AE Illinois

Newsletter of the Department of Aerospace Engineering
University of Illinois at Urbana-Champaign

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Thanks to Our Donors

Welcome to the 2013 Edition of the Alumni Newsletter of Aerospace Engineering at Illinois

As we embark upon a new academic year, I am happy to report that the AE undergraduate and graduate programs continue to be very strong and attract excellent students from Illinois, across the country, and around the world. With 133 new undergraduates, an almost 40 percent increase compared to the average of the last three years, the freshmen class is especially strong this year. Like their freshmen colleagues from the other engineering departments, our new students continue to be highly qualified. For the first time in the history of the College of Engineering, the average ACT score of the incoming class exceeds 32!

An important component of the education that these new AE students will receive over the next four years on campus consists of hands-on courses and extra-curricular activities. Over the past few years, AE has placed an increasing emphasis on this absolutely essential aspect of the education of our students, adding hands-on spacecraft and aircraft introductory design courses at the freshmen level and new experiments in the senior-level fluid and solid mechanics laboratory courses. A new IT/controls laboratory course at the senior level is also required. New hands-on elective courses have also been added to our curriculum, covering topics such as unmanned aerial vehicles, 3D prototyping and manufacturing, GPS technology and applications, and the multidisciplinary design of pico-satellites (CubeSat). Beyond

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the classroom, the students are encouraged to participate and take leadership roles in student-led extra-curricular activities. Most of these involve hands-on design/build/fly projects, including the US Launch Initiative, the NASA-sponsored lunar robotics competition, the Space Grant rocket contest, the UAV challenge, the AIAA remote controlled airplane design competition, the Student Aircraft Builders project, etc. These hands-on courses and projects are the topic of our cover story on page 14.

The newsletter is also an opportunity for the department to report on some of the research activities of our faculty members and students over this past academic year, from the recently announced DOE Center on Plasma Assisted Combustion (page 4), to recent advances in battery technology (page 10), and applied aerodynamics (page 6). Please make sure to read also about some of the accomplishments and awards of our students and alumni, including another first and second place finish in the AIAA Undergraduate Space Design Competition (page 24), and the trip of alumnus Michael Hopkins to the International Space Station (page 32).

I invite you to discover these and the many other stories presented in this newsletter, and, as always, look forward to your comments. Our contact information can be found on the department's web site at www.aerospace.illinois.edu, together with the many other stories on our alumni, students and faculty members that could not fit in this newsletter.

Let me end my introductory words by wishing farewell to our colleague, Mike Bragg, who, after a very successful career in our department as faculty member and Head, and at the College of Engineering as Executive Associate Dean and Interim Dean, recently became Dean of the College of Engineering at the University of Washington in Seattle. We thank him for his years of service and wish him good luck in his new position.

Sincerely,

Philippe H. Geubelle
Bliss Professor and Head

***On the cover:* Students in AE Prof. Greg Elliott's UAV Course built three different unmanned aircraft.**

Department of Aerospace Engineering

Faculty

Joanna M. Austin
Lawrence A. Bergman
Daniel J. Bodony
Michael B. Bragg
Timothy W. Bretl
Ioannis Chasiotis
Huck Beng Chew
Soon-Jo Chung
Bruce A. Conway
Victoria L. Coverstone
Steven J. D'Urso
J. Craig Dutton
Gregory S. Elliott
Jonathan B. Freund
Grace Gao
Philippe H. Geubelle
Thomas L. Jackson
John Lambros
Cedric Langbort
Michael McFarland
N. Sri Namachchivaya
Marco Panesi
Michael S. Selig
Petros G. Voulgaris
Scott R. White

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Rodney L. Burton
Harry H. Hilton
Ki D. Lee
John E. Prussing
Kenneth R. Sivier
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David Leon Carroll
Kenneth T. Christensen
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Nancy R. Sottos
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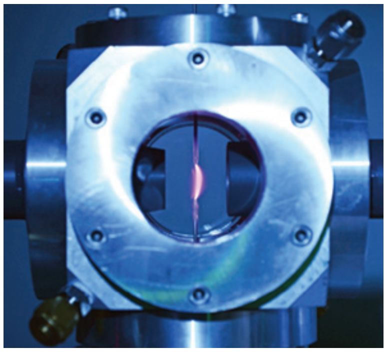
Paul Redman
Caitlin M. Bruning

AE Faculty Listed As Excellent

AE faculty recently included on the List of Teachers Rated as Excellent by Their Students have been: Spring 2013, Daniel J. Bodony; David L. Carroll; J. Craig Dutton; Owen T. Kingstedt (graduate student); John Lambros. Fall 2012, Phillip J. Ansell (graduate student); Bodony; Conway; Timothy W. Bretl; Bruce A. Conway; Steven J. D'Urso; Dutton; Gregory S. Elliott; Philippe H. Geubelle.

AE Faculty Play Major Role in $16 million Center for Simulating Plasma-controlled Combustion

Several Aerospace Engineering professors are participating in the new $16 million, 5-year Center for Exascale Simulation of Plasma-Coupled Combustion that has been awarded to the University of Illinois at Urbana-Champaign.



Plasma flame with cross flow

The new center will leverage extreme-scale computing to predict how plasma—a gas that is transformed into a new state of matter when its atoms are ionized—could be used to control combustion. The research may pave the way for cleaner-burning combustors and more reliable and higher performance jet engines.

"Harnessing the power of forthcoming computer architectures will enable truly predictive simulations that can advance this technology."

The National Nuclear Security Administration (NNSA) is funding the Center through the Predictive Science Academic Alliance Program II. One of three Multidisciplinary Simulation centers that NNSA is funding, the Urbana campus center is comprised of researchers from Illinois and The Ohio State University.

AE faculty participating are Profs. Jonathan Freund and Greg Elliott, Associate Prof. Dan Bodony, Research Prof.Tom Jackson, and Assistant Prof. Marco Panesi.

Freund, who also has an appointment in Mechanical Science and Engineering, co-leads the center with Computer Science Prof. William Gropp, the project's Principal Investigator and director of the Parallel Computing Institute. Freund will orchestrate the predictive physics modeling and simulations, including the supporting experiments, within a framework of uncertainty quantification.

"Plasmas offer a little explored means of tuning combustion to meet engineering objectives of performance or efficiency," he said. "Harnessing the power of forthcoming computer architectures, as is planned within this center, will enable truly predictive simulations that can advance this technology."

Bodony is the Chief Software Architect and part of the Center's Executive Committee with Gropp, Freund, Elliott, and Associate Prof. Luke Olson of Computer Science.

The purpose of the Center is to develop advanced software for future exascale computers that will be 1,000 times faster than petascale computers, like Blue Waters on the Urbana campus, Bodony said. Due to power consumption constraints, exascale computers will be made with a variety of computing elements. The expected arrangement will contain a mixture of multi-core central processing units (CPUs) and accelerators. In current-day computers, general purpose graphical processing units (GPGPUs) act like accelerators.

CPUs are good at managing the information flow within a computer but consume lots of power, while accelerators are good at performing arithmetic operations very quickly with little power consumption. Developing fast and efficient scientific software for future heterogeneous computers with processor counts beyond ten million is a leading edge topic in computational science, Bodony said.

The Center's foundation will be a research code that Bodony led in developing. The code's sufficient modularity and data structure abstraction provide flexibility the exascale architecture requires, and can be built on top of the pre-existing codebase.

Bodony's specific role will be to oversee the Center's primary deliverable—its scientific code and the tools used to develop it—by connecting the computer scientists with the physical application so that the Center can predict plasma-coupled combustion using code that harnesses performance advantages of future exascale computers.

Simulations of integrated multi-physics phenomena require the synthesis of model representation of many physical mechanics. These are often approximate, and therefore rely upon experimental effort. This is where Elliott's expertise comes in. He will lead a mix of low-dimensional, physics-targeted experiments to develop and calibrate models, and full-scale, physics-integrated experiments of the ignition of a turbulent

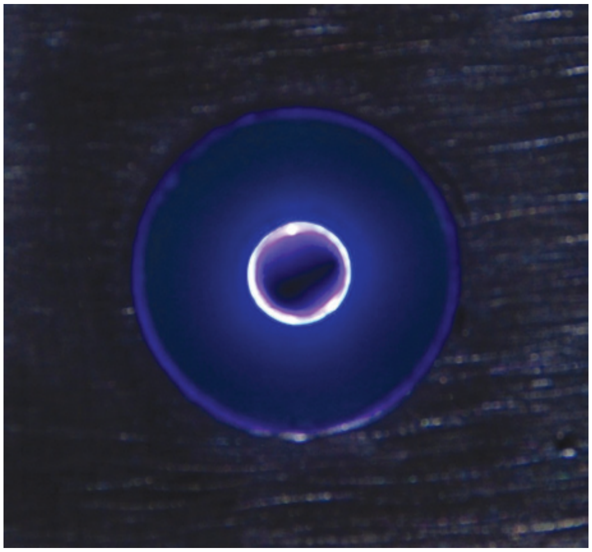


Image created by coaxial plasma gun

jet to evaluate the quality of the full simulation predictions.

Jackson will provide modeling expertise, which will be used both in interpreting the simulation results and in validating their correctness.

A number of model problems will be developed to provide additional verification and validation cases. These model problems will be semi-analytical in nature, in that simplified numerical methods can be used, and these solutions can then provide benchmark cases for code verification and validation, Jackson said.

These model problems also can be used to investigate underlying physical mechanisms, such as flame stability, flame propagation, plasma sheath modeling, electrode surface interactions, etc.

The presence of a plasma can couple with the combustion in one of three primary ways:

- through a body force term in the momentum equation, called the Lorentz force
- by producing radicals that can change the chemical pathways
- or by localized heating by the plasma.

To better understand each mechanism in plasma-coupled combustion, these mechanisms can be switched on or off independent of each other in the model problems, Jackson said.

Panesi,who joined AE a year ago, is an expert in integrating kinetics models into fluids simulations and

"We can't do this as one big computation, so we have to create new techniques that will help us stitch everything together."

quantifying their uncertainty, and will interact collaboratively with the center.

In a normal combustion event, many steps occur between the spark and the firing of an engine. Control of the intermediary steps is not possible with current technology. However, plasma has properties that enable intervention at intermediary steps. Plasma can create the same chemical species that occur during normal combustions and also can produce heat during the different phases, making the chemical process happen faster.

By using plasmas as a control mechanism, researchers believe they can manage the chemical process, thereby reducing emissions of greenhouse gases into the environment. Plasmas could also help stabilize flames for hypersonic, high-speed jet engines, in which air passes through so fast that the flame can be extinguished.

Understanding how to manage plasma is a difficult problem, requiring three-dimensional, fluid computer simulations that can cover many space and time scales. To make reliable predictions, researchers need scalable petascale computational resources to model and analyze the physics components, which range from flow turbulence to electrodynamics.

"You have to be able to understand what's happening at the atomic scale all the way up to the bulk flow in the plasma, which you can measure with a ruler," said Gropp. "We can't do this as one big computation, so we have to create new techniques that will help us stitch everything together."

Established by Congress in 2000, NNSA, a semi-autonomous agency of the U.S. Department of Energy, is responsible for enhancing national security through the military application of nuclear science. NNSA maintains and enhances the safety, security, reliability and performance of the U.S. nuclear weapons stockpile without nuclear testing; works to reduce global danger from weapons of mass destruction; provides the U.S. Navy with safe and effective nuclear propulsion; and responds to nuclear and radiological emergencies in the U.S. and abroad.

Airfoil Design: Keeping Selig Moving

Selig

"The lessons learned have paved the way for many solar-powered airplanes that have followed."

Airfoil design, whether it's in a NASA high-altitude plane, highly efficient wind turbines, the world's fastest bicycle or the rear wing on the $90,000 2014 Ford Mustang Boss 302S race car, is what keeps Aerospace Engineering at Illinois Associate Prof. Michael Selig moving.

He's interested in a wide variety of aeronautical engineering issues, from providing a free online database for aerodynamics designers, to simulating large and small airplanes, to RC modeling, to serving as an expert witness in aviation accidents, including dealing with the problem of inflight icing.

"He's definitely a detail-oriented person," says Christopher Lyon, chief engineering officer at Frasca International in Urbana. Lyon specifically came to the University of Illinois at Urbana-Champaign to do his graduate work with Selig and worked on the FS One flight simulator after he graduated. "His focus is not entirely on books and theory," Lyon continued. "He'd put an airfoil in the wind tunnel. The work I did for him as a grad student gave me a good appreciation for the practical applications of theory."

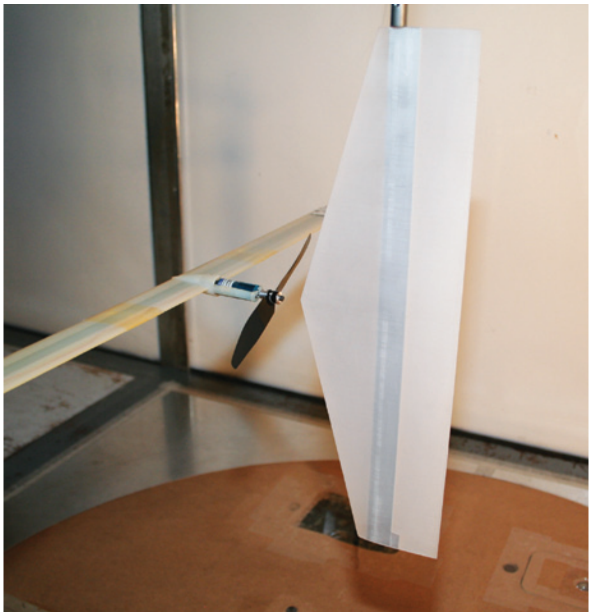
Selig's group has designed and tested new airfoils that are used in aerospace, wind energy, motorsports and sailing, including airfoils for keel and bulb fins used on yachts in the America's Cup. But he is most proud of his airfoil designs for the NASA/AeroVironment solar powered aircraft (e.g., 247-ft span flying-wing Centurion and Helios) and the AeroVironment Global Observer.

He was first contacted by AeroVironment when they were testing their Pathfinder solar powered airplane, originally designed in the early 1980s. "Under new NASA funding, they wanted to fly higher than ever before, but they were limited by the performance of either the wing airfoil or the propeller," Selig recalls. "They were not sure which, and this led to us wind tunnel testing both the wing and propeller airfoils. We found that the original wing airfoil was the limiting factor to climbing higher, and that conclusion led to a big effort to design and test a new series of airfoils, with the final one having the goal of taking the airplane to 100,000 feet under solar power"—in other words, "under the power of its own shadow."

Benefiting from lessons of the Centurion HALE UAS, the wingspan was extended to 247 feet, and the aircraft was renamed the Helios prototype. Initial low altitude flight testing was completed successfully under battery power at Edwards Air Force Base in 1999. Helios was then equipped with high-efficiency photovoltaic solar cells and performed high-altitude flight testing in the summer of 2001 at the U.S. Navy Pacific Missile Range Facility in Kauai, Hawaii. In 2001, during its second high-altitude flight, Helios reached 96,863 feet, shattering the existing world altitude record for sustained level flight for both propeller and jet-powered aircraft (the SR-71 spy plane was the previous record holder, having flown to 85,068 feet in July 1976).

Selig notes that during the attempt to reach 100,000 feet, turbulence in the early part of the flight slowed the climb rate and the airplane ended up reaching peak altitude after the sun had reached high noon. "The lessons learned have paved the way for many solar-powered airplanes that have followed. Besides aerodynamics and low Reynolds number effects, aeroelasticity is a big factor in any new projects like this," Selig said.

He continues lifelong research into the aerodynamics of low Reynolds number propellers. More than 100 propellers have been wind tunnel tested in straight flight, yawed flow and in steep descent. His current research has included testing low Reynolds number



MAV wing (right) undergoing tests in a propeller slipstream in the 3x4 ft wind tunnel located in the UIUC Subsonic Aerodynamics Laboratory.

wings in a propeller slipstream similar to configurations used on many micro UAVs.

His research in realtime flight simulation of aircraft covers a broad spectrum. Over 30 small-scale UAV-sized aircraft have been modeled in the flight simulation software FS One, which is now being used on campus in research. Flight vehicles as small as 3 grams ("nano" MAVs) up to full-scale size are modeled in realtime at 300 Hz using a 4th-order Runge-Kutta integration.

Research in flight simulation at Illinois has also included realtime modeling of the early IAI Pioneer UAV used in the first Iraq war, the NASA Twin Otter icing research aircraft, and the University of Toronto full-scale ornithopter to name a few. "One of our current efforts in flight simulation and modeling is aimed at aircraft flight dynamics and control for energy extraction from wind shear and random gusts, e.g., dynamic soaring," Selig said. His group's work in flight simulation and modeling research has also been applied to aircraft accidents, spins and upset scenarios. His experience has contributed to a better understanding of aircraft loss of control in one of the worst aviation accidents in US history.

In the arena of energy production, Selig worked for a series of companies that Enron and then GE ultimately acquired. His research ranged from blade design with very thick airfoils for mega-watt scale large wind turbines to the airfoil and blade design for low Reynolds number small rotor systems. A working wind turbine based on Selig's research can be seen just outside of Champaign, off of Interstate 74 and 57. Applications of these methods include the large ~70-m dia 1.5-MW GE wind turbine as well as many medium- and small-size rotor systems for companies and for government sponsored research. Research into 3D stall delay of wind turbine blades continues to be a challenging and interesting area of study.

As part of his role in putting the University of Illinois in the public eye, Selig has worked on historic flight issues. For the Discovery Channel's "Unsolved History" series, he worked on the episode "The Death of the Red Baron." Along with Brian Fuesz, a friend and fellow AE alumnus, Selig helped create a simulation of Manfred von Richthofen's last flight, in which he was shot down on April 21, 1918. Selig worked out the flight models for the Fokker Dr.I triplane and Sopwith Camel (aerodynamics, propulsion, and gyroscopic forces) and Fuesz put together the overall simulation framework complete with joysticks, moving control surfaces, machine guns, and realtime bullet trajectories.

Graduate students, Adam Ragheb, Pritam Sukumar, Or Dantsker, and Gavin Ananda checking balance on the 35%-scale aerobatic Extra 260 before conducting spin tests at Eli Field in Monticello, IL.

In 2003, aeronautics celebrated the centenary of Orville and Wilbur Wright skimming the sand dunes of Kitty Hawk, North Carolina, in the first aircraft to fly under its own power. Selig and co-investigators created what's probably the most accurate computerized flight simulation of the kite-like fledgling airplane. "It's flyable; most pilots could fly it with a little practice," said Selig, a pilot himself. But lose concentration for a fraction of a second, and you're likely to be headed nose up or nose down, and headed for trouble either way, he said.

Fast forward 100 years from the days of the Wright brothers, and flight has made unimaginable and amazing advances. Selig contributed to creating a hummingbird-like spy drone that recently was featured on the cover of *Time* magazine. Again with AeroVironment, he was part of the team working through a contract awarded by the Defense Advanced Research Projects Agency (DARPA) to AV to design and build a flying prototype "hummingbird-like" aircraft for the Nano Air Vehicle program. The final concept demonstrator is called the "Nano Hummingbird."

The vehicle can climb and descend vertically, fly sideways left and right, fly forward and backward, as well

continued on page 18

"One of our current efforts in flight simulation and modeling is aimed at aircraft flight dynamics and control for energy extraction from wind shear and random gusts, e.g., dynamic soaring,"

New Energy Management Devices Protect Structures from Damaging Forces, Motions

Bergman

Novel, passive energy management devices that researchers at the University of Illinois developed may effectively mitigate structural damage resulting from large-scale forces and ground motions such as those explosions and earthquakes can cause.

The nine-story structure undergoing a 90 psi-ms blast test at the Army Corps of Engineers Big Black test site near Vicksburg, MS.

These vibration mitigation systems employ passive Targeted Energy Transfer (TET) strategies to rapidly direct input energy nearly irreversibly to one or more of the Nonlinear Energy Sink (NES) devices that harmlessly absorb and dissipate the energy.

The principal investigators include Profs. Lawrence Bergman, Aerospace Engineering; Alexander Vakakis, Mechanical Science and Engineering; Bill Spencer and Larry Fahnestock, Civil and Environmental Engineering; and Dane Quinn, Mechanical Engineering, University of Akron. Also contributing have been Research Prof. Michael McFarland and doctoral students Sean Hubbard, Aerospace Engineering, and Nick Wierschem and Jie Luo, Civil and Environmental Engineering.

The Illinois scientists partnered with the University of Akron in a two-and-a-half-year, $2.1 million project that the Defense Advanced Research Project Agency (DARPA) sponsored.

The project began in the fall of 2010. DARPA requested new materials and/or subsystems that, when placed within a structure, would simultaneously add significant levels of stiffness and energy dissipation over a broad range of frequencies and input amplitudes.

The Illinois-Akron team responded with its TET technology, in which strong nonlinearity is intentionally introduced into the structure at the design stage. The team's work culminated in the design and construction of a 9-story, 10-ton steel frame structure incorporating a total of six NES devices, three on each of the eighth and ninth floors, for proof of concept.

The structure underwent an extensive series of dynamic tests covering a wide range of broadband ground motions, including impulse-like, swept-sine, and several historic earthquake records, with testing on the large-scale shake table housed at the Champaign, Illinois-based US Army Corps of Engineers, Construction Engineering Research Laboratory (CERL).

Tests were run comparing the structure with NES devices in both locked and unlocked configurations. In the former, the devices acted merely as integral masses, while in the latter, they were free to perform dynamically as designed. The comparison was dramatic, with the structure undergoing large, potentially damaging motions when the NESs were locked and barely moving after the first few cycles of response when the NESs were unlocked and free to perform.

In early December 2012, the entire structure was partially disassembled and transported to the U.S. Army Corps of Engineers, Geotechnical and Structural Laboratory (GSL) Big Black Test Site, near Vicksburg, Mississippi, where it was reassembled and blast-tested. The mitigation system performed precisely as predicted. The devices quickly absorbed the blast energy and dispersed it to high frequencies where the inherent damping in the system works most effectively, barely allowing the structure itself to move after the first few cycles of response, even under the largest blast loads.

According to Vakakis, the use of intentional strong nonlinearity in structural design remains a contrarian view. Most designers seek to maintain linearity, viewing nonlinearities, particularly strong nonlinearities, as detrimental to their design objectives. However, it's now been demonstrated that the Illinois-Akron system results in enhanced performance not attainable using conventional passive linear designs, and with no increase in weight.

Chung's NSF CAREER Award: Using Robotic Birds of Prey to Prevent Airport Bird Strikes

The nation's airfields have, quite literally, gone to the birds.

Avian and other wildlife strikes annually cause more than $715 million in damage to aircraft each year, estimated the Federal Aviation Administration in a 2011 Wall Street Journal article. Consider the dramatic 2009 water landing of U.S. Airways Flight 1549 in the Hudson River, after a flock of geese collided with the plane during its climb out.

But Soon-Jo Chung, assistant professor for Aerospace Engineering at Illinois and the Coordinated Science Laboratory, has cried fowl, so to speak. He is working to develop robotic birds of prey that could chase flocks away from airfields, where birds are most likely to cause damage. The National Science Foundation will fund the research at nearly $500,000 for five years through its CAREER Award program.

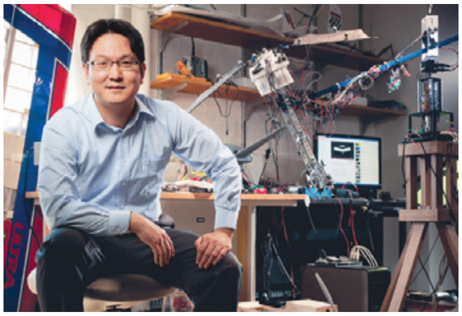
"Robotic falcons could be an efficient and cost-effective solution, but will require significant advancements in control and sensing," said Chung.

Real birds of prey and guns have proved to be the most successful methods for removing flocks. But both come with significant challenges. While falcons were successfully deployed at JF Kennedy Airport and McGuire Air Force Base, for example, real birds are difficult to control and train. As they require human handlers in such cases, they are also expensive to maintain. Further, the most effective performers—peregrine falcons—are an endangered species.

Meanwhile, the use of guns has outraged animal rights groups, which successfully petitioned Kennedy—situated near a bird sanctuary—to quit using arms in 1993.

By creating a robotic falcon that can sense flocks and outfly them, Chung believes he can introduce a viable, though certainly not simple, solution.

"This is basically a grand control challenge problem," said Chung, who is a senior member of the American Institute of Aeronautics and Astronautics (AIAA) and the Institute of Electrical and Electronics Engineers (IEEE). "The dynamics are so complicated due to the complex nonlinear flapping flight dynamics with many articulated wing joints. Then we should take into account the wing flexibility, which is difficult to model and control; flexible wing models are written in the Partial Differential Equations (PDEs)."



Chung

Chung, with his students, has been working on both the dynamic modeling and control challenges of bird-scale flapping flight. The team derived a limit-cycle-based control formulation for flapping flight while establishing PDE boundary control strategies for flexible, articulated-winged aircraft. "There are still some significant issues in flight control that must be resolved for them to work in the real world," he said.

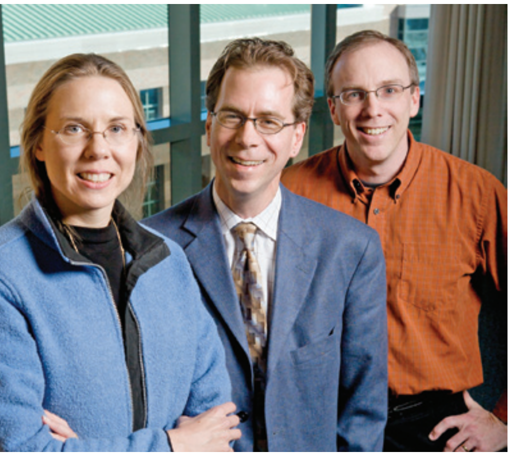
"Birds are smart and can distinguish real falcons from robots. Our robots must fly like real falcons, look like real falcons and even sound like real falcons."

Researchers also must develop algorithms that enable the robotic falcons to identify targets, and then navigate and herd the birds away from the airfield. A novel aspect of the project will focus on multi-agent pursuit-evasion algorithms that will help enable the robotic falcons to chase and navigate the birds away from the airfields.

"Birds are smart and can distinguish real falcons from robots," Chung said. "Our robots must fly like real falcons, look like real falcons and even sound like real falcons." Chung intends to leverage his prior work on distributed control, real-time optimization and synchronization of multi-vehicle systems, as well as game-theoretic or geometric formulations of pursuit-evasion.

In addition to the potential of solving an expensive and dangerous real-world problem, Chung is also excited about the opportunity to contribute to the fundamental understanding of avian flight. He said: "At its core, this is a scientific exploration of how birds fly so well."

Preventing Laptop Fires and "Thermal Runaway"



Sottos, White, Moore

AE Prof. Scott White is leading a team of Illinois researchers in developing a self-healing technique to prevent lithium-ion thermal runaway in batteries that power devices from smart phones and tablets to small appliances and even hybrid cars.

While rare, Li-ion battery-caused spontaneous blazes can be dangerous. Manufacturers have made great strides in improving batteries to ensure against fires, but it could be argued that the fire hazard remains almost inherent in a Li-ion battery's fundamental design. At its most basic level, each Li-ion cell has three thin layers—a positive electrode made of a lithium alloy, a negative electrode made of carbon, and a third thin plastic or polymer layer between the two known as a "separator." The separator performs two basic functions. First it keeps the positive and negative electrodes apart, preventing a short circuit. Second, it has tiny pores that permit lithium ions to flow between the two electrodes (from the positive to the negative electrode when charging, and in the reverse direction when discharging). The separator is bathed in a (typically flammable) liquid electrolyte such as ether, through which the lithium ions flow.

When the battery reaches a certain temperature, the microspheres melt, blocking the pores in the separator through which lithium ions pass and shutting down battery operation.

A problem arises if the separator becomes damaged or destroyed, causing the electrodes to short-circuit and overheat, initiating a chemical reaction between the electrolyte and the electrode. Such a short circuit can trigger a "thermal runaway" whereby the increase in temperature of the cell accelerates the chemical reaction, adding to the heat in turn and leading to the combustion of battery materials. Ultimately such a failure can trigger a chain reaction whereby successive cells in the battery burst into ever hotter flames. Such failures can also be triggered by mechanical injury, by overcharging, or by overheating from an external source.

That's why today's separators are generally designed to perform an additional safety function. Typically composed of a bilayer structure of polyethylene (PE) and polypropylene (PP) or a trilayer PP-PE-PP arrangement, the separators are designed to soften at a critical high temperature, closing the pores through which the lithium ions travel and thereby shutting down battery operation. The problem is that under these hot conditions, the separator also tends to shrink, raising the risk of contact between the electrodes. Moreover, if for some reason the temperature continues to climb, the separator may be entirely destroyed.

White, AE Affiliate and materials science Prof. Nancy R. Sottos, chemical engineering Prof. Jeffrey Moore, and colleagues counteract this by coating either the anode layer or separator layer with heat-sensitive "microspheres," or tiny solid capsules, ranging from two to forty-some nanometers in diameter. When the battery reaches a certain temperature, the microspheres melt, blocking the pores in the separator through which lithium ions pass and shutting down battery operation.

The researchers fabricated two sets of microspheres, one made of polyethylene and another of paraffin wax. They tested the system using coin-shaped CR2032 Li-ion batteries (the type in a car's keyless remote). White's team experimented with different levels of coating to maximize both battery operation at room temperature and the effectiveness of shutdown at high temperatures. They were able to demonstrate shutdown (reduced charge capacity by 98 percent) at 110° Celsius with PE microspheres and shutdown at 65° C with paraffin wax, while sustaining normal battery operation at room temperature. The safety advantage is that these triggering temperatures are considerably lower than the melting point of the two materials in the separator (PE at 130° C. and PP at 165° C.), so battery operation is shut down with the separator still safely intact. Examination of the surfaces with scanning electron microscopy confirmed the melting pattern.

The one key weakness of the experimental system is that shutdown took longer to unfold than it would normally take for a Li-ion battery to go critical. For example, shutdown with the PE microspheres took six seconds, while a battery could go critical in just one second. But having demonstrated the concept, researchers are prepared to look at alternative polymer materials, with more rapid responses, as well as alternative "triggers," since, as the researchers noted, "Microspheres can be engineered to respond to a variety of stimuli, including pressure, pH, electric fields, magnetic fields, and temperature."

The work was supported primarily by the DOE Office of Science.

Bretl Teaches College-Level Robotics Course to Prison Inmates

This spring, Associate Professor Timothy Bretl taught "Introduction to Robotics" to a group of 13 eager students. For three hours every Friday night, the students studied rigid motions, homogenous transformations, velocity kinematics, motion planning, control and other fundamentals in the AE482/ECE470 course.

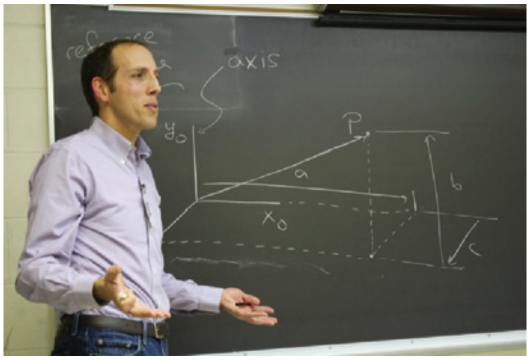
But these students weren't taking the class to graduate with an engineering degree—many of them hadn't laid eyes on cosines, the Pythagorean theorem or matrix algebra in two decades, if ever. Rather, they were inmates at Danville Correctional Facility who were taking the course as part of the University of Illinois-sponsored Education Justice Program, which aims to bring higher learning to prisoners and provide outreach to inmates' families in Chicago.

"They were amazing in their ability to learn," said Bretl, an associate professor of aerospace engineering, whose course was EJP's first foray into engineering instruction. "These students completed a variant of the same lab that we do at the university. It wasn't 'dumbed down' at all."

While the students tackled the same problems as Illinois students, Bretl and a group of student volunteers from Illinois did have to adapt the labs to work in the unique environment. They were not allowed to bring robots into the facility, and computer and network access for inmates—the norm for Illinois students—was extremely limited. Bretl and his group revised the lab manual to focus more on data analysis rather than robotic programming, though the underlying content remained the same. And instead of hands-on time with robots, students watched videos of robots in motion.

For Bretl, the experience underscored the importance of providing education to the U.S. prison population, which stands at roughly 2.2 million people, according to a 2012 Salon.com article. Inmates' access to higher education was limited after Congress revoked their eligibility for Pell Grants in 1994. Reformers believe that education helps improve recidivism rates by making it possible for inmates to rejoin the mainstream after leaving prison.

"These students were just like everyone else, with a whole range of abilities, goals and motivations," Bretl said. "It was inspiring to see the level of ambition and ownership among this group."



Tim Bretl at Danville Correctional Facility

He also used the experience to refine and rethink his teaching methods in general. As most of the students did not have a strong background in math, Bretl had to describe concepts in a different way, though he credits the students with devising the most successful methods themselves.

"At this stage of my life, it's difficult to join a movement like that, but when I saw this program, I saw a way to impact people in a way that corresponds to my values and that I'm qualified to do," Bretl said. "It is the perfect opportunity to make a difference."

"It was inspiring to see the level of ambition and ownership among this group."

Faculty Awards and Honors

Austin

College of Engineering Chooses AE Professor as Willett Faculty Scholar

Aerospace Engineering at Illinois Associate Prof. Joanna M. Austin has received a Willett Faculty Scholar Award in the College of Engineering.

The recognition is targeted for faculty members who, at a relatively early stage in their careers, are excelling in their contributions to the University. The award represents a type of "junior professorship" to encourage continued achievement in outstanding young faculty.

Austin researches fundamental problems in fluid mechanics, particularly in reacting, compressible flows that occur in a broad range of applications. Her research is predominantly experimental, combined with analytical modeling.

Austin established the Compressible Fluid Mechanics (CFM) laboratory in 2003, and with the support of the Air Force Office of Scientific Research (AFOSR), built the Hypervelocity Expansion Tube (HET) facility. This facility uses a novel method of gas acceleration to produce a minimally contaminated free-stream representative of planetary entry conditions for ground-based testing.

Austin earned bachelor's degrees in mathematics and in mechanical and space engineering from the University of Queensland in 1996. She earned a master's and PhD in aeronautics from the California Institute of Technology in 1998 and 2003, respectively.

Bretl

Bodony

Bretl, Bodony Earn Promotions

Timothy W. Bretl and Daniel J. Bodony have been promoted from Assistant to Associate Professor in Aerospace Engineering at Illinois.

Bretl's research interests are theoretical and algorithmic foundations of robotics and automation; and motion planning, control and optimization.

Joining the AE Department in 2006, Bretl garnered a Faculty Early Career Development Program (CAREER) Award from the National Science Foundation in 2010. He and his student, Zoe McCarthy, won the 2012 Best Manipulation Paper Award at the IEEE International Conference on Robotics and Automation. Bretl and Dennis Matthews were finalists for the 2012 ICROS Best Application Paper Award during the IEEE/RSJ International Conference on Intelligent Robotics and Systems.

Bretl earned bachelor's degrees in engineering and mathematics in 1999 from Swarthmore College in Swarthmore, Pennsylvania. He earned a master's degree and PhD in aeronautics and astronautics in 2000 and 2005, respectively, from Stanford University.

Bodony studies aeroacoustics, compressible turbulence, wave propagation, fluid-structure interaction, aerothermoelasticity, numerical algorithms for massively parallel computing and computational fluid mechanics.

Also joining AE in 2006, Bodony was named a Tau Beta Pi Eminent Engineer in 2012, and earned an NSF CAREER Award in Fluid Dynamics in the same year. He earned a bachelor's and master's in aeronautics and astronautics in 1997 and 1999, respectively, from Purdue University; and a PhD in aeronautics and astronautics in 2004 from Stanford University.

In addition to their excellent research contributions and leadership in their respective fields of expertise, both Bretl and Bodony are outstanding teachers. Bretl was named the 2013 Teacher of the Year by the local American Institute of Aeronautics and Astronautics (AIAA). Bodony earned the same honor a year ago, as well as in 2008 and 2010.

Coverstone

Coverstone Named AIAA Fellow

Aerospace Engineering at Illinois Prof. Victoria L. Coverstone has been named a Fellow of the American Institute of Aeronautics and Astronautics.

Coverstone, who also is Associate Dean for Graduate and Professional Programs for the College of Engineering at Illinois, joins AE faculty members David L. Carroll, Harry Hilton, John E. Prussing and Wayne C. Solomon as AIAA Fellows.

In addition to her teaching and research support and accomplishments, Coverstone's position as Associate Dean, co-founder of a company (CU Aerospace), testimony before Congressional committees, and chairmanship of the Council of Institutions for the University Space Research Association contributed to her being named a Fellow, according to Prussing.

She earned all her degrees from AE at Illinois: a bachelor's in 1985, a master's in 1986, and a PhD in 1992, after which she became an assistant professor in the Department. Coverstone's research activities are dynamics, control, and design of aerospace systems. Specific applications are the design and control of spacecraft and the design of optimal spacecraft trajectories.

In her position as Associate Dean, Coverstone leads the Office of Engineering Graduate and Professional

Programs. The office oversees graduate education programs in the college, including online courses and extramural programs, diversity programs for graduate students, professional degree programs, and other issues affecting the 2,700 graduate students in the College of Engineering.

Elliott Chosen for College's Rose Award

Elliott

Prof. Greg Elliott's innovation and dedication in using aircraft design to introduce freshmen to aerospace engineering has been recognized with the 2013 College of Engineering Rose Award for Teaching Excellence.

The Rose Award, named for alumnus Scott Rose, who earned a bachelor's degree in computer engineering in 1987, honors excellence in undergraduate teaching in the College. It especially recognizes innovative teaching methods and instructional programs that motivate freshmen and sophomore students to learn and appreciate engineering.

The AE Department's effort a few years ago to boost hands-on experiences for lower-level undergraduates resulted in Elliott putting together AE 100AD Aircraft Design, with assistance from Associate Prof. Michael Selig.

To aid their understanding of the classroom concepts of flight description (altitude, velocity, and pitching, yaw and roll angles); forces and moments acting on an airplane (lift, drag and thrust); control surfaces; propulsion; structure and aircraft stability, the students take a trip to a local remote-controlled aircraft field, where Elliott and others help the students fly radio-controlled (R/C) planes. The R/C planes are also equipped with onboard video to observe tufts on the wings for flow visualizations and instrumented with GPS, Pitot/static probes, accelerometers, and RPM optical tachometers. The in-flight data is then analyzed in classes to present aerodynamics and flight performance concepts.

The students also work in small teams to design and build a 2-foot-wide, remote-controlled electric flying wing made of Depron foam and reinforced with carbon fiber. Based on the aircraft stability concepts discussed in class, the students have to size the elevons used for both pitch and roll control, the vertical surface(s) for yaw stability, and distribute the weights of the battery, speed controller and actuators to achieve the right level of static stability for the airplane. This aspect is the most challenging part of the course for the students, who then spend a couple of hours manufacturing and assembling their designs.

Freund Elected to APS Fluid Dynamics Executive Committee

Freund

Aerospace Engineering at Illinois Prof. Jonathan B. Freund has been elected a member of the Executive Committee of the Fluid Dynamics Division of the American Physical Society (APS).

The committee is the chief governing unit of the division, and consists of four officers and six members. The Division of Fluid Dynamics exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure.

Freund, who also has an appointment in the Mechanical Science and Engineering Department and is a Kritzer Faculty Scholar, leads a group that investigates mechanical phenomena in a range of systems. Most of the group's investigations utilize advanced computer simulations tools—many of which they have designed—coupled with detailed analysis.

Freund has been an APS Fellow since 2011, and has been an Engineering at Illinois faculty member since 2001. He earned three degrees in mechanical engineering from Stanford University: a bachelor's in 1991, a master's in 1992, and a PhD in 1998.

White Receives Humboldt Research Award

White

Aerospace Engineering Prof. Scott R. White received the prestigious Humboldt Research Award honoring a lifetime of research achievements.

White is a leading researcher in the field of autonomous materials—synthetic materials that respond and adapt to situations on their own. His research applies principles of biological systems, such as healing and vasculature, to materials such as plastics, electronic circuits and batteries. White is best known for designing materials embedded with microcapsules that rupture when cracked or damaged, filling the cracks and "healing" the plastic or circuit.

White used his award to work with Prof. Peter Fratzl at the Max Planck Institute of Colloids and Interfaces in Potsdam-Golm, Germany. The two studied bio-inspired and biomimetic materials systems.

White earned his doctorate in engineering mechanics at the Pennsylvania State University in 1990, joining the faculty at the U. of I. the same year. He also is affiliated with the Beckman Institute for Advanced Science and Technology. He has received widespread recognition for his work, including Scientific American magazine's "SciAm 50" award in 2007. Popular Science chose his work as among the Top Ten Innovations in Science in 2001.

Learning by Doing: Aerospace Engineering Students Given Plenty of Opportunities for Hands-On Education

On any given day in the Department of Aerospace Engineering at Illinois, one could find the traditional classroom setting, with a professor lecturing, and students taking notes. But the observer would most certainly notice many other activities, as well.

In the newly refurbished undergraduate lab space in Talbot Laboratory, students might be molding Styrofoam and plywood into flying wings, or putting together payloads for rockets that will be sent skyward in an open field. In another lab, students might be testing the flight of unmanned quadcopters after computing and re-computing their pathways. Other students might be debating ways to meet criteria in planning a manned mission to Mars competition.

Student Aircraft Builders

Still others, just a few miles south of campus, in a hangar at Willard Airport, might be building their own plane.

This flurry of activity marks the department's growing emphasis on providing students with hands-on experiences to help them prepare for their careers.

"Student projects complement well the theoretical education in our courses," said AE Department Head Philippe Geubelle. "These are things that employers look for. We know the importance of projects not only for students' on-campus experience, but also in their technical education and in their ability to work in teams."

Starting Off Early

Freshmen get their feet wet (and hands busy) during their first semester in campus in the AE 100 Aircraft Design and Spacecraft Design courses.

In Aircraft Design, students investigate fundamental concepts of aerodynamics, performance, stability and control, propulsion and structures as applied to airplanes. Flying vehicle demonstrations are presented, discussed, and analyzed, with an emphasis on design and practical considerations in aerospace engineering. The most fun part comes near the end of the semester when the students demonstrate the principles they've learned by dividing into teams to build and fly a remotely controlled flying wing in an open area on campus. These skills are more stringently tested by the time the students are upper classmen and enroll in Prof. Gregory Elliot's AE 498 UAV course (see page 15).

In the freshmen Spacecraft Design course, students learn principles of rocket, satellite, and space mission design, as well as space environment. Working in teams, students plan a mission and build their own payload modules that they then get to launch on 5 to 6 foot tall model rockets. The students analyze the measured altitude, acceleration, and attitude data using filtering techniques and MATLAB, a scientific programming language code for predicting the rocket trajectory. When launched from a farm field several miles from campus, the rockets shoot up to 4,000 feet into the air then drift to earth by parachute. Students retrieve the rockets—at times landing up to a mile from the launch site—and begin the work of analyzing data. The real science part of the class comes in the analysis, said Prof. John Lambros, who taught the course last fall. "There's building stuff, but there's also understanding how it works."

Both the aircraft and spacecraft design courses provide students with valuable concepts to begin their studies in aerospace engineering, and AE faculty are considering adding more components to the course. "These are great examples of hands-on design, and encourage the students to become involved in other projects in AE and in the College (of Engineering)," Geubelle said.

Competition Has Its Purpose

Illinois students who have participated in the last few years in the Midwestern Regional Space Grant High-Powered Rocket Competition became even more immersed in their rocket studies. This past spring, the challenge was for rockets to come the closest to 3,000 feet altitude. Competition scoring was based on design presentation, design reporting, the flight, and the flight performance evaluation.

The experience was very successful, and the four teams came back with many new ideas for the next competition. "Something that we would like to try next year would be using the local wind tunnel to accurately measure our rockets drag coefficient," said Jacob Dray, one of the team's leaders. "Other than that we feel very pleased with our results for a first year team. Our dual deployment worked wonderfully with no damage done to the rocket and we reached a 'room for improvement' altitude of 2,617 feet. We are excited to go after this competition again next year!"

Organizations, Courses Offer Teamwork Experience

AE encourages students to get involved in competitions, student organizations, and team projects that test and build upon the students' expanding knowledge base.

Since 1996 the student chapter of the American Institute of Aeronautics and Astronautics (AIAA) has sponsored a Design/Build/Fly student design team that each year develops a radio-controlled aircraft to compete in an AIAA/Cessna/Raytheon-sponsored competition.

Students participating in the Cubesat Project have developed the "IlliniSat-2" bus, a generic, scalable picosatellite bus system, along with an in-house payload. The organization is in partnership with local company CU Aerospace to fly additional buses with their payload. CubeSat is an interdisciplinary design class that AE and the Department of Electrical and Computer Engineering manage. The class is run as a systems engineering project, with proposals, design reviews, demonstrations, and final presentations and documentation.

Working on a team project can have many perks, as an Illinois Space Society (ISS) team of five AE students found out in 2012. The members were chosen to

Students Design UAVs with Special Missions in Mind

Aerospace Engineering Prof. Greg Elliott's new course this spring gave groups of students a choice of building one of three unmanned aerial vehicles (UAVs), with designs reflecting the vehicles' intended uses.

In addition to educating students in designing small UAVs, the purpose of the course—AE 498 Uninhabited Aerial Vehicles—is to teach them about various manufacturing techniques including carbon fiber construction, basic and CNC machining, and rapid prototyping techniques. Students also learn about instrumentation, sensors, and electronics associated with UAVs.

Students in the course this past spring were divided into three teams: one building a flying wing (low aspect ratio wing); another, an indoor flyer; and the third, a powered sailplane. "The concept requirements came from the mission," said graduate student Zachary Herman.

The teams spent about two-thirds of the semester conducting analysis to come up with the design concept, then another two to three weeks building their UAVs.

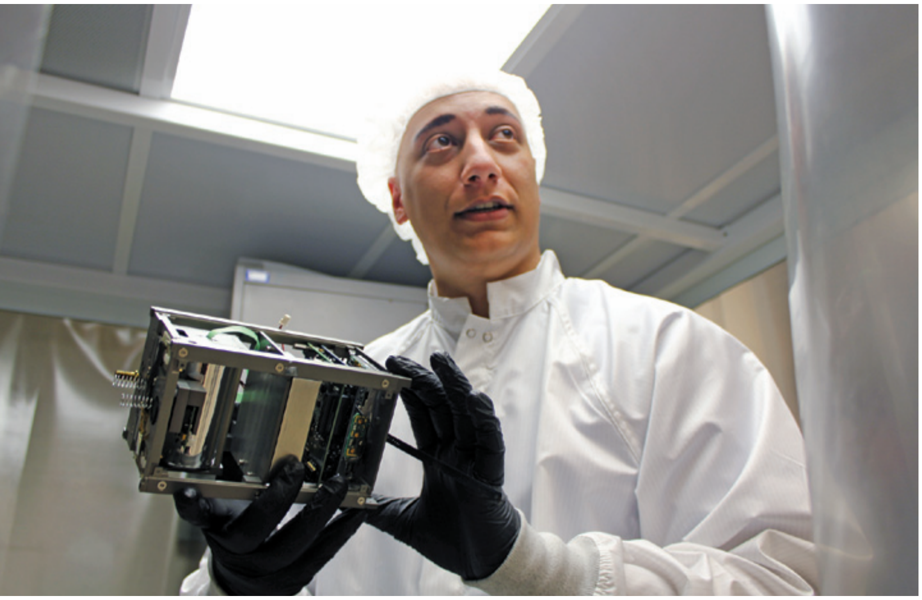
Herman teamed with Sahithi Kalidindi, Steven Cummins and Izan Peris in building the flying wing. The vehicle's Delta design and 40-inch wing span were intended to promote the UAV's maneuverability and allow it to reach speeds of at least 60 miles per hour.

The wing performed well in climbs, drops, and rolls, and hit a top speed of 71 miles per hour when tested early in May at the Champaign County Radio Control Club. The plane was then instrumented with a camera, GPS, system monitoring, and telemetry, completing the dash search and rescue mission for which it was designed.

The mission for Lucas Buwick's group was to build a light, slow-flying plane that could fly indoors and take photos of entertainment events: sports, concerts, or even large theater productions. The UAV needed to be safe enough so that the aircraft would not cause serious injury if it

continued on page 17

Greg Elliott and the new Uninhabited Aerial Vehicles course



Graduate student Alex Ghosh in the CubeSat lab

conduct an experiment in microgravity, and were privileged to ride aboard the National Aeronautics and Space Administration's (NASA) "Weightless Wonder," also known by its alias, "the Vomit Comet." The students flew to altitudes reaching 40,000 feet so they could demonstrate and record human response to using an iPAD tablet computer in microgravity.

Student members of the relatively new Illinois Robotics in Space (IRIS) organization, founded in 2009, have taken part each year in NASA's Lunabotics Mining Competition. Since that time, IRIS has built two lunar excavators and has provided dozens of students with opportunities to apply and develop their engineering skills.

IRIS also has helped sponsor an Illinois team to build a drone aircraft to participate in a national Unmanned-Aerial-Surveillance (UAS) competition. Organized by the Air Force Research Laboratory, Texas A&M University, and Raytheon, the UAS Video Tracking Challenge seeks to address current and future technologies for intelligence, surveillance, and reconnaissance (ISR) missions. The UAS Challenge is scheduled to take place in October 2013 at Texas A&M University, with 11 teams competing.

Intending to make their electrically-powered drone autonomous, the Illinois team members equipped it with a control mechanism they named Aerial-Based Intelligent Surveillance System (ABISS). "We're trying to put all the control and computations within the aircraft, itself," said team leader and recent graduate Xichen Shi. That way, he said, "If we start the mission and lose communication (with the aircraft), we could finish the mission."

Learning Control

Control, along with dynamics, modeling and motion planning, has been the challenge for students in Associate Prof. Tim Bretl's AE 483 Aerospace Decision Algorithms course. The course has a significant laboratory component, requiring students to implement and test algorithms for automatic control of quadcopters (similar to helicopters). The quadcopters, equipped with a circuit board that Laboratory Coordinator Dan Block fashioned and sensors the students build, make possible a dynamic learning experience.

Reflective tape balls placed on top of the quadcopters and on control obstacles appear as bright, white lights to 18 infrared cameras hung throughout Bretl's lab. Those images feed to computers, supplying the vehicles' positions and orientations, so students can track the aircrafts in relation to their grids and the obstacles, and make adjustments for flights.

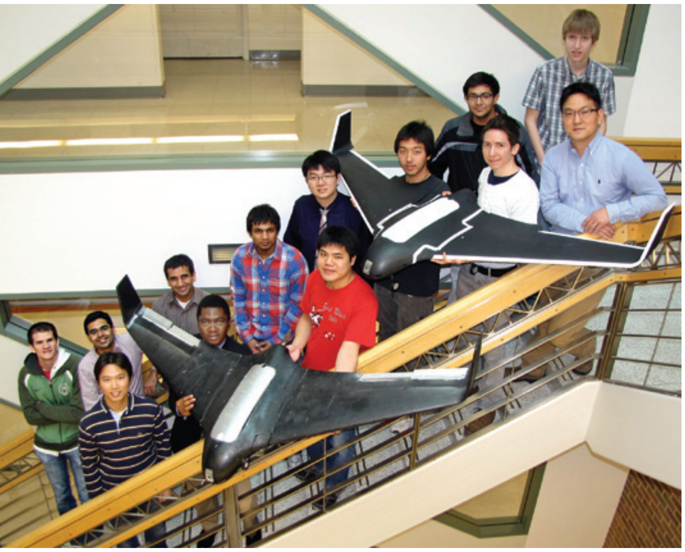
The course was redesigned around the laboratory experience this past year, and Bretl was pleased with the way students responded. "They needed an opportunity to apply what they had already learned to make a real aerospace system work," he said.

Graduate student Miles Johnson working with a quadcopter

Choosing to Fly

This past year, a group of students formed Student Aircraft Builders, with the goal of assembling a manned airplane kit inside a hangar at the University of Illinois Institute of Aviation at Willard Airport.

SAB's overriding goal is to provide students with an opportunity to work on an undergraduate project. "Members will learn teamwork, organizational skills, administrative techniques, communicating and supporting ideas, time management, and, most importantly, hands-on experience in an engineering project," according to the group's website. To support this plan, the group has held professional workshops on riveting, MIG and TIG welding, and training sessions with power tools including sanders, grinders and drills.



Students in the national Unmanned-Aerial-Surveillance (UAS) competition

The group also is working to attract sponsors. SAB estimates the aircraft will cost at least $76,000 to build. Donors have included Northrop Grumman, the University of Illinois Student Organization Resource Fee, and NASA Illinois Space Grant Consortium as well as the AE Department.

Finding the Resources

The value AE places on student hands-on experiences has led to the department dedicating lab space for the work. This past summer, under Elliott's direction, Labs 18 A and B in the basement of Talbot Laboratory were outfitted with tables, hand tools, a laser cutter, a computer numerical control (CNC) router, and other

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accidentally hit a person. Buwick's group members were Fabio Fernandes de Castro Santos, Micah Fehr, David Sherman, and Ernest Company Vallet.

Buwick indicated that the plane was designed based on a small R/C model called a Vapor. It used ribs and a fuselage made out of carbon fiber with light plastic film glued on the wings and control surfaces. It also used a pusher propeller located behind the wing. "That way the prop was not on the front of the plane, which could injure someone if it crashed, " Buwick said.

The plane had to weigh less than 12 ounces, and have a wingspan of less than 38 inches. The plane's top speed had to be less than 15 miles per hour, with a sustained stable flight speed as low as possible for safety purposes and to allow suitable in-flight photography at arena or theater-sized events. The plane met all of its specific criteria, Buwick said. "The wingspan is 32 inches and it weighs about 4.5 oz."

Buwick's team faced a challenge in balancing the plane's weight versus strength. The team needed to make the plane light but structurally strong enough to support the forces generated in acquiring lift. Problems arose in identifying materials that were light but offered necessary support.

"One last issue we faced was with having a motor in the back," Buwick said. "It threw off the center of gravity of the plane, making it difficult to make the plane stable." The plane flew successfully and was able to take in-flight videos around the Engineering Quad.

The sailplane was designed to fly over one or more areas for long periods of time for search and rescue and agricultural observation purposes; for example, emergency situation first response, crop assessment or aerial photography, said team member Cameron Breedlove.

With team members Alfred Yeo, Daniel McDermott and Henry Yan, Breedlove designed the vehicle according to known principals for sailplanes: high aspect ratio wings, a small fuselage, and small control surfaces. But, wanting to beef up the traditional design, the team used an embedded ducted fan to power the plane. "Essentially, we made a traditionally slow, elegant plane go really fast," Breedlove said.

The sailplane's requirements were that it have a wingspan of less than 90 inches, be compact enough to be carried by one person, and be able to fly above 40 miles per hour for more than 20 minutes. The team's design had a 72 inch wingspan, weighed about 2.5 pounds, and could reach speeds of 65 miles per hour. "The first time we flew our aircraft it was flown in 12 to 15 mile per hour winds at almost full throttle for about 25 minutes," Breedlove said.

He said the team had to overcome two challenges.

The first was the wings. "We needed a long wingspan on a fairly thin airfoil. This meant that our wings needed to be very strong but also very light." To do this, the wings were made of foam and covered with carbon fiber composites. "First we tried fiberglass but that proved to be too weak. Then we switched to carbon fiber and made the current wings." The wings apparently were strong enough, having survived all the flight tests, extreme maneuvers (not usually part of a sailplane's design) and a hard landing.

"The second major problem came from the ducted fan," Breedlove continued. "It was a challenge to fit the ducted fan in and still keep a solid structure throughout the aircraft. We ended up making a skeleton out of carbon fiber plates that held all of the components and actually used the ducted fan housing for additional structural support."

equipment specifically to create a manufacturing space for student projects.

"We want to bridge the gap between theory and hardware," Elliott said. "We want students to gain experience with manufacturing technology used in aerospace industry, such as metal fabrication, composites, and rapid prototype technology."

The emphasis also has received a boost from the newly established James J. Kessler, Jr., Endowment Fund.

The $157,000 estate gift from the late Jim Kessler, AE alumnus and former McDonnell Douglas Corporation engineer, happily comes at the same time the numbers of student-based projects and students involved in those projects are on the rise.

"The Department is very thankful for this very generous gift," said Geubelle. "Over the past few years, we have placed an increased emphasis on the active participation of all our students in hands-on design/build/fly projects. We look to further expand the number of hands-on projects and courses over the next few years, and the endowed gift from Mr. Kessler will help us provide the necessary resources to provide opportunities to all our students," Geubelle said. *(For more on the Kessler Endowment, see page 20.)*

AE 100 Spacecraft Design course

Airfoil Design: Keeping Selig Moving, *continued from page 7*

as rotate clockwise and counter-clockwise, under remote control and carrying a video camera payload. During a demonstration, the Nano Hummingbird flew in and out of a building through a normal doorway. Project leader Matt Keennon, working with AE alum Karl Klingebiel at AeroVironment, said about Selig, "He has been very helpful over the years when I asked for general advice on airfoil selection, and I really feel he was a strong supporter of our work on small aircraft, and also my personal work on small flying model aircraft. I very much appreciated all of his inputs, and I wouldn't hesitate to call on him in the future. Aside from being an expert in his field obviously, he is a really nice person to work with, even for those with backgrounds well outside of the aero field."

AeroVironment Nano Hummingbird named one of the "50 Best Inventions of 2011" by TIME Magazine. UIUC's involvement included water channel testing airfoils at very low Reynolds numbers. Photo: WikiMedia Commons

Selig, who has owned three Porsches, has a lifetime love for speed, launching his own career when he stood on a high wooden fence and launched model aircraft of his own design. "The Helios got a lot of attention in the press, but my research in flight simulation and modeling has been the most challenging and rewarding. The first time that I was able to model an airplane in a full spin in realtime was the biggest high," Selig said. He added, "It's been a honor to be part of Illinois, from my early days as an undergrad in the department to now being a member of the faculty and doing interesting aerodynamics research with many great students—some who have gone to work at Frasca, Boeing, Gulfstream, Textron, Northrop-Grumman, GE Wind, General Motors, Sauber Motorsport, Porsche/Weissach, and a couple, now faculty, in academia."

—Paul wood has been a reporter for 30 years

Professor Selig's Applied Aerodynamics group picture from April 2012, from left-to-right: Daniel Uhlig, Robert Deters, Michael Selig, Greg Williamson, Brent Pomeroy, Shreyas Narsipur, Adam Ragheb, Chinmay Sapre, Steven Henry, Agrim Sareen, Arjun Rao, Giovanni Fiore, and Gavin Ananda.

Andreas C. Cangellaris Chosen as Engineering Dean

Andreas C. Cangellaris, former head of Electrical and Computer Engineering, has been chosen as Dean of the College of Engineering at Illinois.

"Andreas Cangellaris has shown exemplary leadership as head of his department, in addition to exceptional achievements in education and research," said Ilesanmi Adesida, Vice Chancellor for Academic Affairs and Provost of the Urbana campus. "I am confident that the vision and drive that he will bring as dean will enhance the interdisciplinary scholarship and innovation that characterize the College of Engineering."

Cangellaris is broadly recognized for his research in applied and computational electromagnetics and its applications to the signal integrity of integrated electronic circuits and systems. His research has produced several design methods and computer tools that are used widely in the microelectronics industry. He has written or co-written more than 250 papers. He is affiliated with the Beckman Institute for Advanced Science and Technology and with the Coordinated Science Laboratory at the U. of I.

Cangellaris earned his doctorate in electrical engineering at the University of California, Berkeley in 1985. He joined the faculty at the U. of I. in 1997. He is the M.E. Van Valkenburg Professor in Electrical and Computer Engineering, and he has served as the head of the department since 2008. He was an Associate Provost Fellow on the Urbana campus from 2006 to 2008, a role in which he oversaw the review and revision of guidelines for recruitment, promotion and tenure; worked on campuswide interdisciplinary initiatives; and broadened campus outreach activities.

Cangellaris is a fellow of the Institute of Electrical and Electronics Engineers. He has received a Humboldt Foundation Research Award and the U.S. Army Research Laboratory Director's Coin.

Cangellaris

Michael Bragg Named Dean of UW College of Engineering

Michael B. Bragg, emeritus professor and former interim dean of the College of Engineering at the University of Illinois at Urbana-Champaign, became the new dean of the University of Washington (UW) College of Engineering in July.

He will continue in Aerospace Engineering at Illinois as a Research Professor.

Bragg earned his bachelor's and master's degrees in AE in 1976 and 1977, respectively. He received his PhD in aeronautical and astronautical engineering in 1981 from The Ohio State University, where he initially served as an assistant, and later, as an associate professor.

In 1990, Bragg returned to his alma mater as an AE associate professor. Named a full professor in 1995, he went on to serve as department head for seven years before joining the administrative team in the College of Engineering.

In 2006, Bragg was appointed as the associate dean for research and administrative affairs, overseeing personnel and financial matters, physical facilities, and administration of the research program and graduate programs within the College. Two years later, he was named executive associate dean for the College, overseeing all faculty and academic personnel, budget and resources, diversity activities, and global initiatives. He was instrumental in curriculum innovation, improvement of student resources and research initiatives, and financial innovations. Bragg is also co-founder of two faculty start-up companies at Illinois.

Bragg's primary area of research is aircraft icing where he is an international expert and consultant on the effect of ice accretion on aircraft aerodynamics and flight safety. More than 50 graduate students and five post- doctoral researchers received their advanced degrees under Bragg's guidance. He has directed over $15 million in externally funded research and published more than 200 research papers.

A Fellow of the American Institute of Aeronautics and Astronautics (AIAA) since 2004, Bragg received the AIAA Losey Atmospheric Sciences Award in 1998 and the AIAA Aerodynamics Award in 2007. He recently completed his term as the organization's vice president-publications.

Bragg

Grainger Engineering Pledges $100-Million to Engineering at Illinois

The Grainger Foundation, Lake Forest, Illinois, has pledged $100 million to support the College of Engineering through establishment of the Grainger Engineering Breakthroughs Initiative. The contribution is made in memory and honor of William W. Grainger, a 1919 Illinois graduate in Electrical Engineering, and the founder of W.W. Grainger, Inc.

A substantial portion of the Grainger Foundation gift will create an endowment for engineering chairs and professorships to attract and retain renowned scholars to lead the College's thrust for groundbreaking impact and international stature in engineering research and education. The gift will also create an endowment for high impact engineering research collaborations.

Bioengineering and "Big Data" are two prime areas targeted to receive significant resources for new faculty positions and research support.

A portion of the donation also will provide the leadership gift to launch a $100-million fundraising campaign to endow scholarships for Engineering at Illinois students, and provide another lead gift for the $40 million renovation of the Everitt Laboratory building. The increased scholarship funds resulting from the new endowment will strengthen the College's ability to attract and retain exceptional engineering students. Following the move of the Electrical and Computer Engineering Department to its new building from Everitt Laboratory, Everitt, will be renovated to meet the needs for state-of-the-art facilities for engineering instructional laboratories, new engineering research centers, and the Bioengineering Department.

Kessler Endowment Adds Resource for Student Projects

Student projects in Aerospace Engineering will get a boost from the newly established James J. Kessler, Jr. Endowment Fund.

The estate gift from the late Jim Kessler, who had earned his bachelor's degree in AE in 1971 and had worked 32 years for McDonnell Douglas Corporation, comes at a time when the numbers of student-based projects and students involved in those projects are on the rise.

The $157,000 gift designated for AE is one-third of the total Kessler Edowment, which has been divided among AE; Grainger Engineering Library; and the College of Agricultural, Consumer and Environmental Sciences, particularly several of ACES's University of Illinois Extension programs.

Jim Kessler was born on November 9, 1936, in Asheville, North Carolina. He returned with his parents to Illinois in the summer of 1939, where they settled in the town of Mounds, halfway between where his parents were raised. Kessler graduated from Mounds Township High School in 1954.

He enrolled in the University of Illinois that fall to study architecture, having won the competition for a county scholarship, but he withdrew after three semesters. This abbreviated university education, however, provided the background to be hired for a perfect job. McDonnell Aircraft Company hired Kessler in May 1956 as a Technical Specialist to analyze mass properties of missiles. This job continued for twelve years until it became clear that further advancements in salary grade level were impossible without a college education.

Kessler re-enrolled at the University of Illinois in June 1968 in the Department of Aeronautical and Astronautical Engineering (now AE) and graduated in February 1971. He attended graduate school in that Department until 1972.

McDonnell Douglas Corporation hired him in July 1972 as a structural analyst at their facility in Titusville, Florida. He worked in a variety of positions, culminating in managing research and development of shoulder-fired weapons. He was transferred to St. Louis in September 1988, the same year he became a member of the President's Council of the University of Illinois Foundation. He retired in October of 1992, with 32 years of company service.

Kessler passed away on August 14, 2012.

Undergrad Coordinator Shares Love of Flying with Students

When students come to chat with Laura Gerhold, Aerospace Engineering at Illinois Undergraduate Coordinator, about courses and professors and the day-to-day necessities for getting their degrees, they learn they have a key common interest with her: a love of flying.

Gerhold, who's been working for AE since March 2012, has a pilot's license and was even a flight instructor at the university's Institute of Aviation at Willard Airport in Champaign, Illinois.

"My passion for aerospace began when I was 8 and attended NASA Space Camp in Huntsville, Alabama," Gerhold said. "I then attended the Future Astronaut Training Program in Hutchinson, Kansas, when I was in high school. There my interest in flying started after I got a few rounds in the flight simulator. The summer before my senior year in high school I received a scholarship from the Decatur (Illinois) EAA (Experimental Aircraft Association) Chapter that paid for my private pilot flight training. The instant the plane left the ground on my first training flight I knew I wanted to study aviation in college."

While working on a degree in Natural Resources & Environment from the Urbana campus (BS 2007), Gerhold continued training at the Institute of Aviation, earning her Commercial, Instrument, Certified Flight Instructor and Flight Instructor Instrument ratings. She now flies mostly Cessna 172s and Piper Archers.

While earning her degree, Gerhold returned to Hutchinson, Kansas, for a time to work as a counselor and later a director for the Future Astronaut Training Program and the Aviation Camp Experience before joining the Institute of Aviation and, later, the AE Department.

Laura Gerhold, AE Undergraduate Coordinator

"My love for both aviation and space led me to apply for the position in the Aerospace Engineering Department (at Illinois)," Gerhold said. "I can relate to students who share the same passion and interests as me."

The student Engineering Council recognized the effort Gerhold puts forth in advising students by presenting her the Excellence in Advising Award this past spring. She also helps student organizations plan trips, general meeting and guest speakers. Furthermore, she coordinates class schedules and manages curriculum changes.

"I love working with the students," she said. "I have been blown away with how innovative and creative the undergraduate students are. Their passion and drive are second to none."

This year Gerhold plans to establish a monthly undergraduate seminar series focusing on resume and interview preparation, study abroad opportunities, internships and co-ops, and undergraduate research. Plans are, at the end of each seminar, to feature an alumni Skype spotlight in which alumni talk about careers, answer questions and offer advice. Alumni interested in the program can contact Gerhold at gerhold@illinois.edu or Tim Cochrane at tcochran@illinois.edu.

Milner Honored as Staff of the Year

Greg Milner, Supervisor of the Research Laboratory Shop, has been named Staff Person of the Year for Aerospace Engineering at Illinois.

Milner began in AE in 2005 as a Laboratory Mechanic. He was reclassified to a Senior Laboratory Mechanic in 2007.

Milner was promoted to Instrument Maker in 2009, then became Shop Supervisor in April 2007.

Greg Milner, left, with AE Affiliate Prof. Jim Phillips

Welcome AE Students!

Graduate Students

Aerospace Engineering at Illinois welcomes 39 new graduate students, for a total graduate student enrollment of 127 this fall! Of those, 67 are U.S. citizens or permanent residents. The remainder bring to Illinois worldwide diversity from countries including China, Korea, India, Turkey, France, the Netherlands, Italy, Australia, and Brazil. The students' research interests are spread among AE's topical concentrations:

- Aerodynamics, Fluid Mechanics, Combustion and Propulsion
- Astrodynamics, Controls and Dynamical Systems
- Structural Mechanics and Materials
- Systems Engineering

Freshmen and Transfer Students

At 133, the Fall 2013 addition of new undergraduates (freshmen and transfer students) represents the largest incoming class that AE at Illinois has seen in recent years! They also are exceptionally bright, averaging a score of over 32 on their ACT exams! The new undergraduates come from Illinois, Arizona, California, Connecticut, Georgia, Louisiana, New Jersey, New York, Oregon, Pennsylvania, Virginia, Washington, China, India, Indonesia, Italy, Pakistan, Singapore, Taiwan, Thailand, and United Arab Emirates. Their addition brings total AE undergraduate enrollment to 410.

ISS Team Plans around Human Factors in Mars Mission Competition

The human factor poses the greatest challenge to a manned mission to Mars, an Illinois Space Society (ISS) group of undergraduates learned as they competed and grabbed third place in a national space exploration competition.

The ISS project dubbed NERIO-I (Nuclear Explorations for Realizing Interplanetary Objectives-I) was one of nine chosen to compete in the National Instittue of Aerospace (NIA) Revolutionary Aerospace Systems Concepts Acacdemic Linkage (RASC-AL) program. This was the first time an Illinois team competed in the program. "Once you factor humans into the picture, everything becomes more complicated and more expensive," said team leader Braven Leung. "Keeping a crew alive in space requires so much more effort than just sending out probes. That's why we've done rovers and satellites in the past. With humans, we'd have to take technology and mission planning to a whole new level, which is really exciting, but kind of slow at the same time. The margin for failure here is very small; that's why there's a lot of deliberate procedures and protocol that really drag out the timeline. It's a trade-off between safety/reliability vs. time/cost."

The group of nine students, mostly from Aerospace Engineering at Illinois, sought to answer the challenge with designs for better space suits, radiation shielding, and a biomass chamber.

"For a while, our catchphrase used to be 'Iron Man is going to Mars!'" Leung said, as the team members referenced the innovative exosuit they proposed to enhance and preserve the physical performance of a crew during their time in space. "You can be surprised at how fast muscle and bone mass deteriorates in zero G. You'd need to combat that especially since a trip to Mars and back would exceed at least 18 months. Again, the human focus was big and we wanted to make sure that the people we sent would be safe."

The ISS project dubbed NERIO-I (Nuclear Explorations for Realizing Interplanetary Objectives-I) was one of nine chosen to compete in the National Institute of Aerospace (NIA) Revolutionary Aerospace Systems Concepts Academic Linkage (RASC-AL) program. This was the first time an Illinois team competed in the program.

"The idea has been around for so long, and it seems like we've been waiting forever for this to happen," he continued. "One of the reasons a manned mission won't happen in the next decade or so is because there are still some critical technologies that need to be developed. Better propulsion, cheaper, efficient access to space, and radiation shielding are a few areas that need some improvement if we want to see ourselves on Mars," Leung said. "Thus, our group set out to learn more about what it takes to land people on the elusive red planet."

The ISS team had these mission constraints:

- Four-person crew minimum
- 30-day minimum Mars surface stay
- Maximum two-year total mission
- No more than five cargo launches of a 130-mT (LEO) payload launch vehicle with a 10-meter-diameter payload shroud
- Leveraging NASA's Space Launch System (SLS) in the mission analysis, or justifying a different launch system if it were determined NASA's SLS was not the best option
- One crew launch

Among the innovations the ISS team proposed were nuclear electric propulsion, improved radiation shielding and countermeasures, human technology advances, and a biomass chamber unit to pave the way for extended deep-space excursions. The team's full report is available at www.nianet.org/RASCAL/images/University-of-Illinois-at-Urbana-Champaign-Final-P.aspx.

Six members of the team traveled with their advisor, AE Prof. Bruce Conway, for the four-day competition in Cocoa Beach, Florida. Their award was based on the quality of the 40-minute presentation in which all team members took part, as well as technical factors.

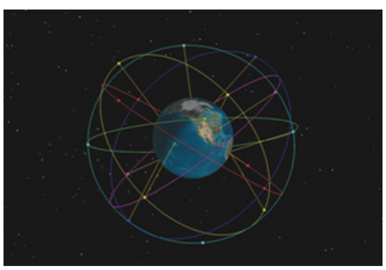
Here are the ISS team members who participated:

- Braven Leung, AE, Team Leader/Systems Engineer/Assist Structural Engineer
- Jason Allen, AE, Orbital Mechanics
- Stanley Chan, AE, Human Factors/CAD Modeler
- Jobin Kokkat, AE, Launch Systems/Assist Human Factors
- Timothy Lanham, AE, Communications
- Julia Liu, AE, Thermal Systems
- Christopher Lorenz, AE, Structural Engineer
- Anthony Park, NPRE (Nuclear, Plasma, and Radiological Engineering Department) Power Systems
- Dayne Rogers, AE, Orbital Mechanics/CAD Modeler

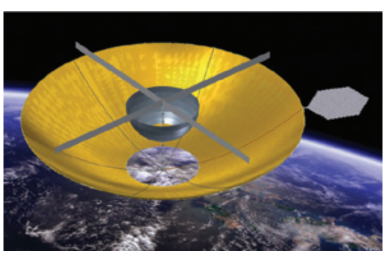
Illinois Teams Take First, Second in AIAA Space Design Competition

First place team, "SolPower"

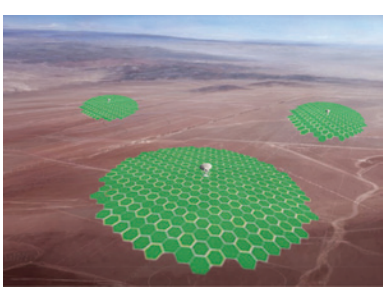
When asked to design a space-based solar power system, one Aerospace Engineering at Illinois team responded with a swarm of 24 satellites that could beam power to at least eight locations worldwide. Another team opted for four satellites sending power to the United States, India, and Australia, with the additional incentive of forging valuable partnerships among the three countries.



SolPower orbit



SolMate



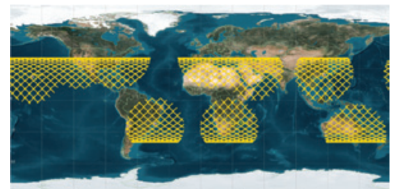
SolPatches

The two AE at Illinois teams recently came away with the top two places in the 2012-2013 Undergraduate Team Space Design Competition sponsored by the American Institute of Aeronautics and Astronautics (AIAA).

"It is incredibly gratifying to see such excellent and hard-working students from Aerospace Engineering at Illinois receive these national AIAA awards," said AE Adjunct Prof. David L. Carroll, who advised both teams. "They went 'all-in,' and the product reflected the amount of effort by and creativity of the two teams."

The first place team, "SolPower," earned a $1,500 award from the AIAA Foundation for the swarming satellite proposal. The "SolPower" system called for the swarm to be divided so four satellites in six different orbital planes would travel 7,500 kilometers above the earth in configurations similar to the Global Positioning System network.

The plan proposed having two Falcon X Heavy Rockets deliver each SolMate satellite into orbit in two separate pieces, according to team leader Brian Levine. One launch would contain the hexagonal microwave transmitter, while the other would bring up the reflecting mirror, solar panels, and supporting structure. The smaller transmitter hexagon elements would unfold one by one to form a full-sized hexagon, while the solar panels and reflecting mirror would unfold like an umbrella. All of these actions, as well as the joining of the two units, would be completed automatically in orbit.



SolPatches coverage map

The satellites would transmit about 50 megawatts each via microwave beaming to deployable rectenna arrays called SolPatches that would be located around the world. Permanent locations proposed were Australia, Brazil, Hong Kong, North Carolina, Las Vegas, Saudi Arabia, South Africa, and Tunisia, while smaller ground stations could be transported to any location within 40 and -40 degrees latitude to receive power. "The portable SolPatches were created with military applications and national disaster relief efforts in mind; situations in which having quick access to a reliable source of electricity is critical," Levine said.

The team realized that the plan would distinguish itself if it focused on the power system's worldwide accessibility. "We increased the number of satellites, which allowed us to decrease the size of each satellite, the amount of launches required, total cost, and the risk associated with losing a satellite," the team leader notes. "Once we got going down this road, the whole team bought into the idea and really produced something amazing."

Throughout the process, team members learned they needed to compromise with one another to reach their goal. "We all really wanted to pick a size/mass/altitude and stick with it, but an issue in one system could only be corrected by changes made in many others," Levine said.

The team was invited to present the design at the AIAA Space 2013 Conference and Exposition held September 10 in San Diego, California. Team members are:

- Brian Levine, Lead Engineer
- Cory Cameron, Ground Stations
- Philip Freidin, Communications
- Izan Peris Marti, Structures
- Michael Reindl, Payload Power
- Jason Swenson, Spacecraft Power/Thermal Systems
- John Teuber, Launch Systems
- Ernest Company Vallet, Orbital Requirements

The AE team "Future Power Systems" took second place in the competition and a $750 prize for the design configuration, "Sienna403." The design called for four sun-facing satellites orbiting 7,000 kilometers from Earth, and three receiving ground stations in DeSoto County, Florida; Charnka Solar Park, India; and Alice Springs, Australia.

"The Sienna403 system is unique in that it is completely scalable in three different ways: the number of satellites, the orbital configuration, and the number of power receivers on Earth," said team leader Laura Richardson. "This ensures that a country's particular needs are satisfied. It is (Future Power System's) ultimate goal to achieve a configuration that is capable of providing power to homes and businesses in every country around the world."

"Furthermore," she continued, "during the deployment and operation of the four Sienna403 satellites, valuable partnerships will be formed between the U.S., India, and Australia that will set the trend for a future global alliance. This partnership is strengthened by the addition of more countries that will be eager to join FPS's mission."

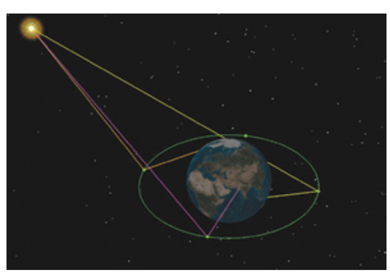
The plan employed developing technology, including thin film solar arrays set on a Kapton substrate, coilable masts and booms, and foldable graphite-mesh springback ("taco shell") antennas. At $17.6 billion, the design was kept under budget and would be operational by 2036, beating the 2040 deadline that the competition required, Richardson said.

Among the plan's challenges was the size of the system. "In order to harvest 1 GW of solar power on Earth, the power collectors on the satellites need to be on the order of km^2, regardless of collection type. Nothing of this scale has ever been launched into space before, so there wasn't much to research or base our design off of!" Richardson said.

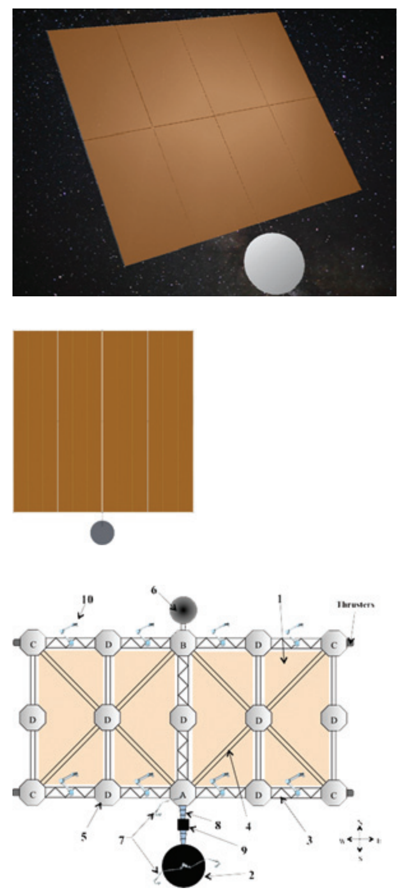
Second place team, "Future Power Systems"

Future Power Systems' team members were:

- Laura Richardson, Lead Systems Engineer, Overall Mission Architect
- James Broches, Launch Systems Engineer
- Yolanda Dionicio, Ground Power Engineer
- Kevin Skender, Spacecraft Power/Thermal Engineer
- Tomasz Slota, Orbital & Coverage Requirements Engineer
- Nicholas Virgilio, Communications, Command & Data Handling Engineer
- Ariel Wilhelmsen, Structural/ Radiation Shielding Engineer
- Joshua Zimmerman, Payload Power/Thermal Engineer



Future Power Systems orbit



Future Power Systems graphics

Aerospace Graduate Student Awarded NSF Fellowship for Robotics Research

AE graduate student Andy Borum has been awarded a Graduate Research Fellowship from the National Science Foundation.

The three-year fellowship, which covers tuition and a stipend for living expenses, allows students opportunities for international research, professional development and additional resources, such as access to an NSF supercomputer.

Borum graduated from Virginia Tech in 2012 with a bachelor's degree in engineering mechanics and mathematics. His research at Illinois focuses on robotic manipulation of flexible objects.

"It is relatively easy to have a robot pick up, manipulate and put down a rigid object, such as a pen," Borum said. "However, doing this with a flexible object, such as a piece of paper, wire or cable, is much more challenging."

Borum added that since a piece of paper can take nearly an infinite number of shapes, it's difficult to give a robot a mathematical description of all the possible shapes a piece of paper could take. Using principles from optimal control theory and differential geometry, Borum and his advisor, AE Associate Prof. Tim Bretl, have created an algorithm to simply communicate the shapes to a robot.

Bretl and Borum, along with electrical and computer engineering graduate student Dennis Matthews and Illinois 2013 bachelors in aerospace engineering graduate Vishwa Shah, BS 13, are working with two robots in Talbot Laboratory and the Coordinated Science Laboratory to test their theories. Baxter, the robot housed in CSL, is a low-cost robot designed to help automate manufacturing in small and medium sized businesses. They are testing their hardware on Baxter, who could be used to assemble flexible parts, such as installing a cable harness in a car. In addition to the practical side of the research, the researchers are working to add additional aspects to their theory, such as taking into account gravity.

AE Graduate Student Receives ARCS Foundation Scholar Award

Aerospace Engineering at Illinois graduate student Michael R. Dorothy has received an ARCS Foundation Scholar Award.

ARCS Foundation advances science and technology in the United States by providing financial awards to academically outstanding U.S. citizens studying to complete degrees in science, engineering, and medical research. The award provides scholars with a tuition/fee waiver and a stipend and is renewable for up to three years.

Dorothy, who earned a bachelor's degree in aerospace engineering from Iowa State University, works with Assistant Prof. Soon-Jo Chung on flapping flight research, and has helped to build a RoboBat, a robotic bat, for experiments. The work was chosen for the Best Paper presented during the American Institute of Aeronautics and Astronautics 2009 Infotech@Aerospace (I@A) Conference.

Said Dorothy: "Humans and animals don't have to consciously think about many repetitive, rhythmic motions such as walking, swimming, or flapping wings. Multiple oscillators in the spinal cord coordinate with low-level reflexes, say, perhaps, from tripping, to automate most of the process. Then, the brain only needs to think about and send high-level signals: do I want to walk or run?

"My research explores the properties of these oscillator networks," he continued. "How do we build them so that they'll synchronize quickly and remain stable? How do we embed them in a robot in a way that will make top-level control design easier? Then, we apply the results to a bat-like flapping flier."

Aerospace Systems Engineering: Defining Systems for Exploring Mars

BY STEVEN J. D'URSO, AEROSPACE SYSTEMS ENGINEERING PROGRAM COORDINATOR AND LECTURER

The Aerospace Systems Engineering 2012-13 class at Illinois took on a topical challenge of defining the scientific systems used in exploring the surface of Mars.

The AE graduate students were invited to present a paper outlining their results and accomplishments during the American Institute of Aeronautics and Astronautics Space 2013 Conference & Exposition held September 10-12 in San Diego, California.

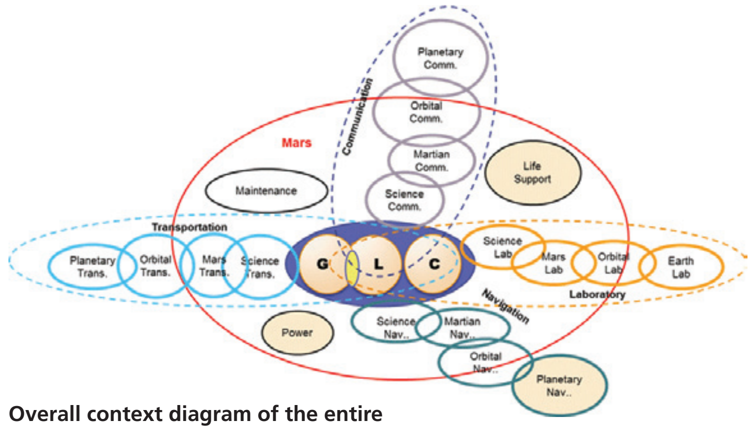
Real-world, complex systems development topics frame the AE542/AE543 sequence. Systems thinking is emphasized, and the systems engineering approach leads to defining objectives, capability, operation concepts, functionality, and requirements for the program discovery phase that further defines architectures and synthesis. Along the way, systems engineering processes and tools are introduced.

In the fall of 2012 the course used an extension to the National Aeronautics and Space Administration's Mars Design Reference Mission Five. This represents a continuation of the previous year's Mars mission study, which focused on in-space transit between Earth and Mars.

The Mars surface mission's objective is to conduct scientific exploration on that planet to investigate life, climate, and geology, and determine whether human presence can be sustained there. This objective satisfies the needs of the stakeholders, including NASA's astronauts and planetary scientists, foreign space agencies, manufacturers, contractors, private industries in the space sector, the United States government, the United States public, and the public around the world.

The AE Systems Engineering students discovered that developing concepts-of-operations led to a functional decomposition approach. Function flows enable mission planners to develop operational functional vignettes and system architectures. This process creates a foundation for accomplishing the mission's objectives.

In their work the students identified the tasks necessary to execute pre-mission setup, scientific objectives, and post-mission needs. The tasks were assembled to



Overall context diagram of the entire Mars surface system

create a functional hierarchy, and the functional segments were then employed to develop systems and requirements. The students divided the Mars surface mission structure into three levels:

The science objectives of climate, geology, life, and ancillary systems dictated the top level of systems.

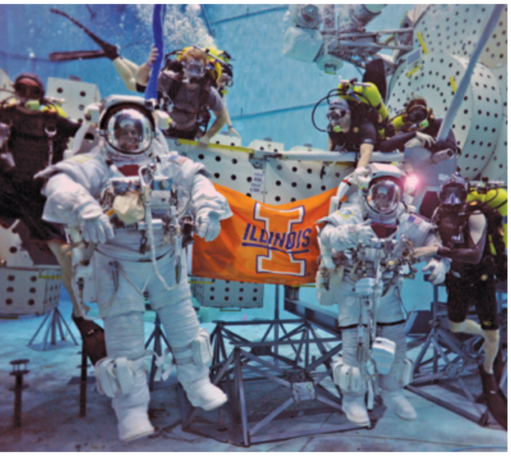
Segment systems formed the intermediate level. Segment systems interface with other surface systems such as transportation, navigation, communication, life support, maintenance, and power. Some systems, like life support and power, are referred to as "city services," because they are necessary for all activities throughout the stay on Mars.

Finally, mission specific systems that include the laboratory, orbital measurement, and decontamination systems, comprised the third level.

Applying this approach to a selected set of "systems-of-interest" demonstrated the method's feasibility. The students individually undertook a "system-of-interest" for further investigation. They selected drilling, navigation, transportation, laboratory, and communication systems.

In addition, the students investigated interfaces between the "systems-of-interest," and followed that by defining systems boundaries. This effectively bound the derived functional requirements corresponding to each system. Martian surface functional requirements were decomposed following the functional architecture. Performance requirements characteristics were established for each higher-level function the system performed.

AE Undergrad Wins National Space Club Keynote Scholarship



Erik Lopez obtained these photos while working in the Neutral Buoyancy Laboratory at Johnson Space Center.

Erik Lopez, fourth from the left, at the Johnson Space Center Neutral Buoyancy Laboratory. Also pictured at left, is astronaut and AE alumnus Michael Hopkins, who traveled to the International Space Station in September.

In March 2012, Erik Lopez and several other Aerospace Engineering at Illinois undergraduates sat in the audience listening as a high school student addressed a couple of thousand aerospace professionals gathered for the Goddard Memorial Dinner in Washington, D.C.

Impressed, Lopez tapped a friend on his shoulder and predicted, "Next year, that's going to be me up there."

A year later, Lopez was true to his word.

Lopez was selected as the 2013 winner of the inaugural National Space Club Keynote Scholarship, an honor that secured his role as the keynote speaker during the club's 56th Annual Robert H. Goddard Memorial Dinner on Friday, March 22, at the Washington Hilton.

Created in 2012 by the National Space Club, the Keynote Scholarship is awarded a high school senior, undergraduate or graduate student whose intention is to pursue a career in the science, technology, engineering or mathematics (STEM) fields. The winner receives a $10,000 scholarship as well as the honor of delivering the keynote address. To qualify, scholarship hopefuls complete online applications and submit 3-minute videos on why space inspires them.

The National Space Club Executive Committee gathered over 100 applications and conducted interviews of the three finalists in early January. Shortly thereafter, Lopez was on the road with his father, traveling to Houston to begin a Co-Op experience at the NASA Johnson Space Center, when he got the call announcing him as the winner.

"When I saw the call was from Washington, D.C., we immediately pulled over and I was hoping for the best," Lopez said. "I was in shock, honestly. Considering how the interview went, I wasn't sure that I was what they were looking for. It was my chance to make an impact so I took a serious tone in the interview.

"I was ecstatic; I'm very blessed," he said.

The National Space Club flew Lopez and his parents to Washington, D.C., on March 19, and his speech was very well received, earning a standing ovation from the 2,000 in attendance. The video can be viewed at www.youtube.com/watch?v=cn9I4kEFO60#t=2m0s.

Lopez expanded upon his interest in space pursuits over the summer with an internship at the Johnson Space Center.

"My internship led me to the Neutral Buoyancy Laboratory where I worked as a Flight Lead," Lopez said. "I was a liaison between the dive team and the instructors to prepare hardware for astronaut training. I would prepare checklist to make sure the pool was perfectly configured to match the International Space Station."

"When I wasn't doing that, I would scuba dive while the astronauts were doing their training to observe and learn more about the process. In addition to that, I was able to participate in some of the training flow that the astronauts would including learning how to operate the Robotic Arm on the ISS and taking class on Extra Vehicular Activity tools."

Aerospace Engineering Honors Outstanding Students

AE recognized several of the Department's undergraduate and graduate students this spring with awards for their scholastic achievement and other contributions.

AIAA Scholastic Achievement Award, to the senior graduating in May 2013 with the highest class GPA—**Paul R. Schlais of Gurnee, IL**, and, graduating in December 2013—**Jennifer A. Roderick of Taylor Ridge, IL.**

H.S. Stillwell Memorial Award, to students showing outstanding scholastic achievement and contributions in extracurricular activities—**Xichen Shi of Shanghai, People's Republic of China**, and **David J. Hanley of Orland Park, IL**.

The H.S. Stillwell Memorial Award was established in honor of Professor H.S. (Shel) Stillwell. At the age of 27, Professor Stillwell founded the Department of Aeronautical Engineering at the University of Illinois in 1944. He served as department head at Illinois for 32 years. Professor Stillwell was influential in the design of the first ramjet-powered missile and was highly respected for his contributions to aerospace engineering education.

H.S. Stillwell Problem-Solving Scholarship, to a junior-level student majoring in aerospace engineering who exhibits exemplary problem-solving skills—**Derek Chen of Edison, NJ**.

This scholarship was set up by a generous alumnus as a tribute to H.S. Stillwell and the role he played as a mentor to students.

Robert W. McCloy Memorial Award, to a junior or first-semester senior student in recognition of outstanding academic performance—**Brandon P. Boyce**.

Professor McCloy was the first faculty member hired in the new Dept of Aeronautical Engineering. He was known for his research and teaching in propulsion and for his pioneering work in jet propulsion.

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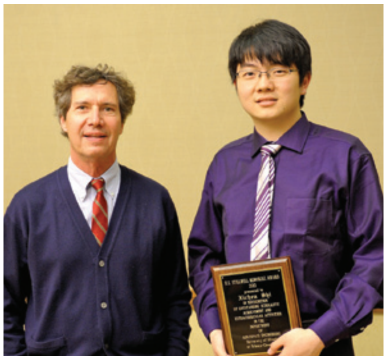
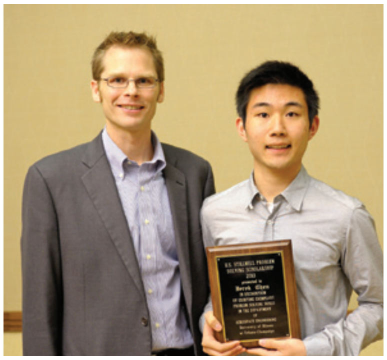
Research Prof. Thomas Jackson with Paul R. Schlais

Research Prof. Thomas Jackson with Jennifer A. Roderick



Prof. Bruce A. Conway with Xichen Shi

Prof. Bruce A. Conway with David J. Hanley



Assistant Prof. Daniel J. Bodony with Derek Chen

Brandon P. Boyce with Department Head Philippe Geubelle

Braven C. Leung with Academic Advisor Laura A. Gerhold

Akash A. Shah with Academic Advisor Laura A. Gerhold

Sapna V. Patel with donor Rob Chappell

Jessica T. Lauzon with Prof. J. Craig Dutton

William P. Flaherty with Associate Prof. Joanna M. Austin

Prof. Bruce A. Conway with Aishwarya Stanley

Department Head Philippe Geubelle with Daniel V. Uhlig

Interim Dean Michael B. Bragg with Phillip J. Ansell

Dale Margerum Memorial Award, to the AE undergraduate who exemplifies outstanding leadership qualities by participation in departmental extracurricular activities—**Braven C. Leung of Glenview, IL**, and **Akash A. Shah of Mumbai, India**.

Dale Margerum was a 1979 graduate who died in an accident the summer after graduation. He was very involved in extracurricular activities.

Jo Ann Haynes Platt & Daniel Wall Platt Memorial Award, to the AE sophomore, junior or senior female undergraduate James Scholar and/or Chancellor's Scholar studying aerospace engineering—**Sapna V. Patel of Carol Stream, IL**

Lee H. Sentman III Scholarship, presented annually to an Aerospace undergraduate student based on academic achievement—**Jessica T. Lauzon of Sandwich, IL**

AE Academic Scholarship, a 4-year scholarship awarded to an incoming freshman based on outstanding academic performance—**Melanie A. Ciancio of Villa Park, IL; Jessica K. Gonzalez of Homewood, IL**; and **Kelsey R. White of Downers Grove, IL**.

Rockwell-Collins Scholarships, awarded to sophomore or junior-level AE students in recognition of outstanding academic performance—**Jason B. Allen of Arlington Heights, IL; Brian J. Gardas of Chicago, IL;** and **Kyle C. Pieper of Henry, IL**

Illinois Space Grant Scholarships, awarded by the NASA Illinois Space Grant Consortium to entering and continuing undergraduate students based on academic performance—**Brandon P. Boyce of Crystal Lake, IL; Yolanda M. Dionicio of Evanston, IL; Leonardo T. Gomes of Naperville, IL; Erik A. Lopez of Los Angeles CA; Jennifer A. Roderick of Taylor Ridge, IL;** and **Paul R. Schais of Gurnee, IL**

Roger A. Strehlow Memorial Award, to a graduate student in recognition of outstanding research accomplishment—**William P. Flaherty of Tyngsboro, MA.**

The award is presented annually to honor Professor Strehlow, who joined the aero faculty in 1961. His *background was in chemistry, and he was an acknowledged expert in the field of detonations and explosions. He also made significant contributions toward the understanding of the structure, stability, and extinction of laminar premixed flames. He was an early advocate of microgravity combustion research and successfully characterized the extinction and flammability states of flames under microgravity conditions. Professor Strehlow was the first AIAA Fellow in the Department of Aerospace Engineering.*

Faculty Outstanding Graduate Award, in recognition of outstanding contributions to the Department's teaching and/or research missions—**Aishwarya Stanley of Savoy, IL**

Kenneth Lee Herrick Memorial Award, presented annually to a graduate student in recognition of outstanding research and academic performance—**Daniel V. Uhlig of Urbana, IL**

AE Alumni Advisory Board Fellowship, presented annually to a graduate student in recognition of outstanding research, academic performance, and research accomplishments—**Phillip J. Ansell of York, PA**

Illinois Space Grant Fellowship, presented to entering and continuing graduate students by the NASA Illinois Space Grant Consortium and based on academic and research performance—**Joan M. Stupik of Higganum, CT; Marianne C. Monastero of North Bellmore, NY;** and **Jorge A. De la Mata of Palmetto Bay, FL**

H.S. Stillwell Fellowships, presented annually based on merit to incoming graduate students—**Robyn L. Macdonald of Urbana, IL; Andrew McKenzie of Irvine, CA; Xichen Shi of Shanghai, People's Republic of China;** and **Eliot I. Wycoff of Urbana, IL**

AE students also recently have garnered awards from several other organizations.

College of Engineering Boeing Scholarships—Manue Jr Martinez of Chicago, IL; Jessica K. Gonzalez of Homewood, IL; Derick A. Carnazzola of Libertyville, IL; and **Michael S. Miller of Forsyth, IL**

National Science Foundation Graduate Research Program Fellowship—Marianne C. Monastero of North Bellmore, NY

Bronze Tablet Awards, recognizing high academic achievement and awarded to the top three percent of undergraduate students across the U of I campus. The names of this select group of students are inscribed on bronze tablets displayed on the first floor of the Main Library—**Jeffrey B. Lawson of Bloomington, IL**; **Paul R. Schlais of Gurnee, IL**; and **Xichen Shi of Shanghai, People's Republic of China**

National Space Club Keynote Scholarship—Erik A. Lopez of Los Angeles, CA

ARCS Foundation Scholar Award—Michael R. Dorothy of Champaign, IL

Mavis Memorial Fund Fellowship Award—Jeffrey M. Diebold of Chalfont, PA; and **Galina V. Shpuntova of Naperville, IL**

Illinois Engineering Enhanced Scholarship—Daniel L. Bill of Romeoville, IL, and **Jessica Lauzon of Sandwich, IL**

Engineering Excellence Scholarship—David R. Brandyberry of Mahomet, IL, and **Jacob R. Dluhy of Riverside, IL**

Illinois Engineering Achievement Scholarship—Jessica K. Gonzalez of Homewood, IL

Illinois Engineering Premier Scholarship—Christopher G. Lorenz of Urbana, IL; Michael S. Miller of Forsyth, IL; and **Jeffrey D. Pekosh of West Chicago, IL**

SURGE (Support for Under-Represented Groups in Engineering) Fellowships—Rebecca Foust of Columbia, MD, and **Christopher C. Herrera of Urbana, IL**

Graduate College Fellowship—Christopher C. Herrera of Urbana, IL

NSF Integrative Graduate Education and Research Training—Hongan Mary Nguyen of Urbana, IL

More photos can be viewed on the Aerospace Engineering Facebook Page.

AE Alum Travels to International Space Station

Hopkins

Aerospace Engineering alumnus Michael S. Hopkins embarked upon his first mission as an astronaut when he traveled to the International Space Station on September 25.

Hopkins, BS 92, joined the ranks of other University of Illinois astronauts, Col. Lee Archambault, BS 82, MS 84; Capt. Scott D. Altman, BS 81; Col. Steven R. Nagel, BS 69; Joseph R. Tanner, BS 73 *Mechanical Science & Engineering;* and Dale A. Gardner, BS 70 *Engineering Physics.*

NASA has plans to connect Hopkins in a live chat with selected University of Illinois students on October 29 while he would be aboard the Space Station. Hopkins, a colonel in the U.S. Air Force, journeyed aboard a Soyuz spacecraft after launching from the Baikonur Cosmodrome in Kazakhstan. He is scheduled to return to Earth on March 12.

His duties while in space focus on biological research, including studying cells and protein growth. "There's a possibility while we're up there that we could have some ants come on board, so that could be very exciting to have some pets for a little while," he said at a news conference prior to the launch.

Hopkins was selected in July 2009 as one of 14 members of that year's NASA astronaut class, and was the first in that class to head into space. He recently graduated from Astronaut Candidate Training, which included scientific and technical briefings, intensive instruction in International Space Station (ISS) systems, Extravehicular Activity (EVA), robotics, physiological training, T-38 flight training and water and wilderness survival training.

Hopkins was Team Captain of the 1991 University of Illinois football team and was a Distinguished Graduate of the Reserve Officers Training Corps while he was on campus. He has earned several medals for his work throughout his career, and had served as a special assistant to the Vice Chairman of the Joint Chiefs of Staff.

Space Shuttle Veterans Altman, Nagel, Return to Campus for Talks

Nagel with Emeritus Prof. Harry Hilton

Astronauts Scott Altman and Steve Nagel, both Aerospace Engineering at Illinois alumni, honored their alma mater in April by returning to campus to present talks about their experiences on space shuttle missions.

Altman, who has flown four space flights and commanded two sent to repair the Hubble Space Telescope, was the keynote speaker for Illinois Space Society's Illinois Space Day, held April 14. The outreach program invites grade school and high school students and their families to campus to learn about space and space sciences.

Altman, BS 81, gave an overview of how he became an astronaut, highlighting his time at the University of Illinois and his service as a pilot for the U.S. Navy. He told about his mission to repair the Hubble Telescope, describing the training needed for the mission and how he managed when operations did not go as originally planned.

Gearing his talk for undergraduate and graduate students, Nagel gave a more technical presentation to a campus audience of about 75 people on April 24. His overview examined the hours-long process required for a space shuttle to re-enter Earth's atmosphere.

"It's like when you're on a big camping trip and you're packing to go home; it takes several hours to get ready to descend," said Nagel, BS 69.

Nagel also is a veteran of four space shuttle flights.

Altman at Illinois Space Day

AE Alum Presented National Medal of Technology and Innovation

President Barack Obama presented Aerospace Engineering alumnus George R. Carruthers with the National Medal of Technology and Innovation in a ceremony on February 1, 2013, at the White House.

Carruthers, among the earliest African Americans to earn an AE degree (BS 1961, PhD 64, MS in Nuclear, Plasma, and Radiological Engineering, 1962) was one of seven scientists nationwide recognized with the medal. A video of the presentation is available at www.youtube.com/watch?v=yZX6GI2sLWU&t=21m36s.

Influenced by the Space Race of the late 1950s and 1960s, Carruthers, a scientist at the Office of Naval Research Laboratory, performed groundbreaking work in far ultraviolet astronomy. His efforts led to a patent for pioneering instrumentation, an image convertor for detecting electromagnetic radiation, especially in short wave lengths. In 1970 he gained international attention when the photographs from his rocket-borne telescope of ultraviolet star radiation brought long-sought proof that hydrogen atoms are converted to molecules in dust clouds in interstellar space and catalyze the birth of stars. In 1972 his far ultraviolet camera spectrograph was sent to the moon with the Apollo 16 mission, allowing ONRL to take readings of and understand objects and elements in space that are unrecognizable to the naked eye. The camera, which remains on the moon, provided views of stars and solar systems millions of miles away.

A second version of the camera was sent on the 1974 SkyLab space flight to study comets, and was used to observe Comet West, Comet Kohoutek and Halley's Comet. Carruthers' instruments were involved in capturing an image of a Leonid meteor shower entering the earth's atmosphere, the first time a meteor has been imaged in the far ultraviolet from a space-borne camera.

US Black Engineer magazine in 1993 named Carruthers among the first 100 recipients of the Black Engineer of the Year award. As the head of the Space Science Division's Ultraviolet Measurements Group, Carruthers in the year 2000 received the first Outstanding Scientist Award from the National Institute of Science, which provides for the exchange of scientific information and the presentation of scholarly research papers by science students and faculty members primarily from Historically Black Colleges and Universities. BlackEngineer.com in 2010 listed Carruthers among the 50 Most Important Blacks in Research Science.

Carruthers received the AE Outstanding Recent Alumnus Award in 1974, and the College of Engineering at Illinois Alumni Award for Distinguished Service in 1975. Other honors Carruthers has received include:

- 1970, The George Washington University's Arthur S. Flemming Award, recognizing outstanding men and women in the federal government
- 1972, National Aeronautics and Space Administration Exceptional Achievement Scientific Award
- 1973, The American Astronomical Society's Helen B. Warner Prize for Astronomy
- 2003, induction into the National Inventors Hall of Fame.

As a youngster growing up in Milford, Ohio, Carruthers enjoyed reading science fiction and constructed model rockets with the help of his father, a civil engineer. At the age of 10, Carruthers built his first telescope with a cardboard tube and a lens he purchased through mail-order. He was 12 when the family moved to Chicago following his father's death. There, Carruthers frequented libraries and museums, including the Adler Planetarium, and joined the Chicago Rocket Society.

Carruthers has been active in many groups aimed at encouraging African Americans to be technologically literate and become involved in science and technology careers. Among them have been the National Technical Association, the National Society of Black Physicists, Project SMART and NASA's District of Columbia Space Grant Consortium.

Farquhar Receives College's Distinguished Service Award

Farquhar

Aerospace Engineering at Illinois alumnus Robert W. Farquhar, was chosen to receive the 2013 College of Engineering Alumni Award for Distinguished Service.

A 50-year veteran of deep space missions and a member of the National Academy of Engineering, Farquhar has made pivotal contributions to deep space missions to asteroids and comets. He led the NEAR (Near Earth Asteroid Rendezvous) mission to Eros.

The NEAR Shoemaker craft, launched in 1996, was the first space probe to orbit and perform an in-depth investigation of an asteroid and then safely land on it. The Eros landing occurred February 12, 2001. Farquhar directed the NEAR mission, designed to answer many fundamental questions about the nature and origin of asteroids.

Also among Farquhar's career highlights has been the ISEE-3/ICE (International Sun-Earth Explorer/International Cometary Explorer) mission. As the mission's flight director, Farquhar led the crew that flew the spacecraft through the tail of the P/Giacobini-Zinner comet in September 1985. This was the first successful mission to a comet.

Farquhar's knowledge of halo orbits, a term that he had coined in his 1969 dissertation at Stanford University, was critical in calculating the trajectory for the successful ISEE-3/ICE mission.

That mission was carried out as part of Farquhar's assignments for the NASA/Goddard Space Flight Center in Greenbelt, Maryland. Also while working at NASA HQ, Farquhar was program manager for the Halley's Comet Mission.

The NEAR mission was accomplished during Farquhar's tenure from 1990 to 2007 with the Applied Physics Laboratory at John Hopkins University in Laurel, Maryland. Also while there, he directed the CONTOUR (Comet Nucleus Tour) Mission; the MESSENGER (Mercury Surface, Space Environment, Geochemistry, and Ranging) Mission to the planet, Mercury; and the New Horizons Mission to the planet, Pluto, and its moon, Charon.

Farquhar, now an executive for space exploration at KinetX Inc. in Tempe, Arizona, has achieved many previous honors and awards for his contributions, including:

- Charles A. Lindbergh Chair of the National Air & Space Museum 2007
- American Institute of Aeronautics & Astronautics Fellow 2004
- National Air and Space Museum Trophy for Current Achievement 2002
- NASA Medal for Exceptional Engineering Achievement (NEAR) 2002
- Tycho Brahe Award (The Institute of Navigation) 2001
- Laureate Award for Space (Aviation Week & Space Technology) 2001
- Space Pioneer Award (National Space Society) 2001
- Baltimorean of the Year (Baltimore Magazine) 2000
- The John V. Breakwell Memorial Lecturer, 1998
- Member of International Academy of Astronautics 1996
- Laurels for 1996 (Aviation Week & Space Technology)
- Asteroid #5256 named Farquhar 1992
- NASA Medal for Exceptional Engineering Achievement (ISEE-3/ICE) 1988
- Distinguished Visiting Professor (Japan's Institute of Space and Astronautical Science) 1987
- Fellow of the American Astronautical Society 1986
- Letter of Commendation from President Ronald Reagan 1984
- Dirk Brouwer Space Flight Mechanics Award (American Astronautical Society) 1984
- Moe Schneebaum Memorial Award (NASA Goddard Space Flight Center) 1984
- Laurels for 1982 (Aviation Week & Space Technology)
- Mechanics and Control of Flight Award (American Institute of Aeronautics and Astronautics) 1981
- Distinguished Alumnus Award, AE Department, University of Illinois, 1980
- NASA Exceptional Service Medal (ISEE-3/ICE) 1979
- Member, Committee on Planetary and Lunar Exploration (National Academy of Sciences) 2003-2005.

Farquhar wrote the book, *Fifty Years on the Space Frontier: Halo Orbits, Comets, Asteroids, and More*, and has written, co-written or contributed to over 200 other publications.

Farquhar earned his BS from AE in 1959. He earned an MS in 1961 from the University of California–Los Angeles, and PhD in Astronautical Sciences from Stanford in 1969.

Jensen, Wells, Distinguished Alumni; McGrew is Outstanding Recent Alumnus

Aerospace Engineering alumni Daniel T. Jensen, BS 88, and Stephen L. Wells, BS 90, MS 92, are winners of the 2013 Distinguished Alumnus Awards. Lynn Craig McGrew, BS 00, has won the 2013 Outstanding Recent Alumna Award.

The alumni were honored during the AE Awards Banquet on April 25, 2013.

Daniel T. Jensen

Jensen is Head of Engineering For Services at Rolls-Royce Corporation in Indianapolis, Indiana. He leads a local organization that, as part of a global function, provides engineering services to the Rolls-Royce businesses operating in Indianapolis. The Indianapolis organization currently includes Life Cycle Engineering, Technical Data Services, Configuration Management, Capability Development, Product Definition Processes and Engineering Outsourcing. During 2010, Jensen's group successfully engaged stakeholders and reached an agreement to bring Service Engineering into the organization effective as of January 2011. Jensen's group currently is responsible for load/capacity matching, data management strategy, process improvement, best practice implementation, global standardization, staff development, strategic initiatives, global coordination and overall organization leadership.

Jensen has been with Rolls-Royce since June 1995, with previous positions as Chief of Engineering Management Systems for Propulsion and Power Systems Engineering; Global Team Lead for the Engineering Improvement Center; Program Manager for Control Systems; Manager, EMS and Advanced Controls for Control Systems; Manager, Mechanical Design, for Combustors, Transmissions & Structures; Technical Program Manager for Transmissions & Structures; Technical Assistant to the Director of Engineering and Technology in the United Kingdom; and Senior Project Engineer for System Performance and Control.

Prior to his career with Rolls-Royce, Jensen had worked for the Boeing Commercial Airplane Group in Seattle, Washington; and worked a summer as a student trainee for Swissair Operational Engineering in Switzerland.

Jensen received NASA's "Turning Goals Into Reality" Award in 2005 for valuable contributions to the Ultra-Efficient Engine Technology Project Component Demonstrations Team. He holds two patents for "Flow Control Apparatus for Gas Turbine Engine Installation Pressure Relief Doors," which have earned him Boeing Invention Awards and a 1996 Special Invention Award. Jensen also earned Boeing Peer Awards in 1993 and 1994.

Daniel T. Jensen with Department Head Philippe Geubelle

Jensen is a lifetime Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA) and is a life member of the Rolls-Royce Heritage Trust. He is a member of the AE Alumni Advisory Board, the Engineering (at Illinois) Career Services Corporate Advisory Board, and the University of Illinois Alumni Association, and is President of the Indianapolis Illini Club.

In addition to his AE degree, Jensen earned a master's of science degree in mechanical engineering in 1990 from the University of Notre Dame, and a master's of project management degree in 2008 from The Pennsylvania State University.

Stephen L. Wells

Wells is Chief Project Engineer for the Boeing Company in Seattle, Washington. He is responsible for the technical integrity of the 767 product.

Prof. Mike Bragg with Stephen L. Wells

Wells started his career in aerospace in 1992 with McDonnell Douglas Aerospace, Advanced Transport Aircraft Division, working under and reporting to Frank Lynch. In this capacity, Wells led the development of a unique database of ice accretions for a modern three-element high-lift system, representative of that found on current state of the art large transport aircraft. The database is in use to this day, for validation of emerging computational methods for ice accretion on airfoils and wings in high-lift configuration.

Wells joined the Boeing Company in 1994 hiring into the 767 aerodynamics group to work on the

continued on next page

Coordinator of External Relations Diane Jeffers with Lynn Craig McGrew

767-300ERY program. After gaining experience on the 747-MD and 767-400 programs, Wells served as the high lift aerodynamics focal on the 777-200LR/300ER program. In addition to these duties, he led a cross functional team that developed the Tail Strike Protection control law used on the 777-200LR/300ER models and included in the 787 control laws.

In 2002, Wells became High Lift Lead Engineer in the Enabling Research and Technology organization. Here he led teams in the development of automated Navier-Stokes computational fluid dynamics techniques for high lift and led investigations for the advancement of high-lift, cryogenic, flight-Reynolds-number test techniques.

Wells then served as the 787 Configuration Aerodynamics Supervisor joining the High Lift Configurations group in March of 2005 and later leading the combined High Lift and High Speed Configuration Aerodynamics groups through 787 derivative studies.

In 2008, Wells joined the flight test team working in Boeing Test & Evaluation (BT&E) in the Flight Test organization. Steve was the Supervisor for the Performance Aerodynamics Analysis group, and was promoted to 787 Deputy Test Program Manager in 2010.

Wells then took a senior manager assignment in Configuration Aerodynamics. He had functional and process responsibility for aerodynamic lines development, lift and drag prediction, aerodynamic database development, and aerodynamics support for manufacturing and in-service operations for all Boeing Commercial Airplanes. He has held his current position since July 2012.

Lynn Craig McGrew

McGrew is in charge of Flight Dynamics and Descent Analysis for NASA Johnson Space Center in Houston, Texas. Her most recent project has been the entry guidance design, analysis and operations for the 2012 Mars Science Laboratory Rover

In this work, McGrew:

Supported collaborative efforts with the Jet Propulsion Laboratory (JPL), and NASA Langley Research Center (LaRC) Entry-Descent-Landing teams to provide subsystem mission support for entry guidance during planning, operations, and the successful landing of the Curiosity Rover.

Participated in Entry-Descent-Landing reconstruction for the entry guidance system to determine contributions of various error sources to the predicted and actual landing location.

Utilized NASA LaRC POST2 aerodynamic flight simulation software to perform various entry guidance analyses for open-loop reference trajectory design, and verified closed-loop guidance performance in Monte Carlo simulations.

Created entry guidance playbook for nominal and contingency scenarios to facilitate ease of operations prior to Entry-Descent-Landing.

Wrote and modified MATLAB scripts for analyses of guidance performance, both for statistical and case-specific trade studies.

Prior to those duties, McGrew's work for NASA Johnson was as Attitude Determination and Control Operator for the International Space Station Flight Systems Training & Operations. From April 2002 to September 2008 she was a member of the Inner Planets Mission Analysis Group engineering staff at JPL in California.

In addition to her AE at Illinois degree, McGrew earned a master's in aerospace engineering in 2001 from the University of Michigan.

Aircraft Accident Investigator: Forensics with a Splash of CSI

The job that Aerospace Engineering alumnus Doug Stoltz does for Pratt & Whitney involves "forensics with a splash of CSI."

Determining the causes for aircraft accidents is the bailiwick of Stoltz, who was the first in a series of speakers the AE Graduate Student Advisory Committee (GSAC) invited to campus last fall. As Chief of Flight Safety and Mishap Investigations, Stoltz, BS 99, MBA 09 Carnegie Mellon University, talked about the skills and tools the aerospace manufacturer uses in investigating gas turbine accidents.

Stoltz has worked 12 years for Pratt & Whitney's Engineering and Customer Support, with 10 years in safety. He has worked over 20 on-site mishap investigations across all military engines product lines (10 engine models).

Upon arriving at an accident scene, the atmosphere is "pure chaos," Stoltz told students gathered for his talk. Often, 15 to 20 people are at the site, including company officials, government officials and investigators, pilots, doctors, accident recorders, and engine technical experts like him.

"There's a lot of tension when you first encounter a crash," he said. "You take a deep breath and bite off a little piece at a time. You take a systematic approach and locate the parts. The hardware can still tell you why (the accident happened)."

A typical investigation requires a month's work: one week onsite, one week in tearing down the evidence, one week in analyzing the evidence, and one week writing the report.

"As a student, I hated technical writing, but it's by far the most useful thing for what I'm doing now," Stoltz said. "We need to produce concise, factual technical reports without bias."

GSAC established the series of inviting industry representatives to give in-person or webinar talks so that students can learn about the types of careers open to them. The talks are intended to allow graduate students to interact with people from industry and learn about particular projects of individual companies, according to GSAC organizer Daniel Uhlig.

Stoltz

Congratulations, Aerospace Engineering Graduates!

Aerospace Engineering at Illinois welcomed 77 new alumni following Commencement ceremonies May 12.

A total of 55 undergraduates, 17 master's degree students, and 5 PhD candidates earned their degrees this spring, and many celebrated by participating in graduation events. Several of the bachelor's and master's degree graduates are continuing in their studies at AE at Illinois and other schools, including Imperial College in London and the University of Southern California. Others have found positions in industry, such as Boeing, Rolls-Royce, General Electric-Aviation and Raytheon Missile Systems; in government, including the National Aeronautics and Space Administration; and in academia, such as the Georgia Institute of Technology.

Class Notes

2012 Engineering at Illinois Hall of Fame Inductee **Preston A. Henne, BS 69,** has retired from Gulfstream after nearly 40 years in the industry. Henne began his career in 1969 at McDonnell Douglas, and, joining Gulfstream in 1994, rose to senior vice president of the company's Programs, Engineering and Test and General Dynamics Aerospace Group by the time of his retirement. A member of the National Academy of Engineering, Henne counts among his achievements the 1994 and 1997 Collier Trophies for aeronautical achievement, the 2011 American Institute of Aeronautics and Astronautics Aerodynamics Award; the 2010 Aviation Leader of the Year Award at the Living Legends of Aviation Awards; the 1996 AIAA Engineer of the Year Award; and the 2001 AIAA Hap Arnold Award for excellence in aeronautical program management. Kiddie Hawk Academy inducted Henne as a Living Legend of Aviation in 2012, and also that year he received the Reed Award, the AIAA's highest achievement honor. In 2005 Engineering at Illinois recognized Henne with the Alumni Award for Distinguished Service.

Randall J. Stiles, BS 69, MS 71, was appointed this summer as Associate Vice President for Analytic Support and Institutional Research at Grinnell College in Grinnell, Iowa. Stiles had been Special Advisor for the President, Analytics, at Colorado College in Colorado Springs. He also had served as a tenured faculty member at the U.S. Air Force Academy, where he taught courses in aeronautics and led the academy's Center for Educational Excellence.

Mark D. Maughmer BS 72, PhD 84, aerospace engineering professor at Penn State University, received the 2013 John Leland Atwood Award from the American Society of Engineering Education (ASEE) Aerospace Division and the American Institute of Aeronautics and Astronautics (AIAA). The Atwood Award is bestowed annually upon an outstanding aerospace engineering educator in recognition of the educator's contributions to the profession. Maughmer received the 1992 Distinguished Young Alumnus Award from AE at Illinois.

U.S. astronaut **Lee J. Archambault, BS 82, MS 84,** has left the National Aeronautics and Space Administration (NASA) after 15 years of service and has taken a position as a systems engineer and test pilot at Sierra Nevada Corp. As an astronaut, Archambault completed two shuttle missions to the International Space Station, piloting his first in June 2007, and commanding the second in March 2009. Among Archambault's awards have been AE's 1993 Outstanding Recent Alumnus Award, and, from the military, the Legion of Merit, Distinguished Flying Cross, the Defense Meritorious Service Medal, the Meritorious Service Medal, the Air Medal, the Aerial Achievement Medal, the Air Force Commendation Medal, the Air Force Achievement Medal, the Southwest Asia Service Medal, and the Kuwaiti Liberation Medal.

Robert "Robb" Gregg, BS 78, has been appointed chief aerodynamicist for Boeing Commercial Airplanes.

Larry D. Lucas, BS 86, is retired from the U.S. Air Force and is continuing to work at Scott Air Force Base. His daughter attends the University of Illinois at Urbana-Champaign.

Donald J. Leo, BS 90, has been named Dean of the University of Georgia College of Engineering. Leo previously had served at Virginia Tech, where he had roles including vice president, associate dean, and professor of mechanical engineering. Leo wrote the textbook, Engineering Analysis of Smart Material Systems. He is a Fellow of the American Society of Mechanical Engineers, and received the Virginia Tech Dean's Award for Excellence in Research and the 2004 Outstanding Recent Alumnus Award from AE at Illinois.

Bradley G. Deblauw, BS 06, MS 08, PhD 12, is a Future Technical Leaders at Northrop Grumman in Huntsville, Alabama.

Chang Katie Qian, BS 06, is a systems engineer at ATK Space & Defense near Salt Lake City, Utah. She is in the Executive MBA program at the University of Utah, and expects to earn her degree in 2014. She was on campus earlier this year and visited with Emeritus Prof. John Prussing.

Jacob A. Englander, MS 08, PhD 13, is a technician for the National Aeronautics and Space Administration's Navigation and Mission Design Branch at Goddard Space Flight Center.

Nachiket Kale, PhD 13, works for the Quality Park Aviation Center.

Boudi El Fouly, BS 08, is a systems engineer for commercial and military helicopter programs at Sikorsky Aircraft Corporation.

Ryan P. McDonald, BS 08, MS 13, is a Project Engineer for Pratt & Whitney AeroPower, San Diego, California.

Nachiket Vinayak Kale, MS 09, PhD 13, is a Research Engineer for Quality Park Aviation Center in Berlin.

Andrew J. Mortonson, BS 09, MS 12, is a Heat Transfer Analyst for Rolls Royce, Indianapolis, Indiana.

Andrew B. Swantek, MS 09, Phd 12, is a postdoctoral research associate at Argonne National Laboratory.

Takashi Tanaka, MS 09, PhD 12, is a postdoctoral research associate at Massachusetts Institute of Technology.

Drew Ahern, BS 10, MS 13, is a PhD candidate working with AE Emeritus Prof. Rodney Burton.

Christopher Triphahn, BS 10, MS 12, is a PhD candidate working with AE Adjunct Prof. Eric Loth.

Thomas P. Galpin, MS 12, in an intern at EADS Astrium Satellite, Toulouse, France.

Bindu B. Jagannatha, MS 12, is a PhD candidate working with AE Prof. Victoria Coverstone.

Gavin-Kumar Ananda Krishan, MS 12, is a PhD candidate working with AE Associate Prof. Michael Selig.

Nanjundamurthy Venkatasubbu, MS 12, is a Weld Distortion Analyst for Capertillar, Inc., Peoria, Illinois.

Ankit Verma, MS 12, is an intern for Xerion Advanced Battery Corp., Champaign, Illinois.

Carlos Almeida, BS 13, is working for GE Aviation.

Erin K. Anderson, BS 13, is a stress engineer for Boeing's SLS Project.

Sagar Bansal, MS 13, is a Business Technology Analyst for Deloitte Consulting, Daytona Beach, Florida.

P. Dan Chuchawat, BS 13, work for Boeing's Propulsion Branch.

Cameron J. Ebner, BS 13, is working for the National Aeronautics and Space Administration's JSC Aerosciences.

Donald H. Ellison, MS 13, is a PhD candidate working with AE Prof. Bruce Conway.

Alexander R. Ghosh, MS 09, PhD 13, is a postdoctoral research associate for AE Prof. Victoria Coverstone.

Preston T. Goulson, BS 13, is a Product Design Engineer for Big Ass Fans Company in Lexington, Kentucky.

Justin P. Indelicato, BS 13, BS 13 Psychology, is working in Rolls-Royce's Performance division.

Ashwin V. Jadhav, MS 13, is an Assistant Manager for ATM Infrastructures at International Air Transport Association.

Sahithi Kalidindi, BS 13, is working on GE9x LPT Design for GE's Aviation division.

Kwang Ki Kim, PhD 13, is a postdoctoral research associate at the Georgia Institute of Technology's School of Electrical and Computer Engineering.

David E. Kuerth, BS 13, is a project engineer for Belcan.

Brian M. Levine, BS 13, is a consultant for Capgemini.

Samantha D. McCue, BS 13, is an engineer for Cimarran and is working on a master's degree in astro engineering at the University of Southern California.

Philip T. Michel, BS 13, is an S&IS Engineering Rotator for Boeing.

Michael C. Monzella, BS 13, is a Fluid Systems Engineer for Boeing.

Christopher M. Ostoich, PhD 13, is a mechanical engineer for L-3 Communications, Applied Technologies in San Diego, California.

Sapna V. Patel, BS 13, is attending aerospace engineering graduate school at Imperial College in London.

Izan Peris Marti, BS 13, is attending graduate school at RTWH AACHEN in Germany.

Carla T. Procaccino, MS 13, works for TASC.

Colin P. Reid, BS 13, is an engineer for 2H Offshore.

Laura K. Richardson, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Paul R. Schlais, BS 13, is attending graduate school in aerospace engineering at Georgia Tech.

Matthew H. Schonert, BS 13, is a structural analyst engineer for Boeing Defense, Space and Security.

Elliot S. Schwartz, BS 13, is a systems engineer in Guidance, Navigation and Control for Raytheon Missile Systems.

Xichen Shi, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Joan M. Stupik, MS 13, is a Guidance and Control Engineer for Jet Propulsion Laboratory, Pasadena, California.

Mahesh Manchakattil Sucheendran, PhD 13, is an assistant professor in the Aerospace Engineering Department at the Defense Institute of Advanced Technology in Pune, India.

Piotr C. Szponder, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Ryan Tomokiyo, MS 13, works for Commercial Airplanes Division in Everett, Washington.

Zlatan Ulemek, BS 13, is a Software Engineer at Boeing.

Shannon M. Weber, BS 13, is a Structural Engineering for Bell Helicopter.

Ariel N. Wilhelmsen, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Enric Xargay-Mata, PhD 13, is a postdoctoral research associate in the Mechanical Sciences and Engineering Department at Illinois.

Alfred J. Yeo, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Hong-Bin Yoon, BS 13, is attending graduate school at Aerospace Engineering at Illinois.

Deaths

Daniel R. Cichy, BS 55, of Greenville, Rhode Island, and Johnstown, Ohio, passed away on January 14, 2013 due to complications of Alzheimer's disease. He was born on May 19, 1928 in Chicago, IL.Cichy was employed with Rockwell International for over 30 years and continued his career with the firm North American Aeronautical Consultants until his retirement. For many years, he was Adjunct Professor of Aeronautical Engineering at The Ohio State University. Daniel is preceded in death by his beloved wife of 53 years, Corky. He is survived by his three children, granddaughter, and two sisters.

Charles F. Herndon, BS 50, died January 23, 2013, from cancer. He was born April 4, 1928, in Hammond, Indiana. He worked for Consolidated Aircraft Co., retiring after 42 years as director of structures and design. Chuck married Jacqueline Hughes and they had three children, Dayna (deceased), Elliot and David. After Jackie's death, he married Pat Price, and their children were Natalie and Nathan. Herndon volunteered for United Way, Mission Granbury and his church. He is survived by his wife, children, grandchildren, and a sister.

Dear Fellow Alumni, Students and Faculty,

Crowley

It has been a very exciting year for the interaction of the Aerospace Engineering Department with many aspects of the Advisory Board and the industry in general. The Aerospace Systems Engineering master's degree, on the forefront of graduate education supporting a direct need in the aerospace industry, is in its second year and making great progress. The industrial interaction continues to increase with a greater level of seminar and classroom speaker opportunities growing each year. We are also starting to discuss the critical issues for the future, such as enhanced use of on-line academic interaction. Always looking to provide increases in support and participation for the department, the industry team hopes to continue and build upon the legacy of distinction for our program.

The advisory board looks forward to its upcoming meeting and visit to campus. We will be using a new approach to our meeting this year, with two days of interaction and participation from students, staff and industry. First, we will be discussing the status of the overall department and the various aspects of the programs both undergrad and graduate. We will then break into working groups with both staff and alumni leadership to focus on making the positive interactions sustainable for years to come. Lastly, student participation opportunities will be available on Friday and Saturday, for presentations and technical interaction, and on Saturday, socially at the tailgate prior to the football game.

Looking forward to another great academic year for the Aerospace Engineering Department!

Mark Crowley, AAE 1983
President, Advisory Board

Why I Give

Brown

It seems like just yesterday when I was hustling between classes, studying intently for the next exam, and wondering where all this hard work was going to lead from a career standpoint.

But that was over 30 years ago and I have been blessed with a rewarding Aerospace career that would not have been possible had it not been for the great faculty, alumni, and fellow students of what was then the Aeronautical and Astronautical Engineering Department. I am grateful to the people who established and grew the Department over the decades and ultimately enabled the opportunity for me to become a graduate.

As a member of today's AE Alumni Advisory Board, I can see how our Department has evolved over the years with the addition of talented faculty members, the introduction of new classes and tailoring existing ones to better prepare students for their professional careers in industry, and reaching out to encourage a more diverse and talented group of incoming students.

I also see Alumni from this Department who have tremendous pride in our roots and have a passion for continually improving this Department so that it stays among the premier Aerospace Engineering Departments in the country.

One of the simple ways that we all have to participate in the progress of the AE Department and help the next generation of AE graduates is to participate in the annual fund drive and to designate your donation specifically to AE. Every dollar counts, no matter how large or small so I encourage all of you to do as I do and make it a habit to participate in the annual fund drive every year. And don't forget about the corporate matching donation that many companies offer.

We owe it to those who gave us the opportunities in the past and those who will benefit in the future.

Blaine Brown
Lockheed Martin Orion Team
LM IS&GS Orion Program Director
Crew and Service Module Deputy

Thanks to Our Donors

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