilinguals who simultaneously learned English and another language very early in life, suggesting that neural pathways for language are modifiable during early development. However, there is very little direct evidence from young children because traditional brain imaging methods, such as functional Magnetic Resonance Imaging (fMRI), are not approved for use in child research. The present research used a newer brain imaging technique — Near Infrared Spectroscopy (NIRS), which has been approved for use in children — to investigate the development of neural pathways for language in the monolingual brain. Specifically, we compared neural activity in the temporal lobes of 3-year old and 6-year old monolingual English speakers during a language production task. The outcomes lend credence to the idea that left-hemisphere dominance for language in monolingual English speakers emerges gradually, perhaps as a result of increased experience with the language.

Joseph Kummer, Ph.D.

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2000–2004 Astronaut Scholar, Syracuse University
Propulsive Wing, LLC

Dr. Joseph Kummer is currently the president of Propulsive Wing, LLC, a Syracuse area engineering company. As a PhD candidate at Syracuse University, Dr. Kummer's research, under funding from NASA Glenn Research Center, focused on the application of computational fluid dynamics to the simulation of the cross-flow fan and integration of this unique propulsion device into an ultra high-lift, high payload wing configuration. Propulsive Wing was formed to commercialize this technology as a new unmanned airplane for the military and wildfire suppression. Recently, Propulsive Wing also developed a personal air purifier device called the Personal Breeze, a project that was funded by the Syracuse Center of Excellence and U.S. Environmental Protection Agency.

In addition to Propulsive Wing, Dr. Kummer is a partner with J3 Wind Power, LLC, a company that is focusing on the development and manufacturing of wind turbine technologies. He is also Principal Scientist at Allred & Associates, Inc., a company partnering closely on the Propulsive Wing, where he focuses on the design of advanced carbon-fiber structures for the military and industry clients.

Jarret Lafleur

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2005–2007 Astronaut Scholar, Georgia Institute of Technology

Trading Robustness Requirements in Mars Entry Trajectory Design

The design of complex engineering systems frequently calls for attention to the property of robustness, or the ability of a system to perform well under unexpected or off-nominal conditions. This concept of robustness frequently lies at odds with the desire for an optimized design that has the best possible nominal performance but may perform poorly under off-nominal conditions. In aerospace engineering, one example of this can be seen in Mars entry trajectory design.

One of the most important metrics characterizing an atmospheric entry trajectory is the size of its predicted landing ellipse. Often, requirements for this ellipse are set early in design and significantly influence the expected scientific return from a mission and the cost of development. Requirements typically specify a certain probability level (σ-level) for the ellipse, and frequently this is taken at 3σ. However, searches for the justification of 3σ as a robustness requirement suggest it is an empirical rule of thumb. An analysis framework and example application are presented involving the manipulation of design variables to effect trades between performance and robustness, providing decision-makers valuable information to consider in the process of selecting system performance and robustness requirements.

Jarret Lafleur is a Ph.D. Candidate in the Space Systems Design Laboratory at Georgia Tech. He is a National Defense Science and Engineering Graduate (NDSEG) Fellow, and his research considers how to design flexibility into future space systems. Currently he is supporting work on the Defense Advanced Research Projects Agency (DARPA) F6 fractionated spacecraft program, and during summers he works at NASA Johnson Space Center. Jarret received his B.S. in Aerospace Engineering from Georgia Tech in 2007 and has worked at the Naval Undersea Warfare Center and NASA White Sands Test Facility in addition to NASA Johnson Space Center. Jarret received the Astronaut Scholarship during 2005-2007.

Heather Muñoz

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2008–2009 Astronaut Scholar, University of Michigan

Combining Green Engineering with the Concrete Canoe Team

Every year schools across the country participate in the Concrete Canoe student team competition, competing to create the most innovative concrete canoe. While the concept of concrete floating may be foreign to some, these university students make it happen every year. The University of Michigan Concrete Canoe Team (MCCT) stepped up the design this year with the intent of exceeding the "green" initiatives outlined within the regulations. In addition to the traditional tasks of structural analysis, canoe construction, and product research, the team considered the environmental impact of all aspects of creation of this year's canoe. The MCCT succeeded by using over 75% recycled aggregates, glass shard by-products from the glass industry, along with other by-products of coal-fired powered plants. Even with a density less than water, the lightweight concrete must have sufficient strength to resist the fatigues of competition, including four-person canoe races. The concrete canoe team is an excellent hands-on resource for learning more about civil engineering outside of the classroom.

Heather has been a member of the University of Michigan's Concrete Canoe Team for the past three years and was captain of the team for the past two years. Heather just received her Masters' in Civil and Environmental Engineering from the University of Michigan, concentrating in structural design. Throughout the school year, she also worked with HDR|Cummins and Barnard as a structural engineer in training. She will be relocating to the Atlanta, Georgia area upon graduation, pursuing a career in structural design.

Robert Panish

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2005–2006 Astronaut Scholar, Harvey Mudd College
Bluefin Robotics

Autonomous Underwater Vehicles

Autonomous Underwater Vehicles (AUVs) are currently used worldwide to accomplish underwater tasks in an economical and safe way. Applications range from academic research to commercial survey work to military surveillance and reconnaissance. Bluefin Robotics is a ~70 person company that provides an extensively adaptable suite of AUVs to meet a wide range of customer applications.

Robert Panish is a 2005-2006 Astronaut Scholar who attended Harvey Mudd College in Claremont, CA. After graduating with a B.S. in Engineering in 2006, Robert received a Master's degree from the Department of Aeronautics and Astronautics at MIT in 2008. Currently with Bluefin Robotics in Cambridge, MA, Robert serves as the Control Systems Engineer and works with Autonomous Underwater Vehicles. He has had experience working with the vehicles all the way from concept design to sea testing.

Matthew Pittman

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2007–2009 Astronaut Scholar, North Carolina A&T State University

Developing Health Oriented Workshops in Faith-Based Organizations to Reduce Health Disparities and the Incidence of Type-2 Diabetes

Type 2 Diabetes is a major public health threat. This ailment stems from problems in the pancreatic secretions of insulin into the bloodstream. It can also be linked to cells' inability to identify surface receptors coding for insulin. The incidence of this condition is most common in African-American communities throughout the US. Faith-based organizations play a pivotal role in administering health information to medically underserved communities. In order to learn more about faith-based organizations a telephone survey was conducted. The contacts for the telephone interviews were collected from networking with New York Presbyterian Hospital employees and members of FBOs throughout New York City. The specific focus was to look at churches and other places of worship that were located in medically underserved areas. We found that most faith organizations made some attempt to promote health awareness. This suggests that these congregations are more educated on issues concerning their community. The churches fell into various categories within the Stages of Change model. The next step in this research is to develop health workshops in faith-based organizations. These workshops will help organizations to gain access to governmental funding and services that are beneficial to starting and continuing faith-based efforts. These gatherings will also serve as a means to create and expand new ways to disseminate health information into medically underserved communities.

Matthew Pittman is from Greensboro, NC. Matthew is a senior biology major at North Carolina A&T State University. He plans to attend medical school and eventually become a cardiologist. This June he conducted research at Cornell Medical College in New York City.

Lisa A. Schott

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1987–1990 Astronaut Scholar, Georgia Institute of Technology
President and Principal Acoustical Consultant, Quietly Making Noise, LLC

Recent Advances in Reducing Floor-to-Floor Sound Transmission

At last year's Astronaut Scholar Technical Conference, Lisa discussed the number one emerging issue in acoustics and noise control within multi-family and mixed use residential buildings: floor-to-floor sound transmission. Noise complaints are an ever-increasing pollution issue in cities and suburban areas, worldwide, due to increasing population density. More people are living in multi-family residential buildings than ever before, and complaints have increased over the past several years in spite of recently enacted building code requirements.

Through extensive laboratory and field testing, Lisa has uncovered the root causes of this sound transmission problem. Her presentation will review selected test data and discuss the fundamental issues. She will present the traditional technology solutions that have been used to date and provide the reasons that they have had limited success. Finally, she will discuss her proposed design changes and next steps that will have a major impact on the industry.

Lisa Schott is President and Principal Acoustical Consultant of Quietly Making Noise, LLC, a company that she founded in 2002. She graduated with highest honors from Georgia Tech with a bachelor's degree in Mechanical Engineering. She was an Astronaut Scholar from 1987 to 1990, serves on the Board of Directors of the Astronaut Scholarship Foundation, and served on the Scholarship Committee from 1991 to 2007. During the past year, she was named the Engineer of the Year for Technical Excellence by the Florida Section of the American Society of Mechanical Engineers. She also was notified by the U. S. Patent Office that her patent application for an Acoustical Window and Door Covering has finally been approved, 4.5 years after the initial application!

Fiona Turett

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2008–2009 Astronaut Scholar, Washington University in St. Louis

The Effect of Lunar Simulant on Solar Panels

The adverse effects of lunar dust on solar panels could potentially be very detrimental for extended-stay missions on the Moon. Lunar dust blocks light to the solar panels, thereby decreasing the power output of the solar cells. Decreased power could result in reduced mission objectives and it could adversely affect the safety of the crew. A Washington University undergraduate team designed and flew an experiment to test the effects of tilting and vibration on the removal of lunar regolith from solar panels in a lunar gravity environment. The experiment was extremely successful, and initial data analysis shows that tilting can restore a solar panel to above 90% of its optimal current output. When vibration is used in conjunction with tilting, the power output increases even more significantly.

Fiona Turett is a senior studying Mechanical Engineering at Washington University in St. Louis. She is the current project manager of the Akoya/Bandit nanosatellite program, which was awarded 2nd place in the Air Force Research Laboratory's University Nanosatellite Program 5. Fiona has interned at both Goddard Space Flight Center and Johnson Space Center, as well as participating in NASA's Reduced Gravity Student Opportunities Program three times. She will begin her full-time career at Johnson Space Center in July.

Pavan Vaswani

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2008–2009 Astronaut Scholar, University of Washington

Using Focused Ultrasound to Measure Intracranial Pressure Non-Invasively

Intracranial pressure (ICP) is a critical parameter of brain function and, when elevated, is associated with a number of serious neurological conditions, including intracranial masses, hydrocephalus, stroke, high altitude sickness, and brain edema from traumatic head injury. Monitoring ICP in these traumatic situations has been shown to improve clinical outcome. Currently, ICP is measured invasively by drilling a hole through the skull to place a transducer near the brain, a procedure requiring surgery and the skills of a neurosurgeon. My work proposes a simple, non-invasive method of monitoring ICP using vibroacoustography, which would allow for faster, easier, and safer measurement of this critical parameter. Two beams of confocal high intensity ultrasound are used to remotely and non-invasively palpate and vibrate tissue while its acoustic response is analyzed to determine frequency content, tissue stiffness, and, hence, pressure. Current experiments focus on proof of concept using ex vivo and in vivo models of ICP.

Pavan Vaswani is graduating with degrees in Computer Science, Biochemistry and Neurobiology, summa cum laude. He worked with Dr. Pierre Mourad in the Department of Neurosurgery and the Applied Physics Lab at the University of Washington on this work. He is a Washington NASA Space Grant Scholar and Goldwater Scholar as well as an Astronaut Scholar. After graduating, Pavan intends to pursue an MD PhD in neuroscience at Johns Hopkins University.

Vincent Viscomi

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2007–2008 Astronaut Scholar, Pennsylvania State University
University of California, Berkeley

The Radio Interferometric Planet Search

As of April 2009, astronomers have found 346 extra solar planets, including 27 planetary systems. Most of these planets are massive, about the size of Jupiter, and orbit very close to their host star. Several current and future research projects seek to find earth-like planets, including the Radio Interferometric Planet Search (RIPI). Over the course of three years, RIPI will use high precision astrometry to detect the motion induced in stars by a planet as both objects orbit their common center of mass. The study will focus on low mass stars, as they are difficult to research via other methods, the most abundant type of star and possibly the most likely to host low mass planets. Furthermore, RIPI will observe stars which are within 10 parsecs of Earth in the hopes of identifying direct imaging candidates. As this technique develops, radio interferometry as the potential to become one of the most powerful planet finding tools.

Vincent graduated from the Pennsylvania State University in 2008 with degrees in astronomy, physics and mathematics. As a research assistant for the IceCube Neutrino Observatory, he developed techniques for the indirect detection of dark matter. He is currently attending graduate school at the University of California, Berkeley, pursuing a Ph.D. in astronomy. His research focuses on the detection of planets around low mass stars using precision radio astrometry.

Richard Wagner

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2008-2009 Astronaut Scholar, Miami University (Ohio)

Performance of a Quantum Teleportation Protocol Based on Collective Spontaneous Emission

Recently a conditional quantum teleportation protocol has been proposed by Chen et al. [New J. Phys. 7, 172 (2005)] which is based on the collective spontaneous emission of a photon from a pair of quantum dots. We formulate a similar protocol for collective emission from a pair of atoms, one of which is entangled with a single mode of an optical cavity. We focus on the performance of the protocol as characterized by the fidelity of the teleported state and the overall success probability. We consider two strategies to distinguish super-radiant from subradiant emission on the basis of a single detected photon: a temporally resolved photodetection scheme and a spacially resolved scheme. We find the fidelity approaches unity as the spacing of the atoms becomes much smaller than the emission wavelength with a success probability of 0.25 assuming perfect collection and detection of the emitted light. Incorporating finite collection and detection efficiency into the temportally resolved scheme we find the protocol will still exceed a fidelity of 2/3 provided that the combined collection and detection efficiency is at least 3/4.

Richard will graduate with a degree in physics in May 2009 and begin graduate studies in the Department of Physics at the University of Oregon in September 2009.

Matthew Wold

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2008–2009 Astronaut Scholar, North Dakota State University

Forced Continuously Variable Transmission

Continuously Variable Transmissions (CVTs) using variable diameter pulleys are commonly used in recreational vehicles. CVTs use a system of weights and pulleys to vary the gear ratio based on engine speed. This capstone design project developed an electronic control system for the CVT that allows its gear ratio to be varied by the operator independent of engine speed. The project was done for the 2009 Bison Pullers tractor, which is built for an annual student design competition sponsored by the American Society of Agricultural and Biological Engineers.

Matt Wold is a senior in Agricultural and Biosystems Engineering at North Dakota State University scheduled to graduate in December of this year. Last school year, Matt worked with faculty at the University to develop an experimental biomass reactor to complete pretreatment of biomass for cellulosic ethanol. This past summer, he completed an internship with Caterpillar in their Global Engine Development division.

Matt Young

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1986–1989 Astronaut Scholar, North Carolina State University
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AC-130U Gunship Infrared Suppressor System

Today, the US Air Force AC-130U "Spooky" gunship is the most requested asset by operational commanders in the war on terror. This is particularly surprising when one remembers that such gunships entered service nearly 40 years ago during Vietnam. Emerging from that same conflict were the world's first surface-to-air missiles, or SAM's. To counter those new weapons, America's gunships were hastily outfitted with primitive shields to mask the heat signature created by their four propeller-driven engines. Since then, SAM's have evolved into the most significant threat faced by our aircrews and the technologies we employ to defeat those missiles have been forced to keep pace. The maintenance depot for the gunships is located at Robins Air Force Base in Warner Robins, Georgia. My job there is to redesign and construct a new line of mechanical systems to replace the existing AC-130U Infrared Suppressor System, or IRSS.