Astronaut Scholars Honor Society

Technical Conference Abstracts and Scholar Biographies

May 2008

Keynote Speaker:
Edgar Mitchell
Apollo 14 Lunar Module Pilot

Edgar Mitchell was the lunar module pilot of the Apollo 14 mission and the sixth man to walk on the moon. Together with Apollo 14 commander Alan Shepard, he holds the record for the longest ever moonwalk (9 hours and 17 minutes) and longest distance traversed on the lunar surface.

Mitchell was born in Hereford, Texas. He obtained a Bachelor of Science degree in industrial management from Carnegie Institute of Technology in 1952. The following year, he joined the US Navy where he trained as a pilot and flew off the aircraft carriers USS Bon Homme Richard and USS Ticonderoga. Later he qualified as a research pilot and taught at the navy's research pilot school. While in the Navy he obtained a Bachelor of Science degree in aeronautical engineering from the U.S. Naval Postgraduate School and a Doctor of Science degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology.

Mitchell was selected as a NASA astronaut in April 1966 after graduating first in his class from the Air Force Aerospace Research Pilot School, where he was both a student and an instructor. Mitchell's only space assignment was as Lunar Module Pilot for Apollo 14, a 10-day lunar exploration flight that lifted off January 31, 1971. During 33 hours on the lunar surface, Shepard and Mitchell made two excursions exploring the moon's hilly Fra Mauro region during which they set up a nuclear-powered science station, collected 92 pounds of moon rocks, and gathered deep-down soil samples by driving core tubes into the surface.

Following the Apollo program, Mitchell retired from NASA and the Navy and founded the Institute of Noetic Sciences in an effort to integrate various scientific disciplines into the study of human consciousness. He has written several books, including "The Way of the Explorers," which addresses the latest research in this field. Mitchell 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.

Scholar Presentations

Daniel Araya
Texas A&M
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Aggies Against Apophis

In 2029, the potentially hazardous near Earth asteroid Apophis (NEA: 99942) will pass within approximately 6 Earth radii of the center of the Earth. During this close approach in 2029, if Apophis passes through a region in space dubbed the "gravitational keyhole, it will strike the Earth on its resonant return in 2036. This talk presents the work of Texas A&M students to design a satellite to track Apophis well before its close approach in 2029. The background of Apophis is presented along with a discussion of the challenges for planning a mission to track Apophis and an overview of the conceptual design for this satellite mission.

Daniel Araya is currently a senior aerospace engineering major at Texas A&M University scheduled to graduate in December of this year. Daniel has worked as a co-operative education student with the NASA Johnson Space center since August of 2005 and plans to continue work with NASA throughout graduate school.

Larry Bradley, Ph.D.
The Johns Hopkins University
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Discovery of One of the Youngest and Brightest Galaxies in the Early Universe

Using NASA's Hubble and Spitzer Space Telescopes, with a boost from a natural "zoom lens," we have uncovered what may be one of the youngest and brightest galaxies ever observed. The infant galaxy, which we refer to as A1689-zD1, was found 13 billion years in the past, placing it in the middle of the cosmic "dark ages," just 700 million years after the beginning of our universe. The galaxy is undergoing a firestorm of star birth during the dark ages, a time shortly after the Big Bang but before the first stars reheated the cold, dark universe. The Hubble and Spitzer images provide the most detailed look to date at an object so far back in time and offer insights into the formative years of galaxy birth and evolution. I will give an introductory overview of this exciting discovery and describe how I am using Hubble Space Telescope observations of strong lensing galaxy clusters to search for the most distant galaxies in the universe.

Larry received the Astronaut Scholarship in 1993 while completing Bachelors degrees in physics and mathematics at the University of Central Florida. He holds a Masters and 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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Flame Speed Measurements in a Constant Volume Bomb

The Gas Dynamics Laboratory has developed a new flame speed measuring experiment capable of withstanding initial pressures up to 30 atmospheres. The cylindrical vessel supports two quartz windows that making optical flame measurements possible with the use of a Schlieren optics system and a high-speed camera. Systems in operation during a single experiment include a mixing tank, a gas plumbing system, an ignition system, a data acquisition system, a venting and vacuuming mechanism, and a blast wall capable of standing up to any system failures. The first studies performed have been fuel mixtures of methane and ethane at atmospheric and intermediate pressures (up to 5 atmospheres). These results are show flame speeds that are higher than computer models predict they should be, and thus show a lack of understanding of basic combustion science. Future data from this experiment will aide in the design of fuel-flexible gas turbine power generation systems.

Ben is passionate about space exploration. He is the former president of the Students for the Exploration and Development of Space at UCF and received the SEDS Todd B. Hawley National Leadership Award. He graduated from UCF in Spring 2008 and will be attending MIT to start his Master's degree in Aerospace Engineering. Ben loves exploring the outdoors and hopes to be part of a manned Mars mission in the future.

Jayleen Guttromson
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Since graduation from Purdue University, Jayleen Guttromson continues to work at NASA Johnson Space Center in Houston, Texas, as a deputy subsystem manager with the Extravehicular Mobility Unit (EMU). She manages the technical aspects of the EMUs, leading a team of engineers and technicians who successfully maintain the United States spacewalking capability. During the past year, Jayleen and her team have supported 26 spacewalks totaling over 177 hours of EVA time. She coordinates day-to-day operations, interacting with all levels of management at the Center, and facilitates EMU failure investigations including the on-going investigation of damage to the EMU gloves outer layer. Jayleen is continuing her education after hours earning a Master of Aeronautical Science from Embry-Riddle Aeronautical University.

Joseph Han, Ph.D.
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ASF Scholar: Texas A & M, 1999-2000
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The Proliferation of Linux Clusters in High-Performance Computing (HPC) Applications

The concept of a Beowulf cluster was formed in the early 1990's as a less expensive alternative to million dollar supercomputers by harnessing the power of a collective of commodity computers. Since then, the concept has grown such that Linux clusters now account for a large portion of the Top500 computer installations in the world. At Penguin Computing, we strive to help our customers deploy Linux clusters in a manner where they can shorten the time required to reach production status. This includes a custom software stack, factory integration, software installation and tuning, as well as training and long-term support. With these services, we are helping government organizations, academia, and commercial companies realize the cost savings and beneftis of doing work *in silico* prior to physical tests.

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.

Alex Kossett
ASF Scholar: University of Minnesota, 2006-2008
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The Xplorer Robot:
A Versatile and Inexpensive Platform for Distributed Robotics Research

In the field of distributed robotics, swarms of robots work together toward a common goal. The robots must thus be inexpensive and have varied capabilities. The design of a new robot, the Xplorer, will be discussed. In addition to being small, inexpensive, and versatile, the Xplorer is capable of being picked up and charged by larger robots equipped with a mobile robot docking station.

Alex Kossett is a senior in Mechanical Engineering at the University of Minnesota. Since starting college, he has volunteered in three University of Minnesota laboratories, and has served as a teaching assistant in a calculus class for talented high school students. For the past two years he has been an undergraduate research assistant at the Center for Distributed Robotics, where he designs and maintains robots for distributed robotics research. He has also had several internships in product development at Medtronic, where he has helped develop medical devices for the treatment of Atrial Fibrillation. Alex will continue his work in robotics as a graduate student at the University of Minnesota next fall.

Jarret Lafleur
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**The Design of *Pharos*:
A Mission to Shed Light on the Near-Earth Asteroid Apophis**

For a short time in December 2004, the world was the closest it has ever come to a real-life rendition of the film *Armageddon*. The 1/8-mile-wide asteroid Apophis was re-discovered, and in a matter of days its impact risk leapt to an unprecedented probability of 1 in 37 for a Friday, April 13, 2029 collision with Earth. Until then, no known Earth-crossing asteroid had become so threatening, and none has become so since. Luckily, observations and analysis have by now eliminated the possibility of a 2029 impact, although a small probability (2.2×10^{-5}) of a 2036 impact and the regional-scale destruction that it would incur still exists.

This presentation gives a glimpse of a design for a robotic exploration mission to Apophis envisioned to launch in 2013. Named for the ancient lighthouse at Alexandria, *Pharos* acts as a beacon shedding light not only on the orbital state of Apophis for tracking purposes, but also on physical properties which are important to science and any future asteroid deflection design efforts. *Pharos* consists of a single 720 kg spacecraft with four science instruments and four 7-kg low-velocity impactor probes which are used to assess asteroid compositional properties. The total cost of *Pharos* is estimated at about $430 million (FY07), on par with other robotic missions such as it Dawn in NASA's Discovery Program. Completed by a team of six students at Georgia Tech, *Pharos* has received recognition from The Planetary Society, NASA's Exploration Systems Mission Directorate, and several conferences and other organizations.

Jarret Lafleur is a graduate student working in the Space Systems Design Laboratory at the Georgia Institute of Technology. He is currently a National Defense Science and Engineering Graduate (NDSEG) Fellow, and his research considers the design of implementation of flexibility in space systems. Currently he is supporting work on DARPA's F6 fractionated spacecraft program. Jarret graduated from Georgia Tech with his bachelor's degree in Aerospace Engineering in 2007 and during his time as an undergraduate worked at the Naval Undersea Warfare Center, NASA Johnson Space Center, and NASA White Sands Test Facility. Jarret received the Astronaut Scholarship during 2005-2007.

Matthew McKeown
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Numerical Simulation and Experimental Testing of Rocket Engines

The common theme during my Masters Degree program has been rocket engines. Ive participated in two projects at very different ends of the engineering spectrum. The first is a numerical simulation of a small reaction control thruster, and the other involves the design and test of a re-startable hybrid rocket engine.

The goal of my Numerical Simulation project was to simulate the complex flow field of a reaction control thruster plume during re-entry into the atmosphere. Before the project began, the original code (LeMANS) had been only used for external hypersonic flows, such as flow over a re-entry capsule. My project was to modify and validate the code so that a rocket nozzle flow could also be simulated. Because LeMANS had only been used to simulate supersonic flows, it was unknown if the code could converge to a solution when the flow was initialized as subsonic inside the thruster body.

My systems engineering / design project involves the design, build and test of a hybrid rocket motor. Hybrid rockets utilize solid fuel and liquid oxidizer, giving the control of a liquid propellant system and the simplicity of a solid rocket motor. A key advantage to hybrid rockets is the ability to shut down and restart the motor during flight. The focus of this project is to prove the feasibility of restarting a hybrid rocket engine using no additional propellants other than the main fuel and oxidizer. The project was a continuation of previous research in hybrid rocket combustion; from concept to testing took less than 7 weeks. The project culminated in a test of a 300 pound-force combustion chamber, which was able to be shut down and restarted at the users command.

This past week, I finished my 5th year at the University of Michigan with a BSE and MSE in Aerospace Engineering. In June, I will begin work with Space Exploration Technologies (SpaceX) in Hawthorne, CA. At SpaceX I will work in the propulsion department, working on the development of the upper stage engine of the Falcon 9 Launch Vehicle. The Falcon 9 is SpaceXs entry in NASAs Commercial Orbital Transfer Services program, better known as COTS. The Falcon 9 is designed to deliver cargo, and someday a crew to the International Space Station and Beyond

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Vehicle Motion Estimation Using Computer Vision

GPS and Inertial Measurement Units (IMUs) are widely used to determine an aircraft's position. IMUs drift over time and are corrected by GPS. However, for a small aircraft flying indoors or beneath rooftop level, GPS may not always be available and another source of low-drift position estimation must be used. A set of cameras can be used to provide that information. By observing the motion of a few points in the camera view, the motion of the vehicle can be determined.

Robert Panish is a 2005-2006 Astronaut Scholar who attended Harvey Mudd College in Claremont, CA. He graduated with a B.S. in Engineering in May, 2006. Robert is currently a National Defense Science and Engineering Graduate (NDSEG) Fellow pursuing a Master's degree in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology. He plans to graduate in August.

Jonathan Pikalek
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Constrained Resource Collection Problems in Sensor Networks

A constrained resource collection problem (CRCP) combines aspects of classic operations research problems such as scheduling and routing. A CRCP seeks an assignment of agents to a set of recurring, temporarily constrained tasks which is optimal manner with respect to some well defined metric, for instance, maximizing cumulative reward of all assignments. The problem has many practical applications including patrolling of multiple assets for mobile threats and coordinating agricultural operations such as grain harvesting. This presentation explores CRCPs in the context of sensor networks.

Sensor networks have numerous applications in civilian, industrial and military environments. Advances in sensor size, efficiency and durability continue to accelerate their suitability for additional problem domains. However, advances in application are not only dependent upon advances in hardware, but in advances utilization as well. Over time, an initially functional network of sensors may become disjoint. Separate clusters of sensors may continue to collect data, but may no longer be able to route information to its intended destination. This may be overcome by dispatching one or more mobile agents to collect data and use some means to route it to a destination. Scheduling agents to visit these disjoint sensor sites is an example of a CRCP.

Jonathan is a PhD candidate and research assistant at NDSU mentored by Dr Kendall Nygard. While under ASF sponsorship he has contributed to several research projects involving unmanned air vehicles and was selected for charter membership in NDSU Chapter of Upsilon Pi Epsilon, the International Honor Society for Computing Sciences. In addition to the ASF scholarship, he is a recipient of the NDSU Presidential Fellowship. He and his son Nicholas live in Fargo, North Dakota. Jonathan is very much looking forward to marrying his fiancee Stephanie Hanson this August.

Matthew Pittman
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The Role of Sigma-1 Receptors in Breast Cancer Tumor Cell Proliferation

Brown Univ., Department of Molecular Pharmacology, Physiology, and Biotechnology Mentors: Wayne Bowen PhD and Zhiping Wu PhD

One of the chief causes of breast cancer metastasis and other illnesses can be attributed to the dysregulation of signal transduction. Neoplastic cells disregard the extracellular and intracellular chemical signals that regulate cell proliferation. There are several intricate physiological processes that enable benign tumors to spread throughout different tissue systems. Sigma-1 receptors enhance the IP3 stimulated release of calcium from the endoplasmic reticulum when agonist activation of

G-protein coupled receptors stimulates phosphoinosite turnover[1]. Hence, we wanted to determine whether there is a differential effect on the sigma-1 receptor from the activation of the calcium-dependent pathways in the phosphoinositide system, by assessing the effect of selective pathway inhibitors (anticancer drugs) on the rate of cell proliferation and survival compared to cells without the sigma-1 receptor. To monitor this, three selective pathway inhibitors were added to both cell lines (using the Promega One Solution Cell Proliferation Assay), to measure the cell viability and proliferation of cells in vitro. The data will show whether the sigma-1 receptor is using the pathway proteins phosphalipase C, cam kinase II, and/or calcineurin in its mechanism to stimulate cell growth. This will help us to determine which pathway is being activated by an enzyme to induce or retard cell proliferation. This study will allow us to draw a parallel between the expression rate of sigma-1 receptors in line 41 cells and cell proliferation rate.

Reference: 1.Hayashi et al., J PharmacolExp Ther 293: 788-798 (2000)

I am from Greensboro, NC. I am a junior biology major at North Carolina A&T State University. I plan to attend medical school and eventually become a cardiologist. This June I will conduct cardiovascular research, take some medical classes, and shadow a physician at the Weill Cornell Medical College in Manhattan, NY. I am the community service organizer for MAPS (Minority Association for Pre-Medical Students)

Jocelyn Renner
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A Numerical Study of Colliding Diffusion Flames

Many different aspects of combustion have been studied through the past century including combustion of solid materials, liquid sprays, and gaseous mixtures. We turn our attention to the third because of the wide range of applications and the richness of the dynamics. The complexity of the chemical reactions, coupled with the difficulties of understanding the underlying fluid mechanics, make the challenge of fully understanding turbulence in combustion a daunting task; however, some insight can be reached by studying simplified models of combustion under limiting cases. Through these studies of the fundamentals underlying this common process, questions such as when a gas ignites, how it propagates, and under what circumstances will the flame be extinguished are posed to gain deeper insight into the mechanisms that govern combustion and the conditions necessary for it.

Here, we numerically consider the effects of Lewis number on a two dimensional colliding flame model. We are able to fit the velocity of the edge of the flame near collapse to a polynomial expression and determine that the coefficient is dependent on Lewis number while the exponent is dependent on strain rate. Also, we examine the effects of Lewis number on critical radius, showing how decreasing Lewis number increases the critical radius within a given strain rate and that all critical radii scale between strain rates in the same fashion. Having a better understanding of the effects of the Lewis number helps bridge the gap between analytic work (where unity Lewis numbers are presupposed in many cases) and the dynamics observed through experimentation, and could lead to greater understanding of turbulent combustion and flame extinction. An improved understanding of colliding planar flames provides insight into more complicated problems such as flame hole collapse and turbulence as well as having very practical applications to engine design

Jocelyn graduated in 2003 from the University of Colorado with degrees in applied mathematics and Russian studies. Recently, she has been working as a teaching assistant at Northwestern University while pursuing a PhD. in Mechanical Engineering in the field of combustion. She is planning to graduate from Northwestern University in June 2008, after which she will be moving to Cincinnati, OH. In July, she will join General Electric's Aviation division working on engine design. On April 1, she became engaged to Benjamin Passty, and they will be married November 1 in Chicago.

Rebecca Rought
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Exploring the Accuracy of Several Grid Clustering Schemes for Computing Forces

Forces acting on an airfoil are often found using computational fluid dynamics, and the accuracy of the solution is highly dependent on the type and resolution of the grid used to capture the flow. The simplest way to increase the accuracy of a grid is to globally increase the number of grid points, but this results in significantly higher computing time. Alternatively, the error can be reduced if the grid points are moved such that the points cluster around areas of high gradients of properties such as pressure or density. These techniques have limited success since the errors in the force calculation are not always linked to high solution gradients. The adjoint solution can be used to cluster the grid around areas where the flow properties significantly affect the forces on the airfoil. My research examines the error in force calculations for several different types of structured grids, including a locally clustered scheme, and adaptive schemes based on the density gradient and adjoint solutions

Rebecca is graduating with a degree in aerospace engineering from Syracuse University in May 2008. While an undergraduate, she participated in a variety of activities such as the Syracuse University Marching Band where she was a member of the color guard. She was also a member of Tau Beta Pi, Sigma Gamma Tau, and the professional engineering sorority, Alpha Omega Epsilon. For the last four summers she has worked as an intern at BAE Systems. As a member of the Honors Program, Rebecca completed an honors thesis on improving the accuracy of CFD force calculations. After graduating, Rebecca plans to work on her PhD in aeronautics at the California Institute of Technology.

Lisa A. Schott
President and Principal Acoustical Consultant
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An Incredibly Diverse Range of Acoustical Projects and the Biggest Challenge in Building Construction Today

Noise is an ever-increasing pollution issue in cities and suburban areas worldwide. As our population continues to increase and the population density in our cities continues to grow, noise impacts on residential areas and other noise-sensitive environments are becoming more common and severe. Lisa will discuss the diverse range of projects in acoustics, vibration, and noise control that she encounters in her consulting practice. Projects include industrial facilities and commercial and residential buildings.

Last year, Lisa discussed the revolutionary advances she has made in developing and verifying acoustical computer modeling capabilities that did not previously exist in the building construction industry. This year, Lisa's presentation will include a discussion of the number one design issue facing this industry today: floor-to-floor noise transmission in wood frame construction. Material reductions and attempts to save cost in the construction industry have resulted in excessive sound transmission, as proven in field tests performed over the past several years. Materials such as flooring acoustical underlayments and ceiling sound isolation clips and hangers have had only limited success in improving the situation, and these materials are quite costly. Lisa is now working with developers and builders to develop new designs for the floor / ceiling systems and test them in the field. She will discuss her approach for developing these designs, specific details, progress to date, and the design philosophy that will lead to success.

Lisa Schott founded her own company, called Quietly Making Noise, LLC six years ago. She is an acoustical consultant and provides a wide range of engineering, design, and testing services related to acoustics and noise control to clients in the development and operation of residential, commercial, and industrial facilities. Lisa has a bachelors degree in Mechanical Engineering from Georgia Tech where she graduated with highest honors. 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. She is a frequent public speaker and active member of the American Society of Mechanical Engineers, Acoustical Society of America, Institute of Noise Control Engineers, and National Council of Acoustical Consultants.

D. Adam Young
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Mechanical Loading of Adult Stem Cells for Regenerative Medicine

There are currently 21 million Americans suffering from osteoarthritis, a debilitating disease of the joints that reaches onset in the later stages of life. The aging Baby Boomer population will certainly elevate these numbers in the near future and heighten the need for a more effective arthritis treatment. Current research has studied the use of stem cells to produce replacement tissues in the laboratory. Stem cells have the ability to grow into multiple types of tissues, but require specific external cues to determine their final cell type. By altering either the soluble chemicals present in the cells environment or the external forces felt by the cells, a scientist can hopefully control stem cell development in the lab. This talk will focus on the application of compression loading and fluid shear to encourage stem cells to develop into cartilage and bone tissue, which can then be substituted for damaged tissue in the joints of an arthritic patient.

Adam is currently a senior at North Carolina State University and will receive a BS in Biomedical Engineering this May, concentrated in Biomaterials and Tissue Engineering. He has spent the past year researching the effects of mechanical forces on stem cell differentiation at the National Institutes of Health (NIH) in Washington DC and the NC State Cell Mechanics Laboratory. He has also worked on developing HIV drug formulations at Trimeris, Inc., a small research pharmaceuticals company in North Carolina. This fall, Adam will continue his studies at the University of California, San Diego to pursue a PhD in Bioengineering. He will be investigating the use of stem cells, seeded on various polymeric scaffoldings, as a post-heart attack treatment.