AE Illinois

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

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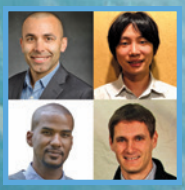

Inside

Faculty News

Department News

Teaching Excellence

Student News

Alumni News

Thanks to Our Donors

Welcome to the 2015 Edition of the Alumni Newsletter of Aerospace Engineering at Illinois

In last year's newsletter, I started my introductory words by reporting with great excitement that four new faculty members were going to join the Department during the 2014-15 academic year. This was the culmination of a remarkable recruitment effort that our Department had never experienced in the twenty or so years that I have been in AE@Illinois. Well, I am absolutely delighted to report once again that *four more faculty members* will join AE during the 2015-16 academic year to help the Department with its teaching and research missions in the areas of space exploration and technology, aeroelasticity, big data, topology optimization and additive manufacturing. The profiles of these four highly talented new faculty members, Dr. Maciej Balajewicz, Dr. Koki Ho, Dr. Kai James, and Dr. Zachary Putnam, can be found on pp. 4–6.

This substantial increase (by more than 40 percent!) in the size of our faculty over the past two years reflects the drastic corresponding increase in our undergraduate enrollment, which, for the first time in decades, now exceeds 500 students. As reflected by the test scores of the entering freshmen class (the average

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ACT score now approaches 32.5/36), and especially by the accomplishments of these students in class and in extra-curricular activities, this rapid increase in undergraduate enrollment (from about 350 two years ago to about 510 this fall) has not come at the detriment of quality. To the contrary! I encourage you to read about some of their truly remarkable accomplishments in this newsletter.

Delivering innovative and quality instruction has long been a key emphasis of the AE education mission. The main cover story on pp. 18–23 of this newsletter is dedicated to some of the recent educational initiatives in the creation of new hands-on courses and the introduction of novel delivery techniques.

The other cover stories of this newsletter include an update on the on-line AE MS program that was started about a year ago (p. 15) with emphasis on both flexibility and quality, and on the creation this fall of the first departmental professorship created in honor of Professor Al Ormsbee by one of his former PhD students, Dr. R. Liebeck (p. 14).

I encourage you to learn in this newsletter about these and other stories on the accomplishments of AE faculty, students and alumni. I also encourage you to check regularly the Department's website, www.aerospace.illinois.edu, where we post many more stories that cannot fit in this publication. And, as always, I look forward to your comments.

Philippe H. Geubelle
Bliss Professor and Head

On the cover: **This photo taken of Earth and the edge of space resulted from a Spring 2015 student project in AE Prof. Victoria Coverstone's high altitude balloon course.**

Department of Aerospace Engineering

Faculty

Phillip J. Ansell
Maciej Balajewicz
Lawrence A. Bergman
Daniel J. Bodony
Timothy W. Bretl
Ioannis Chasiotis
Huck Beng Chew
Soon-Jo Chung
Victoria L. Coverstone
J. Craig Dutton
Gregory S. Elliott
Jonathan B. Freund
Grace X. Gao
Philippe H. Geubelle
Koki Ho
Kai James
John Lambros
Cedric Langbort
Vincent Le Chenadec
Deborah A. Levin
N. Sri Namachchivaya
Marco Panesi
Zachary R. Putnam
Taraneh Sayadi
Michael S. Selig
Petros G. Voulgaris
Scott R. White

Lecturers

Steven J. D'Urso
Gail C. Jonkouski
Brian S. Woodard

Emeritus Faculty

Michael B. Bragg
John D. Buckmaster
Rodney L. Burton
Bruce A. Conway
Harry H. Hilton
Ki D. Lee
John E. Prussing
Wayne C. Solomon
Shee Mang Yen

Affiliate/Adjunct Faculty

Joseph Bentsman
Kenneth A. Christensen
Naira Hovakimyan
Tonghun Lee
Eric Loth
Arif Masud
D. Michael McFarland
George H. Miley
James W. Phillips
Srinivasa M. Salapaka
Nancy R. Sottos
Alexander F. Vakakis

Staff

Lee A. Booher
Timothy A. Cochrane
David E. Farrow
Laura A. Gerhold
Diane E. Jeffers
Kendra Lindsey
Stephen S. Mathine
Staci L. McDannel
Gregory S. Milner
Susan K. Mumm
Irene Sakellarakis
Ann Marie Zettervall

Shared Services

Tessa M. Hile
Lori Ann Ballinger-Pankau
Leslie L. Reinhart
Lori A. Rairden Willoughby

Teachers Ranked Excellent by Their Students

Spring 2015
Timothy W. Bretl
Steven J. D'Urso
J. Craig Dutton
Grace Gao
Alexander R. Ghosh
John Lambros
Brian S. Woodard

Fall 2014
Gavin K. Ananda
Daniel J. Bodony
Timothy W. Bretl
Sparsh A. Chadha
Vishal Chikkerur
Steven J. D'Urso
J. Craig Dutton
Gregory S. Elliott
Giovanni Fiore
Alexander R. Ghosh
David J. Hanley
J. Puig Navarro
Brian S. Woodard
Hoong Chieh Yeong

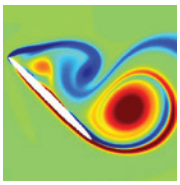
AE Gains Four New Faculty

Balajewicz

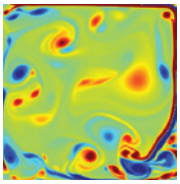
Data Drives Balajewicz's Simulations

More and more, scientists use simulations to model physical systems. Often, they model smaller and smaller pieces of the system, resulting in billions of equations and a plethora of data.

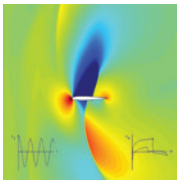
"That's fine if you're interested in something very specific," believes Maciej Balajewicz, new AE assistant professor. "The problem is, for a lot of applications, you don't know exactly what configuration you want to solve. You know you want to build something, but how is that going to look? The design keeps evolving and for a computer, every time (design) changes, you have to resolve the equations. Especially to achieve many answers for different changes of parameters, it becomes too expensive."



Complex flow over inclined airfoil



Modeling turbulent fluid flows



Unsteady transonic aeroelastic simulation

Balajewicz's research in developing theoretical and computational tools for low-dimensional and low-rank models of multi-scale and multi-physics problems examines questions in reverse, using data to derive which equations are necessary for the simulation, which can be changed and simplified, and which can be discarded.

"Instead of looking at the equations, you look at the data so it can tell you something about the equation you're solving. That way, you can reduce the number of equations and the complexity," he said.

Balajewicz uses the approach to study aerodynamic challenges such as aeroelasticity and turbulence. "How does the air, itself, behave? The equations are simple; the solutions are very complicated. It can take weeks and weeks and weeks to do one simulation of a turbulent flow. But we want to get that information quicker with changes of design and purpose incorporated.

"The reality is now that these models aren't being used routinely because they're too complicated and expensive," Balajewicz maintains. "I work to reduce and simplify these complex high-fidelity models to the point at which only a desktop computer is required to solve them.

"The cool thing is that what I do really applies to a lot of systems," he said. "For example, several colleagues and I are trying to develop model reduction for stock pricing equations. (My work) can be applied to any physical system that is governed by partial differential equations."

He believes his research in data reduction will be beneficial in collaborations with many of AE's faculty, including Larry Bergman, Harry Hilton, Marco Panesi, Dan Bodony and Phil Ansell. Using Ansell's experimental work in dynamic stall as an illustration, Balajewicz said, "In experiments, you collect a lot of data, and you have to get something out of it. Model reduction can provide a smaller, simpler kind of model, and tell other things like 'What are the coherent structures that live in the flow?' 'What are the large vortices and how do they interact?'"

The combination of AE faculty working in computational and experimental aspects played a big role in Balajewicz's decision to come to Illinois. "The idea of working with both parts of the problem was a major attraction," he said.

In addition to his research, Balajewicz will teach this fall, starting with AE 451, Aeroelasticity, which is both an on-campus and on-line course offering.

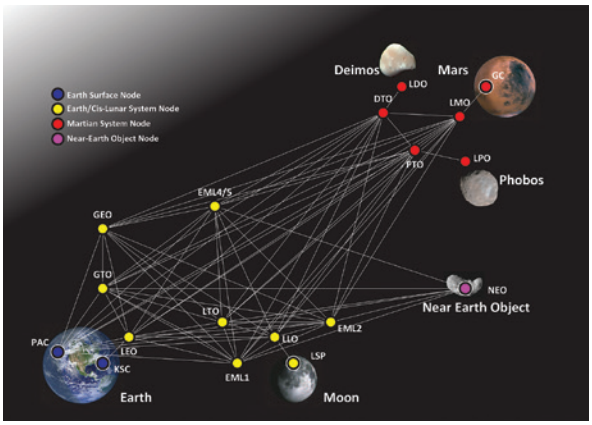
Balajewicz comes to Illinois from Stanford University where he was a postdoctoral research fellow in aeronautics and astronautics. He earned his PhD in mechanical engineering and material science at Duke University in 2012. He earned a bachelor's and a master's degree in mechanical and aerospace engineering in 2004 and 2007, respectively, from Carleton University in Ottawa, Canada.

Ho

Ho Brings Expertise in Infrastructure for Interplanetary Travel, Small Satellite Systems

New faculty member Koki Ho hopes to design infrastructure system support for interplanetary travel as well as add expertise to the Aerospace Engineering at Illinois small satellite program when he joins the department in Spring 2016.

A recent PhD from the Massachusetts Institute of Technology's aeronautics and astronautics department, Ho's work has involved mathematical modeling



Space Logistics Network © Koki Ho and Takuto Ishimatsu

of logistics in human space exploration to planets, including Mars. A supply chain network would need to be established between Earth and Mars so launches from Earth can be kept to a minimum, Ho maintains. "There are lots of logistics challenges."

"My PhD research develops a dynamic network optimization methodology for interplanetary supply chain management of human/robotic space exploration missions," he said. "The application cases include human Mars and asteroid exploration."

Ho worked on small satellite projects as a master's student at the University of Tokyo, including the Nano-JASMINE, a 50 centimeter-class micro satellite designed to create a map of the stars. Small satellites could be used in interplanetary missions as well, Ho said. "We could send the small satellites before sending humans to Mars."

The use of small satellite systems data can be used in combination with global positioning systems (GPS) data for agriculture, disaster recovery, healthcare, or other humanitarian projects, Ho believes. He hopes to collaborate with AE Prof. Vicki Coverstone on the CubeSat project she leads, as well as work with AE Associate Prof. Soon-Jo Chung, who has researched satellite swarm formations, and AE Assistant Prof. Grace Gao, an expert in navigation systems.

"Illinois is very good at optimal control on the more theoretical side," Ho said. "Illinois also has a pretty strong background in astrodynamics, and that's something I want to integrate into mission planning."

Formally an AE research assistant professor for the Fall 2015 semester, Ho will be at the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL), working as a visiting researcher on robotic missions from September through December. He will begin on campus in January.

James Creates Programs for Simulation, Complex Structure Design

Kai James, new AE assistant professor, focuses his research on creating algorithms for computational design and analysis of structures.

"I am especially interested in developing novel algorithms that leverage high-fidelity, non-linear computational models and numerical optimization methods for the design of complex engineering systems," James said.

"Some of my major research projects include aero-structural optimization of aircraft wings, and design optimization of resilient structures while accounting for material damage and viscoelastic creep effects. I develop algorithms that simulate the physics of engineering."

Because of this focus, the Blue Waters supercomputing facility and campus computing cluster were major draws in James' decision to begin his academic career at Illinois. "The computational facilities are topnotch; probably the best in the country," he said. "That's something I hope to leverage."

He also found AE's faculty composition attractive. "The size and areas of expertise in the department are a good fit for me," James said. "There's a good number of junior and senior faculty, providing good mentors and a cohort of colleagues that are going through the same process as I am."

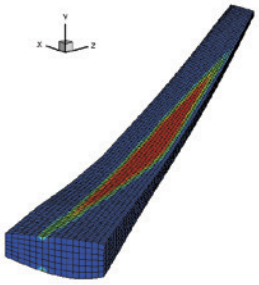
Beyond his technical interests, James is passionate about increasing diversity in the Science, Technology, Engineering and Mathematics (STEM) fields through outreach to economically disadvantaged students, women, and underrepresented minorities.

"It's something I have been involved with going back to my undergrad years," he said. "As a junior and senior in college, I volunteered at a drop-in tutor program for disadvantaged youth, providing mentorship, helping with homework, and helping the students explore their options."

At his most recent position as a postdoctoral research associate at Columbia University in New York City, James participated in Diversity in Graduate Engineering, a program mandated to increase the number of underrepresented students enrolling in engineering graduate school.

James would like to continue advocating for underrepresented groups when he begins at Illinois this fall. "I'd be interested in meeting with the students when

James



Optimal material distribution within a wing structural box, obtained using three-dimensional topology optimization

they come to visit and help out in any capacity that they need."

He also enjoys teaching, having gained experience as a course instructor while earning his PhD in aerospace engineering at the University of Toronto (2012), where he also earned a bachelor's (2004) and master's (2006). He will teach AE 321, Mechanics of Aerospace Structures, this fall, and plans to develop an optimization course to teach in the spring.

James also wants to develop a lab that would include 3D printers to be used as learning tools. "I think it's important to have some hands-on research, and to validate computer programs with things you can see and touch. It anchors in reality what can be a pretty abstract research program."

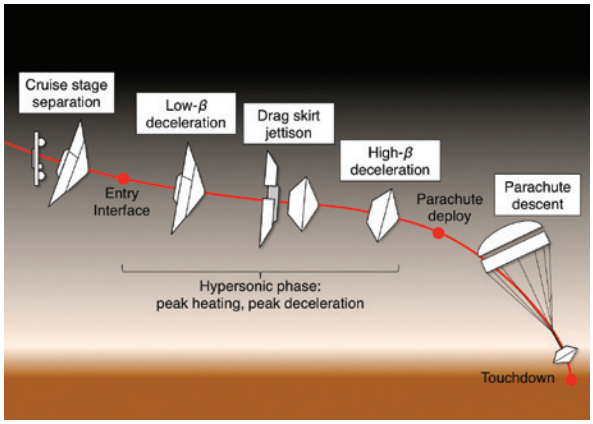
Putnam

Putnam Brings Expertise in Hypersonic and Space Systems to AE

New Assistant Prof. Zach Putnam will bring to AE expertise in hypersonic and space systems, with an emphasis on planetary entry, descent, and landing systems.

"One of the really cool things about planetary entry is that we do everything from a systems perspective," he said. "(Planetary entry) involves tightly coupled components and systems: a change in every little piece absolutely affects everything else….(Planetary entry is) a tough problem that we're still learning how to solve."

Developing analytical methods to evaluate ways to change drag areas for hypersonic space vehicles and improve trajectory control has been the subject of Putnam's doctoral work, completed in May at Georgia Institute of Technology, where he also earned his bachelor's and master's degrees.



Graphic showing planetary entry

"The work I did for my thesis was largely motivated by the need to develop better steering methods for new classes of planetary entry, descent, and landing vehicles NASA is developing," Putnam said. "Many of these new vehicles deploy a big drag area to help the vehicle slow down; it's like the difference between (slowing) a bowling ball and a beach ball.

"When you have big drag areas, you can steer the vehicle just by changing the drag area—you don't need any lift. It simplifies the entire entry, descent, and landing system while providing performance similar to the current state of the art.

"The most logical extension of my PhD research is to determine how large of a payload we could land on the surface of Mars using these drag-modulation techniques," Putnam said. "I also intend to explore coupling the analytical methods I developed to build linear covariance analysis tools for high-speed atmospheric flight."

In continuing his work, Putnam expects to collaborate with AE faculty including Associate Prof. Soon-Jo Chung, Prof. Vicki Coverstone, Prof. Debbie Levin, and new Assistant Prof. Kai James. He also plans to collaborate with personnel at NASA's Jet Propulsion Laboratory and Johnson Space Center.

While much of Putnam's work is computational and theoretical, he envisions creating a guidance, navigation and control (GNC) system laboratory in AE.

"My long-term goal is to build up infrastructure that would include hardware, navigation equipment, flight computers and flight control factors so that we can really look at GNC systems as a whole," he said. "That would enable a lot of design and architecture studies, and establish rigorous connections for high level mission requirements."

Prior to his doctoral studies, Putnam worked at The Charles Stark Draper Laboratory, Inc., in Cambridge, Massachusetts, and in Houston, Texas. He led the development of the entry guidance algorithms for NASA's Project Orion. He also served as technical advisor for two master's degree engineering students.

In addition to his research, Putnam will teach AE 442, Senior Space Systems, in the fall, and the second semester of that course, AE 443, in the spring.

In choosing Illinois over other universities to begin his faculty career, Putnam said: "It was clear from the get-go that the Department was very well organized. Also, I am really excited about the (Department's) emphasis on mentorship for assistant professors; I thought this is a place where I could succeed."

Selig and Chung Earn Promotions

Selig

Chung

AE faculty members Michael S. Selig and Soon-Jo Chung have been promoted to full professor and associate professor, respectively.

Selig's research interests are in applied aerodynamics; aircraft design, performance, stability, and control; flight simulation and modeling; wind energy systems; airfoil design and analysis; and computational and experimental aerodynamics. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA), and among his recent honors has been the 2014 AIAA Aerodynamics Award.

An AE alumnus with a bachelor's degree in 1984, Selig joined the faculty in 1992. He had earned a master's degree in mechanical and aerospace engineering in 1988 from Princeton University and a PhD in aerospace engineering in 1992 from The Pennsylvania State University.

Chung's research interests include astrodynamics; control and estimation; dynamical systems; information technology; and robotics. His honors include the 2014 Dean's Award for Excellence in Research; a 2014-15 selection as a Center for Advanced Study Beckman Fellow; and a 2013 National Science Foundation Faculty Early Career Development Award.

Chung earned a bachelor's in aerospace engineering in 1998 from the Korea Advanced Institute of Science and Technology (KAIST), and a master's in aeronautics and astronautics and a doctorate in estimation and control in 2002 and 2007, respectively, from the Massachusetts Institute of Technology (MIT).

Bodony Named Willett Faculty Scholar

Bodony

Associate Prof. Daniel Bodony has been named an Engineering at Illinois Donald Biggar Willett Scholar for 2015. The recognition is targeted for faculty members who, at a relatively early stage in their careers, are excelling in their contributions to the University of Illinois.

Bodony is a lead principal investigator for the Department of Energy Center for Exascale Simulation of Plasma-Coupled Combustion whose aim is to develop algorithms, computer science tools, and a multiphysics computational fluid dynamics code that will utilize future, exascale-class supercomputers.

Designated a year ago as a Blue Waters Associate Professor, Bodony uses Blue Waters' sustained 11+ petaflop computer facilities to study the noise pollution caused by commercial and military aircraft. This study aims to improve near-airport community conditions and reduce hearing damage and related health care costs.

Bodony earned an NSF CAREER award in 2012 to support his work in investigating the biomechanics of sound generation of the human vocal folds. Also in 2012 he was named a Tau Beta Pi Eminent Engineer.

An Illinois faculty member since 2006, he has held affiliate positions with Computational Science and Engineering, the Department of Mechanical Science and Engineering, the National Center for Supercomputing Applications, and the Parallel Computing Institute.

He is regularly included on the campuswide list of Teachers Ranked as Excellent, and was named the Aerospace Engineering Teacher of the Year in 2008, 2010 and 2012. During his teaching career he has introduced a new graduate-level computational fluid dynamics course and a sophomore-level new application-focused programming course.

Bodony is very active in the American Institute of Aeronautics and Astronautics, and was named an AIAA Associate Fellow in 2013.

Bringing Aerodynamics Research to Life, Elliott Builds on Illinois' Tradition

Prof. Greg Elliott appreciates the rich tradition the University of Illinois has established in high speed and supersonic aerodynamics research, and considers himself a beneficiary of such work dating back to the 1940s.

Elliott, now a 12-year veteran of Aerospace Engineering at Illinois, counts among his mentors the late Prof. Helmut H. Korst, who developed a groundbreaking gas dynamics research program at Illinois; Emeritus Prof. A.L. "Tad" Addy, known internationally for research in fluid dynamics; and fellow AE Prof. J. Craig Dutton, a leading researcher in compressible flows.

Photo by James Phillips

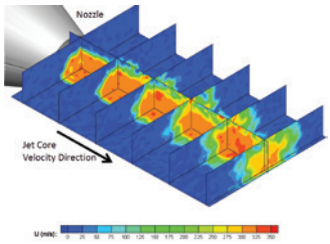
Four "generations" of researchers in the area of supersonic aerodynamics at the University of Illinois. From left to right Professors Greg Elliott, Helmut Korst, A.L. (Tad) Addy, and J. Craig Dutton.

Inspired by their work as well as by their intellectual pedigree through his graduate advisor, Prof. Mo Samimy, who was an Illinois alumnus, Elliott now is carving his niche in aerodynamics, focusing on the areas of supersonic flows, laser diagnostics, plasmas and combustion. As an experimentalist, Elliott believes strongly in hands-on education and research, and even has equipment for machining and welding at his home to manufacture experimental apparatus and models.

"I enjoy designing and building experiments and manufacturing some of the models we use for research and lab courses," Elliott said. "It is fun being involved through the entire process of design, manufacturing, and testing, as well as, the discovery that takes place when conducting research with my students and colleagues. Being able to do some of the machining myself not only helps our research group turn things around quickly, but also allows me to better instruct the students as they design components and systems."

Over the years Elliott has made research contributions in a variety of areas including, advanced laser/optical diagnostics, high-speed compressible flows, plasma flow control, and combustion. Always on the experimental side of things, Elliott conducts research ranging in size from small bench top experiments to those conducted in large wind tunnel facilities at NASA and Wright-Patterson Air Force Base.

"Many of the large scale experiments have involved taking advanced diagnostics that are developed in the lab and extending them for use in these challenging facilities," Elliott said. "This not only allows us to gain more complete insight about the aerodynamics associated with the vehicle or its components, such as the supersonic inlet work that we did in association with Gulfstream and NASA, but also gives a unique opportunity for the students to gain experience in the government labs."



Instantaneous "snapshot" of tomographic PIV measurements of a sonic axisymmetric jet displayed as contours of the streamwise velocity shown on multiple planes. Data taken by Ph.D. graduate student Ruben Hortensius.

Tomographic PIV Investigations

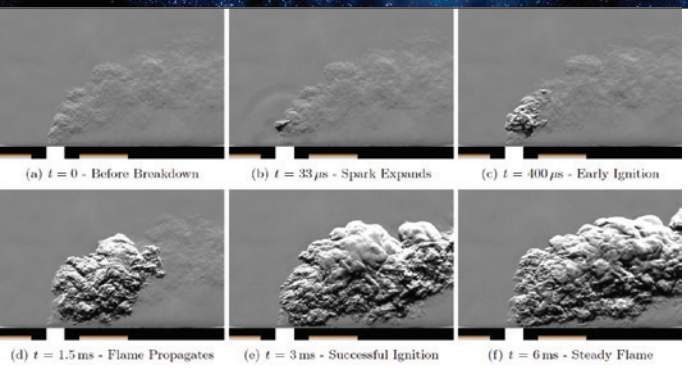
With Dutton, Elliott recently purchased a new tomographic particle image velocimetry (PIV) system as part of a Defense University Research Instrumentation Program (DURIP) grant that can provide 3D measurements of a flow in a wind tunnel. Previous PIV systems provided two components of velocity in a planar measurement region.

Equipped with four cameras viewing particles seeded in an illuminated volume, the new tomographic system measures all three components of velocity and resolves the vectors throughout the entire 3D volume.

"This allows us to get a more complete picture of the structure of the turbulence and flow phenomena present, so we can understand the physical phenomena and make more complete comparisons with theory and computational models," Elliott said.

This system will be used to study a variety of supersonic and combustion flow fields.

AE graduate student Reuben Hortensius currently is using tomographic PIV to study supersonic fluid/structure interactions. The system will also be used in a study of highly separated supersonic flows that Elliott and Dutton are conducting with new AE graduate student James Favale. They will use PIV measurements to analyze the structures occurring in these flow fields, incorporating Proper Orthogonal Decomposition techniques to improve their understanding of the flow fields leading to more responsive models for control systems.



Schlieren images of the laser spark ignition process of a Hydrogen/Argon jet issuing into a subsonic air cross-flow under the influence of a Dielectric-Barrier-Discharge plasma. The width of the jet is 4.8mm for scale. Images by Dr. Ryan Fontaine.

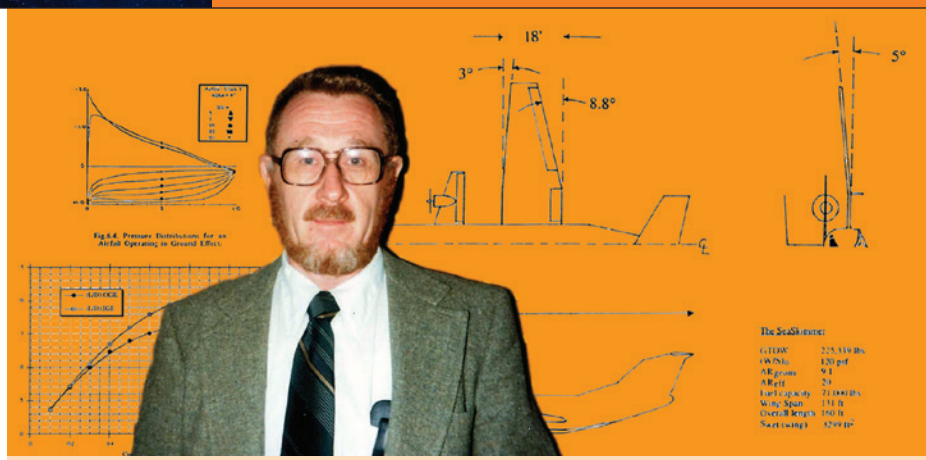
Center for Exascale Simulation of Plasma-Coupled Combustion

Additionally, Elliott is part of the $20 million, 5-year Department of Energy (DOE) Center awarded to the University of Illinois (Co-directors Profs. Bill Gropp and Jonathan Freund) for Exascale Simulation of Plasma-Coupled Combustion (XPACC).

The goal of the center is to conduct research necessary to utilize the platforms of exascale computing (a billion, billion calculations per second) for computer simulations. As test case, the center is focused on computations to predict how plasmas can be used to enhance and control combustion. The research may pave the way for cleaner-burning combustors and more reliable and higher performance jet engines.

Elliott has a role in the center's work because the DOE emphasizes problems that not only stretch computer simulations into the next generation of systems, but also conduct "predictive science" with these simulations. Experiments are needed to validate the models used in the computations, accessing and incorporating uncertainty, and providing a predictive target that can be validated, Elliott said.

He is part of the center's executive committee of investigators—including Gropp, Freund, AE Associate Prof. Dan Bodony, and Associate Prof. Luke Olson of the Computer Science Department—who lead the experimental research group. The experiments investigate the processes involved in igniting combustible mixtures using laser-induced optical breakdown (laser sparks), and the use of plasmas to enhance combustion. The computer simulation and experimental research efforts culminate each year with a large-scale computation, combining aspects of turbulent flow, combustion, plasmas and ignition in one multi-physics coupled prediction that is validated with an experiment. Working on these experiments are postdoctoral research associates Tomoya Wada and Ryan Fontaine, and AE graduate student Jon Retter.



Friend, Colleague Recalls Professor Sivier

"He was my teacher, my mentor, a professional collaborator, and a good friend," Aerospace Engineering at Illinois faculty member Steve D'Urso remembers of AE Emeritus Associate Prof. Kenneth R. Sivier.

On the AE faculty for 26 years, Sivier died Tuesday, Dec. 23, 2014. He had retired in 1993, and had continued living in Mahomet, Illinois, near the university before his death.

D'Urso, currently Lecturer and Coordinator of AE's Aerospace Systems Engineering Program, had worked with Sivier after D'Urso earned a master's degree from AE in the late 1980s. D'Urso worked fulltime for McDonnell Douglas in St. Louis while earning the degree through a distance-learning program.

"Sivier taught design, aerodynamics and performance," D'Urso said. "At work, I needed to put a training program together, and Sivier mentored me. Subsequently, I taught the course on campus to the senior design class. (Sivier and I) integrated real-life problems into the design class, and published a couple of them."

Sivier and D'Urso worked with the students on designs for a multi-mission tactical aircraft, carrier resupply and wing-in-ground effect vehicles to name a few.

Sivier had gained practical experience by having worked in industry, including the McDonnell Aircraft Corp., before starting his academic career in 1967. Later, he had played a role in designing aerodynamics for the F15 Eagle fighter jet, "the standard air superiority fighter airplane for the US Air Force until 2000s with the introduction of the F-22," according to D'Urso.

"Ken had real experience doing real airplanes: he was a design guy," D'Urso said.

As a charter member of the International Council on Systems Engineering, Sivier urged D'Urso to join. "He encouraged me to get involved in the organization and my membership was number 100. Now we have about 10,000 members."

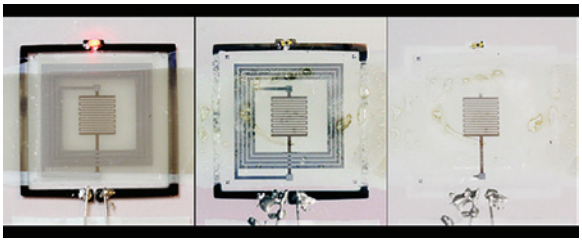
Sivier was active in the Illinois Space Grant Consortium. He began the Illinois Aerospace Institute high school summer camp, now in its 24th year. Sivier also served as faculty advisor for the student Design/Build/Fly project for several years.

Mission Possible: This Device Will Self-Destruct When Heated

White

AE Prof. Scott R. White has led a group of Illinois researchers in developing heat-triggered self-destructing electronic devices, a step toward greatly reducing electronic waste and boosting sustainability in device manufacturing. They also have developed a radio-controlled trigger that could remotely activate self-destruction on demand.

The researchers, including AE Affiliate Prof. Nancy R. Sottos, published their work in the journal, *Advanced Materials*.



"We have demonstrated electronics that are there when you need them and gone when you don't need them anymore," White said. "This is a way of creating sustainability in the materials that are used in modern-day electronics. This was our first attempt to use an environmental stimulus to trigger destruction."

White's group teamed up with John A. Rogers, a Swanlund chair in Materials Science and Engineering and director of the Frederick Seitz Materials Laboratory at Illinois. Rogers' group pioneered transient devices that dissolve in water, with applications for biomedical implants. Together, the two multi-disciplinary research groups have tackled the problem of using other triggers to break down devices, including ultraviolet light, heat and mechanical stress. The goal is to find ways to disintegrate the devices so that manufacturers can recycle costly materials from used or obsolete devices or so that the devices could break down in a landfill.

The heat-triggered devices use magnesium circuits printed on very thin, flexible materials. The researchers trap microscopic droplets of a weak acid in wax, and coat the devices with the wax. When the devices are heated, the wax melts, releasing the acid. The acid dissolves the device quickly and completely.

To remotely trigger the reaction, researchers embedded a radio-frequency receiver and an inductive heating coil in the device. The user can send a signal to cause the coil to heat up, which melts the wax and dissolves the device.

The researchers can control how fast the device degrades by tuning the thickness of the wax, the concentration of the acid, and the temperature. They can design a device to self-destruct within 20 seconds to a couple of minutes after heat is applied.

The devices also can degrade in steps by encasing different parts in waxes with different melting temperatures. This gives more precise control over which parts of a device are operative, creating possibilities for sophisticated devices that can sense something in the environment and respond to it.

White and Rogers are both affiliated with the Beckman Institute for Advanced Science and Technology at the U of I. The Defense Advanced Research Project Agency and the National Science Foundation supported this work.

Chung Co-leading $1.5 Million Development of Robot Bats for Construction Site Monitoring

Chung

AE Associate Prof. Soon-Jo Chung and Electrical and Computer Engineering (ECE) Prof. Seth Hutchinson are leading a $1.5 million National Science Foundation (NSF) project to develop mechanical robot bats to supervise construction sites.

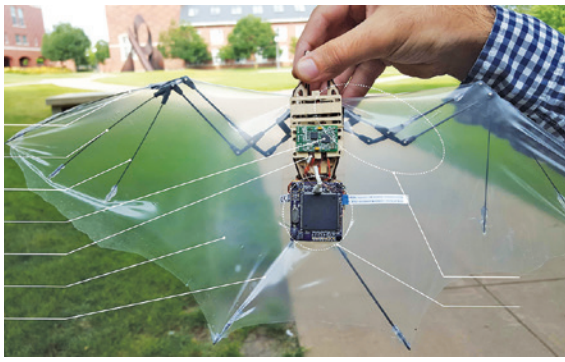
The robot bats are being designed to fly around a site to compare building model information with actual construction.

Chung has been working on the flight control and dynamics of bat-like aerial robots as well as on synchronization and PDE control of flexible articulated wings, and is the key researcher in the design and control of the robot bats. Hutchinson is focusing on the higher-level aspects of the robot planning and control algorithms, such as planning flight trajectories that take into account constraints of operating in a human environment.

Also contributing are AE Associate Prof. Tim Bretl, who works on the motion planning of the robot, and Civil and Environmental Engineering (CEE) Assistant Prof. Mani Golparvar-Fard, who is researching the various applications the robot can have on a building construction site. The Illinois team is collaborating with Brown University researchers with expertise in the field of bat flight.

Bats were chosen as the architectural inspiration because of the unrivaled agility and maneuverability of bat flight.

By replicating bat flight patterns, Hutchinson and Chung expect the robots to have a longer battery power than rotorcraft robots, such as quadcopters and helicopters, because of their ability to flap and glide rather than rely on constantly rotating propellers.



Ansell Wins Young Investigator Award for Work on Dynamic Stall Unsteady Flow

AE Assistant Prof. Phillip Ansell has won a Young Investigator Award from the Air Force Office of Scientific Research (AFOSR) for his work in understanding the unsteady flow associated with the onset of dynamic stall.

Dynamic stall is a problem that is relevant to a number of different aerodynamic applications, including rotorcraft, fixed-wing aircraft, wind turbines, and flapping wing vehicles, to name a few. Such stalls can be undesirable when they cause an aircraft to become uncontrollable. However, they also can be useful in applications requiring extreme maneuverability: a bird uses a dynamic stall to decelerate rapidly to perch on a branch, for example.

"I'm looking at this from the perspective of making the flow behave in such a way that we can either avoid or obtain the desired effect from dynamic stall, while maintaining control of a vehicle," Ansell said. "The significant difficulty in this problem is that the understanding we currently have of the flow is centered on the large-scale features, not the subscale components that contribute.

"Various aspects of (the flow) are changing as the wing motion continues. Time scales change in relation to spatial scales," Ansell maintained. "A lot of methods and approaches to analyze the flow simply won't work because of the changes in scales, and we have to use more advanced signal processing techniques to characterize (the phenomena)."

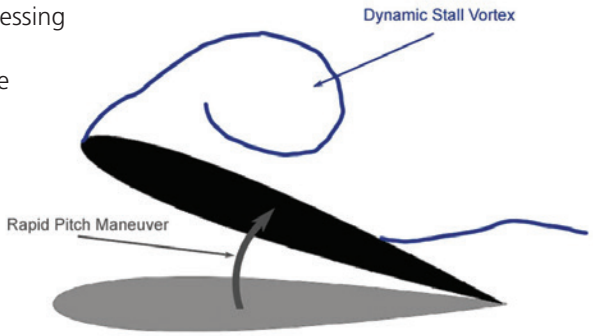
Ansell conducts experiments on airfoils (wings) undergoing unsteady motion in a wind tunnel in the Aerodynamic Research Laboratory on the Urbana campus. He takes measurements on the wing's surface as well as time-resolved particle image velocimetry (TR-PIV) measurements in the flow field. PIV is an optical method of flow measurement and visualization.

Ansell

"When dynamic stall occurs, there is a large vortex that is shed from the lead edge of the wing," Ansell said. "The vortex swirls around over the top of the airfoil creating a suction region, a low pressure that can act to increase drag and lift. The vortex itself we understand fairly well, though there are various subscale features that lead up to the shedding of this vortex that we actually don't know nearly as much about.

"We want to mitigate the problems of losing control authority when going into those kinds of maneuvers, and the key is to better understand how to influence the subscale features. By manipulating these subscale flow structures, we can avoid or delay the production of the dynamic stall vortex and the ensuing effects on the performance and vehicle controllability.

"Once we have the measurements, we use advanced signal processing techniques to determine the characteristics of the subscale structures. If you instrument a wing section and you measure the unsteady components, you can correlate the scales and structures observed in experiments to those being measured in real-time. This allows you to make predictions as to what the state of the flow is, and actuate the flow to prevent the vehicle from becoming uncontrollable."



AE Scientists Examine Deflecting, Exploring Asteroids

Conway

Chung

Two AE scientists have taken part in projects focusing on asteroids—one, theorizing how to deflect asteroids from colliding with Earth, and the other, to explore asteroids as a prelude to sending humans to Mars.

Avoiding Asteroid Collisions

Scientists have explored ideas for diverting asteroids by sending nuclear weapons to explode on the invader's surface. However, technology needed to make such explosions happen at just the right time could prove challenging.

"A nuclear explosion is complicated," said Emeritus Prof. Bruce Conway. "You would need to detonate just before it hit the surface. When (the spacecraft) is moving 20 miles a second, that's difficult to time. A few thousandths of a second too late and you could hit the asteroid and the bomb doesn't blow up."

Conway envisions a simpler method.

"The one I always liked is deflection by impact," he said. "You could send up a spacecraft (about the size of a car, and traveling about the same speed as the asteroid) and simply hit the asteroid to give it a slight push. That would change the asteroid's speed by a few centimeters per second from what it was before and would put it on a course that would cause it to veer away.

"The collision mechanism is nice because it's very unsophisticated—you don't need a complex nuclear weapon," Conway said. "It's probably the cheapest method, too, although I don't think anyone would worry about the cost if an asteroid were going to destroy the Earth."

Conway began research almost 20 years ago on these theories. In 1999, the National Aeronautics and Space Administration's "Deep Impact" mission showed deflection could work, although that mission's purpose of running a spacecraft into a comet was to see under the surface of a comet's crater rather than to deflect it.

Conway has revisited the topic because of the European-led Asteroid Impact and Deflection Assessment (AIDA) mission planned for 2022 to collide a spacecraft into the asteroid Didymos. Scientists chose Didymos for practice because it isn't currently expected to collide with Earth. The mission carries a "do no harm" caveat: the "nudge" can't move the asteroid so that any of its resulting passes by Earth within the next 100 years can be closer than they would have been originally.

"I came up with an approach for treating it as a problem in optimization: maximizing the initial deflection, by choosing the location and direction of the impact of the spacecraft, but subject to the constraint that no future encounters are closer than they would otherwise have been," Conway said. "It worked."

Although scientists do not expect any sizeable asteroid to collide with Earth in the next 150 years or so, Conway said it's "100 percent likely" to happen at some time, and that Earth is hit all the time by meteors, crashing mostly into the oceans. Some invaders have caused extensive damage, including one that flattened trees for a hundred miles around in Siberia in 1908, and one 65 million years ago that caused the extinction of the dinosaurs.

"A mission like AIDA will be quite inexpensive," Conway maintains. "It's probably worth it to try it out to know that we could do it if there was ever a need to in the future."

First asteroids, then Mars

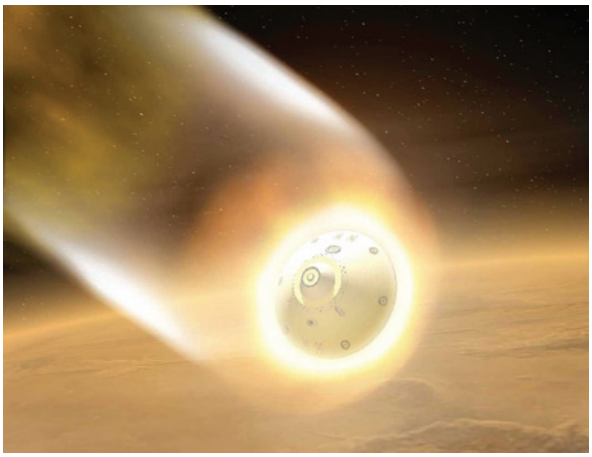
Purposes of NASA's Asteroid Redirect Mission (ARM) are for astronauts to be able to explore an asteroid in the 2020s, and to advance the new technologies and spaceflight experience needed for humans to pioneer Mars in the 2030s.

Associate Prof. Soon-Jo Chung is collaborating with Guidance, Navigation, and Control (GNC) experts of NASA/CalTech Jet Propulsion Laboratory (JPL) in developing control strategies to capture and redirect a near-Earth asteroid to a stable obit around the moon.

The ARM project is expected to produce the first in-depth results and first-of-a-kind tools for attitude stabilization and control of an asteroid in the 3 to 10 meter range. Chung said the NASA scientists are investigating multiple concepts of capture mechanisms, one of which is an inflatable system, similar to a bag. The inflatable bag captures the selected asteroid, tightens around it, and pulls it to another orbit.

Chung will contribute to attitude control designs for de-spinning and stabilizing the asteroid-spacecraft combination.

Panesi earns NASA Early Career Faculty Award for Modeling of Mars Entry



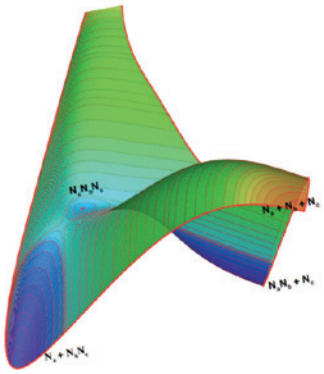
AE Assistant Prof. Marco Panesi has won several awards over the past year for his work in modeling non-equilibrium thermophysical processes that occur during hypersonic flight.

NASA has recently selected Panesi's project, "Reduced Order Modeling for Non-equilibrium Radiation Hydrodynamics of Base Flow and Wakes: Enabling Manned Missions to Mars," for the Early Career Faculty Award. Earlier this year, Panesi was also selected for the Air Force Office of Scientific Research (AFOSR) Young Investigator Award (YIP). Panesi's early YIP research efforts were then selected for the 2015 Physical Modeling Award at the 8th European Symposium on the Aerothermodynamics for Space Vehicles in the spring for his paper, "A Reduced-order Modeling Approach to Enable Kinetic Simulations of Non-equilibrium Hypersonic Flows."

For the Mars exploration project, Panesi plans to devise a framework for the construction of reduced order models for chemical kinetics and radiation, relevant to Mars entry applications, based on an adaptive *coarse-grained* method. The model will enable the description of the strong non-equilibrium kinetics and radiation generated by the recombination of CO_2 molecules in the back shell region of entry spacecraft, without the usual reliance on case-specific empiricism.

These Early Career efforts, combined with the separate efforts of the YIP project aim to develop new governing equations for chemically reacting flows for Mars and Earth entry applications. Vehicles traveling at very high speeds are subject to extraordinarily high temperatures, in the tens of thousands of degrees. Research efforts of Panesi's group focus on the characterization of detailed chemical kinetic processes to enable predictive models for peak heating, material selection and design of thermal protections systems capable of withstanding extreme environments.

Panesi



Chasiotis, Ansell and Gerhold Recognized for Advising

Prof. Ioannis Chasiotis, Assistant Prof. Phil Ansell and staff member Laura Gerhold, Academic Advisor & Coordinator of Undergraduate Programs, all received the Engineering Council Award for Excellence in Advising for the 2014-15 Academic Year.

The top 10 percent of engineering advisors are chosen for the award, which recognizes the important role that advisors play in the academic planning process of every engineering student on campus. Students nominate the candidates.

Liebeck Endows Ormsbee Professorship

Liebeck

"[Ormsbee] was a powerful influence, not just for me but for many others."

Saying it's "payback time," alumnus Bob Liebeck has channeled his respect and gratitude for his mentor, the late Aerospace Engineering at Illinois Prof. Al Ormsbee, into the department's first named professorship.

"Al really made it happen for me; he was a scholar and a motivator, and how lucky could I be," said Liebeck, a member of the National Academy of Engineering and a world-renowned authority in the fields of aerodynamics, hydrodynamics and aircraft design. "Things have worked out well for me as an aeronautical engineer."

The professorship will be officially announced during the Al Ormsbee Memorial Symposium on Aerodynamics and Aircraft Design on Thursday, Oct. 1, 2015, in Room B02 of the Coordinated Science Laboratory, 1308 W. Main Street, Urbana. The symposium features a host of successful engineers who have benefited from Ormsbee's influence, including Liebeck, Senior Fellow of The Boeing Company; Adjunct Professor of Mechanical & Aerospace Engineering, University of California, Irvine; and Professor of the Practice, Massachusetts Institute of Technology.

Liebeck would like for the professorship to encourage work in the core areas of aeronautical and astronautical engineering, including aerodynamics, flight vehicle design and structures. He hopes his gift to be an example, encouraging other AE alumni who have experienced success to consider giving back as well. And, he said it is a "thank you" to Ormsbee.

"I hope he'd like it," Liebeck said. "He was a powerful influence, not just for me but for many others."

Liebeck was an undergraduate when he first developed his appreciation for Ormsbee's teaching skills, and decided to go to graduate school upon Ormsbee's encouragement. The two worked closely together on airfoil design, research that Liebeck credits for leading to his 2011 Daniel Guggenheim Medal, one of the most prestigious awards in aviation.

Ormsbee also introduced Liebeck to A.M.O. Smith, who, in 1966, led the Aerodynamics Research Group at Douglas Aircraft Company in Long Beach, California. Smith advised Liebeck to work on maximizing airfoil lift, and the work continues to be referenced in aerodynamics textbooks today.

Quoting Sir Isaac Newton, Liebeck said, "'We stand on the shoulders of giants.' I was blessed to have the opportunity to stand on the shoulders of two giants: Allen Ormsbee and A.M.O. Smith."

AE Celebrates 70th Anniversary, Harry Hilton

About 90 AE alumni, faculty, staff and friends gathered over Homecoming Weekend 2014 to celebrate AE's 70th anniversary and congratulate Emeritus Prof. Harry H. Hilton on 65 years at the University of Illinois at Urbana-Champaign.

The program began with a video tribute to the late Steven R. Nagel, AE alumnus and astronaut. The evening event then turned to Hilton's presentation of the department's history: from its founding in 1944 by first Department Head H.S. Stillwell; to significant growth in the 1960s in response to the Space Race; to today's continued prosperity, outstanding faculty, and excellent students.

Emeritus Prof. Harry H. Hilton gives a presentation on AE's history during the Department's 70th Anniversary celebration dinner.

AE's Online Master's Degree Has Successful Start

Kyle Smith was one course short of earning his master's degree in Aerospace Engineering at Illinois when he started working full time in 2011 as a systems software engineer at FRASCA, an Urbana flight simulation company.

Smith, who had earned a bachelor's in AE at Illinois in 2009, wanted to finish the master's degree, but "working full time, I really didn't have the option to come to campus," he said. Then, a year ago, he learned of AE's new online master's degree program being offered starting Fall 2014.

Going online, Smith went on to finish the remaining course—Applied Aerodynamics—and earned his degree in December. "It was super convenient," he said. "It was the same (as being in the class physically). The only difference was, I watched a recording of the class."

The new program has gone extremely well, believes AE Prof. John Lambros, who has been instrumental in getting the online master's up and running. The program attracted 10 students last fall, and an eleventh in January. Fourteen students have enrolled as of Fall 2015.

"The online students all did extremely well; their grades were mostly A's and A+'s," Lambros said, noting, "I think most of them enjoyed the experience and thought it was useful."

AE's online master's degree program is identical to the on-campus non-thesis degree because the online courses are streamed recordings of the on-campus courses. The homework is the same, the instructors are the same, and the exams are the same.

"The differences are (online) is more flexible and you can apply what you're learning to the real world at your job," believes online student Cassie Meisner, who works for Rolls-Royce. "But of course it's still the same notes, homework, and exams."

Actually, online students see an advantage in having access to course recordings.

"If I'm feeling tired from a long day of work or from staying up the night before working on an assignment, I can just stop the lecture and come back. Plus, if I didn't catch something, I can always rewind," said John Alaimo, who earned a bachelor's in AE in 2012. Alaimo is pursuing the master's while working full time for Boeing in Everett, Washington.

Luke Firsching, another online student, also likes the flexibility. "Being able to choose when I watch lectures and the ability to re-watch lectures was extremely useful. I no longer need to worry about schedule conflicts or not being able to scribe all of my notes quickly." Firsching's employer, UTC Aerospace Systems in Rockford, Illinois, is paying for his degree through its Employee Scholar Program.

Online students have used discussion boards, Google. docs, and other technology to interact and collaborate with on-campus students taking the identical courses. In fact, Smith said, he and his group partner won a couple of competitions in class assignments using online collaboration tools.

While online students submit homework electronically, the students take their exams in the presence of a pre-approved proctor, who then sends in the test through standard mail. Proctors make sure that online students face the same time limits and other exam standards required of on-campus students.

"The differences are (online) is more flexible and you can apply what you're learning to the real world at your job."

NASA chief technologist delivers Stillwell Lecture

Miller

Dr. David W. Miller, Chief Technologist for the National Aeronautics and Space Administration (NASA), delivered AE's H.S. Stillwell Memorial Lecture in March.

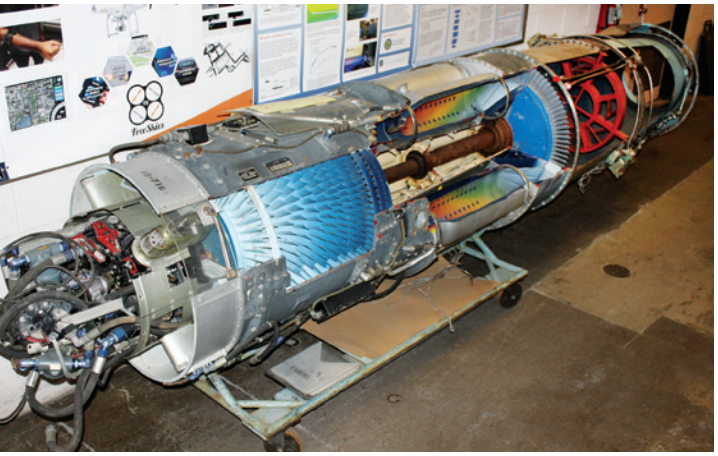
Miller's talk, "NASA Technology Drives Explorati (And How You Can Get Involved)" covered NAS work from the Apollo missions that blazed a path to space, to the next giant leap—the path to Mars. Technology drives exploration, Miller said, and NASA is building on the Apollo program's accomplishments to test and fly transformative, cutting edge technologies today for tomorrow's missions. But unlike the Apollo missions, where the public could only watch, NASA wants the public to get involved and be a part of the journey.

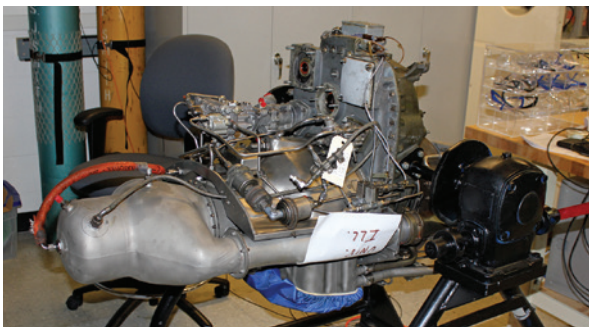
Miller serves as NASA's principal advisor and advocate on the agency's technology policy and programs. The Chief Technologist's Office coordinates, tracks and integrates technology investments across the agency and works to infuse innovative discoveries into future missions. The office leads NASA technology transfer and technology commercialization efforts, facilitating internal creativity and innovation, and works directly with other government agencies, the commercial aerospace community and academia.

THE H.S. STILLWELL MEMORIAL LECTURE

The H.S. Stillwell Memorial Lecture was established in honor of Prof. H.S. (Shel) Stillwell.

Rolls-Royce Model 250, J35 Engines and Propeller Blades Add to AE Display





Rolls-Royce Corp. has added to a display of one of the company's Olympus supersonic engines by presenting to AE a Model 250 small turbine engine, a cut-away display of a J35 Allison Turbojet engine, and two Allison Aeroproducts propeller blades.

Every day, students coming to the building for classes and labs in Talbot Laboratory will have hands-on exposure to the engines and equipment. The displays also can be featured in events such as Engineering Open House and other outreach activities that impact future engineers.

"We are very thankful for Rolls-Royce's continued involvement with our Department," said AE Department Head Philippe Geubelle. "Having access to these remarkable examples of aerospace technology might inspire future generations of students."

The Model 250 is one of the most successful small turbine engines ever developed.

Although a mature engine that has just passed its 50th birthday, the Model 250 remains a major force in the small turboshaft and turboprop market.

The J35 engine was built in the late 1940s and was the United States Air Force's first axial flow turbojet. The propeller blades were used on the Lockheed C-130A aircraft from the mid 1950s until 2004.

Students Gain Hands-On Learning from High-Altitude Balloon Course

On a fine day in April a sizeable crowd gathered to watch as a helium-filled balloon rose, carrying into the sky several students' projects from Prof. Vicki Coverstone's high-altitude balloon class.

The balloon would rise some 90,000 feet before popping from the pressure outside it, and being carried via parachute to somewhere in Indiana. A radio, also strung to the balloon, would reveal its location for recovery along with -or so the students would hope—good data, photos and video.

After a few years' absence, the balloon course AE offers was brought back in Spring 2015 as another opportunity for hands-on learning. Throughout the semester, students—many of them AE freshmen—were tasked with defining and designing a project, constructing it, and writing a report on their results.

"They all had to formulate a reason for why they should fly their payload; they all had to have their own objective."

The students worked in eight teams of about five members each to prepare independent projects as payloads for the balloon launch. "They all had to formulate a reason for why they should fly their payload; they all had to have their own objective," Coverstone said. "Success would be determined by whether the data provides information that allows them to meet the objective or prove their hypothesis."

Goals varied. Some teams sought to take measurements to gain data on atmospheric pressure, different frequencies of light, or solar energy. Others sought to gain impressive photographs, with the possibility of entering them in the Global Space Balloon Challenge.

The class allowed the young engineers to learn management and collaboration skills. "They worked as a team to divide the work; no one person could do it by themselves," Coverstone said. "They were pretty ambitious projects."

Each team was supplied a $50 budget and cameras from previous AE glider and rocket courses. Expenses over the budget came from the teams' own pockets, so they were creative in repurposing used equipment.

The prep work led to the class's highlight: three launch dates in April. Held in carriers the teams designed from mainstay materials of Styrofoam, Gorilla Glue and duct tape, projects were tied in a row, one after another, and then strung to the balloon. Once the balloon was released, all eyes

followed the skyward procession, with the line of projects swaying like the tail of a kite.

"This is team-based project learning and hands-on stuff," Coverstone said. "It helps students develop the ability to formulate an experiment."

AE Upholds Tradition of Teaching Excellence

Aerospace Engineering at Illinois emphasizes education and teaching through many avenues: faculty-student interactions; hands-on education; and programs that present materials in effective, innovative ways.

People figure strongly in this mission towards productive learning: 70 percent of current AE faculty members who have been with the department at least two years have been honored by the College of Engineering with excellence in teaching and/or advising awards. Several faculty members have been named to the campus lists of teachers ranked excellent by their students. Some, including Department Head Philippe Geubelle and Profs. Scott White, John Lambros, Vicki Coverstone and J. Craig Dutton, have earned the University of Illinois' highest recognitions for work with and/or on behalf of undergraduate, graduate and professional students. This tradition has been long established, with examples set in the recent past by stalwarts such as Emeriti Profs. Bruce Conway and John Prussing, both highly awarded and fondly regarded by AE alumni for dedicated teaching.

Continuing the tradition are faculty like Associate Prof. Tim Bretl, as well as Lambros and Assistant Prof. Grace Gao, all honored over the past year for their efforts. And, in the department's persistent goal to heighten students' educational experiences, teaching laboratories have seen major improvements, and new curriculum is being offered.

Bretl Puts Students First

It's near the end of the Spring 2015 semester and the 100 students in AE 353, Aerospace Control Systems, are chatting and laughing, looking forward to seeing how the programming strategies for their simulated quadcopters play out in the day's competitions.

As the students enter the room and settle in their seats, Associate Prof. Tim Bretl calls out, "There's lots of food and drink and strawberries and stuff like that," then jokingly warns, "but hands off the cupcakes!"

Cupcakes are for the winners.

This extra effort extended to make the class fun while the students are learning is typical of Bretl. The care he takes in teaching has led the American Institute of Aeronautics and Astronautics (AIAA) student group to choose him as the Aerospace Engineering at Illinois 2015 Teacher of the Year. His determination to improve upon his teaching techniques has resulted in the College of Engineering recognizing him with this year's Collins Award for Innovative Teaching.

"It really seemed like Professor Bretl had the students in mind before doing anything."

But perhaps the most satisfying reward for Bretl has been his students' responses. Among student comments in Instructor & Course Evaluation System (ICES) reports have been: "Bretl made this class seem very useful and was very clearly here to help us—he was awesome!"; "It really seemed like Professor Bretl had the students in mind before doing anything."; and "Thank you for being the light in the darkness that was junior year!"

It wasn't always that way. Bretl remembers his first AE teaching experience in 2007 to have been less than stellar. Hoping to engage a large class of over 100 students, he began lobbing questions to no one in particular. A resounding silence met him; no one responded.

Finally, one student raised his hand and queried, "Why are you asking all these questions?"

"I was not satisfied with my teaching impact when I started," he admitted. He feared the excellent examples that AE's veteran teachers Bruce Conway, John Prussing and Craig Dutton had set were far from his reach. "I wondered, 'How do they do that?'" Bretl said. "You can't copy them; you have to develop your own skills. You don't look at a master carpenter and know how to build a house. You have to practice a lot."

And so he did.

"Teaching is a skilled profession: If you care about it and work hard at it, you will get better," Bretl maintains. "And it's important for students to recognize this process is going on—they should encourage the faculty to get better."

Bretl believes he turned a corner in 2012 when he was assigned to teach AE 482, Introduction to Robotics, and AE 483, Aerospace Decision Algorithms. He had become comfortable with teaching smaller classes with up to 20 students, but these were significantly larger, with 60 to 70 students each.

"That semester I decided to learn names," Bretl said. "I sent [Undergraduate Coordinator] Laura [Gerhold] an email in the middle of July and told her I wanted to memorize all the [students'] names." Gerhold responded by creating flashcards with the students' photos on one side and their names on the other.

"For 15 minutes or so before every class I reviewed the flash cards," Bretl recalled. "There was a complete change in how things went in the class. It's hard to speak directly to someone if you don't know their name. Before, I would speak to the ground. After learning names, I could ask individual students questions and they would answer me; they were more open to speaking to me. It was engaging and I was building a relationship with them."

Over the years, Bretl has tried many techniques to enhance students' learning experiences; some with great success, others, not so much. "Students see that you're always trying to improve, and they're extremely supportive and forgiving. What's most important is that they see you care about them, and that you're willing to invest time and energy."

His penchant for trying new things most recently produced a two-course sequence in control theory that is required of all AE students and that is now a highlight of the curriculum.

In Spring 2014, Bretl revamped AE 353, the junior-level controls class. One key change in content was to focus on modern, state-space methods of analysis

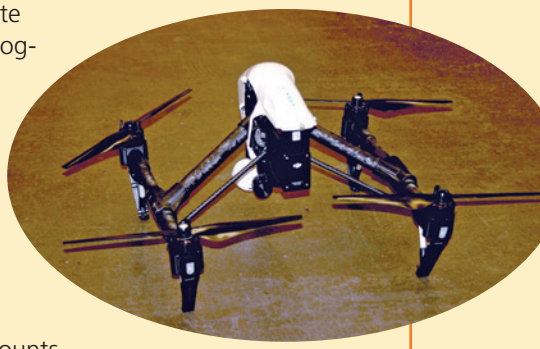
Applications for Bretl's Robotics Research Range from Construction Monitoring to Prosthetics

In addition to his continual efforts to improve his teaching abilities, AE Associate Prof. Tim Bretl conducts a vigorous research program based on his interests in controls, dynamic systems and robotics. Among more recent projects have been a project to benefit construction monitoring, and programmable 3D-printed prosthetics.

Vision-based Robotic System for Construction Monitoring

Bretl and colleagues are developing a first of its kind automated vision-based construction progress monitoring system that uses video and still images taken with the aid of a robotic quadcopter.

The aerial robotic device would autonomously transport recording equipment to strategic points along a job site. Eventually returning to a home base, the video and images would be downloaded and the operations on the site analyzed, giving project managers a more accurate status of current construction progress, together with a comparison to the project plan. This improves the project management team's understanding of when actual or potential construction progress deviations happen.



The robotic quadcopter also autonomously mounts and demounts a network of video cameras to building elements on the site to record dynamic construction operations from strategic locations and viewpoints. From these video streams, new computer vision methods will detect, track, and analyze activities of the construction equipment and craft workers in 3D to provide an accurate and direct measurement of productivity on the site, and enable root-cause assessment on performance deviations. By providing a visual interface to the outcome of monitoring operations, the system improves decision-makings that can lead to efficiency in executing the project.

The National Science Foundation awarded the research team a nearly $1 million Cyber-Physical Systems (CPS) grant for the project, which kicked off in January 2015 and continues through the end of 2019. Bretl's research group is building the robotic quadcopters and its operating system that controls the autonomous data collection process. These robotic quadcopters also magnetically dock the video cameras at various places through an autonomous operation, allowing for video recording of the site operations.

3D-Printed Prosthetic Lends a Hand in Ecuador

Bretl and his group have been conducting research on electromyographic (EMG) control of prosthetics and sensory feedback for the past three years. The group used of 3D-printing last fall to create model hands with pattern recognition capability. A

continued on page 22

and design, previously thought as too advanced for undergraduates. Students apply these methods to design competitions held at the semester's end.

In these competitions, students design control systems that make a wheeled robot track a given trajectory with application to autonomous cars, and make a quadcopter move to a sequence of targets with application to package delivery.

Both contests have been well-received. "I felt like I was actually doing real engineering," commented one student. Another wrote, "[The competitions] were great at summarizing everything we had learned."

In Fall 2014, Bretl taught AE 483, the senior-level course in aerial robotics that he created two years earlier. In this course, students apply what they learned in AE 353 to implement and test algorithms for automatic control of quadcopters in the laboratory. It is the first chance some students get to fly something real.

The response to this new course has been overwhelming.

As one student put it, "[AE 483] was by far one of the best courses I have taken at this institution. The lab sections were practical and gave a hands-on approach. This produced excellent results with students spending office hours and extra time to improve their algorithms, which you'd never see in other classes. What Professor Bretl has done with this course is great."

An ABET accreditation reviewer agreed, labeling Bretl's course, "truly unique among all aerospace engineering programs across the country."

Bretl continues to fine-tune both AE 353 and AE 483. For example, he established a policy whereby students could retake exams as many times as they wanted, keeping their highest grade. This was done with the understanding that partial credit would not be given; answers were either right or wrong.

"A common misconception is that (retake exams) make things easier for the students; nothing is further from the truth," Bretl maintained. "Some students have to work very hard to do well on these exams. By the end of the semester, some students may have taken an exam as many as a dozen times."

The policy reduces stress and allows students to work their way into a good grade, Bretl reasoned. "Retake exams put me and the students on the same team. Eliminating partial credit promotes an atmosphere in which correct answers are important, and clearly exposes what is not understood. Students are encouraged to care about really getting the material."

Many of the students ended the semester with As or A-pluses. "I'm not giving an A for knowing less; it just took some of them longer to get to the same point. If you believe in education, you believe that anybody can improve and achieve their goals," Bretl said.

This philosophy that drives him was extended to men incarcerated at the Danville (Illinois) Correctional Center in 2013. He taught AE 482—the same course on robotics that he has taught at the University of Illinois—to a class of 13 incarcerated men. Some had college educations; others had earned a GED (the General Education Development Test taken in lieu of a high school diploma) and an associate degree in prison.

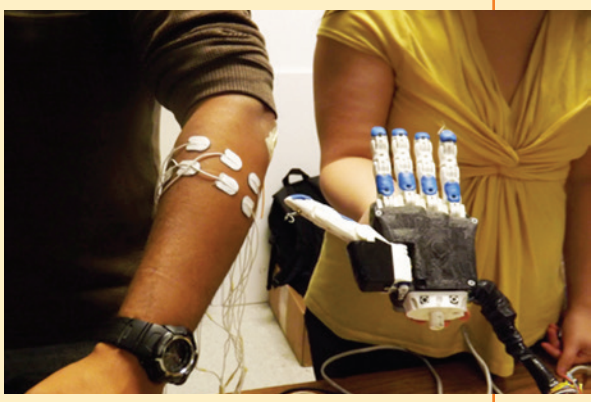
"It's a very different teaching environment," Bretl said. "Unfortunately, incarcerated men rarely have the opportunity to get a job in a technical area upon release—they face a lot of barriers. These are mature students who care deeply about education. They are in it to learn, purely for learning's sake."

Reaching out to the incarcerated men was of personal importance to Bretl.

"I'm not saving the world, but I am doing something that has a real, positive impact on the men inside the prison, and their families, and the community outside," he believes.

"If you believe in education, you believe that anybody can improve and achieve their goals."

Applications for Bretl's Research, continued



machine-learning algorithm allows the model to open and close as well as learn other positions of the hand for more functionality.

The hand is trained to replicate several motions by taking the electrical signal from muscles in the arm and sending it to an EMG board, which is then sent to a microprocessor with a machine-learning algorithm on board. Based on those signals, it sends commands to motor drivers, which churn the motor and make the hand move.

Bretl's students were able to provide the prosthetic for an Ecuadorian man who suffered a below-elbow amputation on his left arm 33 years ago. The test of the device was successful.

Lambros Develops New Graduate Courses, Online Master's Degree

Prof. John Lambros' creation of graduate level courses and development of the Aerospace Engineering Online Master's Degree program have earned him the 2015 Campus Award for Excellence in Graduate and Professional Teaching Award.

Lambros, a 15-year veteran of the AE Department, has been responsible for introducing innovative graduate level courses on topics including fracture mechanics and dynamic response of materials. Over the years, graduate students in civil engineering, materials science, and mechanical engineering, as well as aerospace engineering, have attended these courses.

In the Lambros-created course, AE 522, Dynamic Properties of Materials, he added a hands-on component in which students perform a set of carefully crafted experiments using some of the advanced experimental tools available in his own lab, the High Strain Rate Mechanics Laboratory.

In AE 560, Fracture Mechanics Laboratory, another course Lambros created, students apply state-of-the-art experimental techniques to fracture problems. They work in small teams to perform a set of experiments, and submit reports in the form of research manuscripts formatted according to solid mechanics journals. Lambros then reviews these "research manuscripts," thereby providing a dual assessment of the experimental work itself and of the technical writing.

Lambros

In his role as AE Associate Head for Graduate Programs, Lambros has led in creating an online master's degree program in aerospace engineering that emphasizes the same quality curriculum that students experience on campus. The effort has significantly expanded the reach of AE's graduate teaching.

In establishing AE's online master's degree, Lambros focused on the curriculum being completely equal to the on-campus degree in every aspect: The admission process is identical, and courses are taught by the same instructors during the same semesters as the campus offerings, with the same homework assignments, midterm and final exams. Lambros has emphasized advising online students, particularly in regards to course selection.

Gao Helps Students Navigate GNSS

Assistant Prof. Grace Gao has created many paths for students to find their way in learning about navigation systems. For these efforts, she has been recognized as the 2015 winner of the Engineering at Illinois Everitt Award for Teaching Excellence.

Since joining the Aerospace Engineering faculty in 2012, Gao has strengthened the undergraduate course ECE456/AE456: Global Navigation Satellite Systems, which covers the Global Positioning System (GPS) and other navigation systems.

In addition to increasing the course's availability, Gao has emphasized hands-on laboratory work that gives students a more direct experience of the technology. Multiple research papers have resulted from class projects, and one has earned a "Best Presentation of the Session" award at a major technical conference.

Gao has made it a priority to open the pipeline between industry and her students by inviting guest lecturers from companies to interact with her classes.

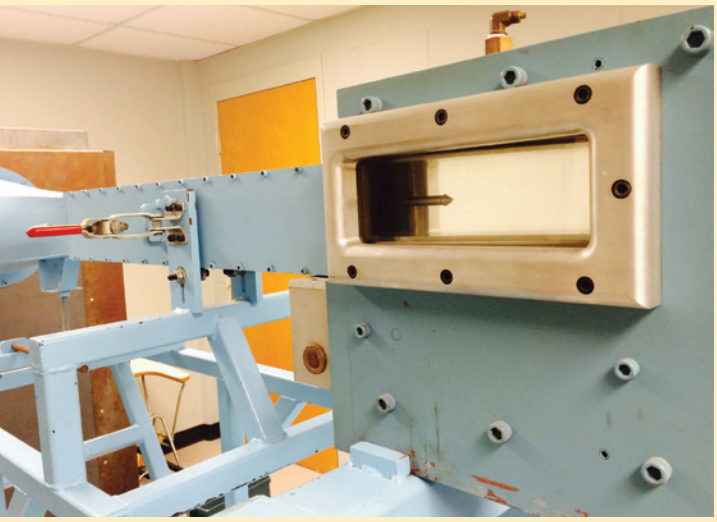
Gao's efforts have attracted industry support, and a number of companies have supplied funding to further develop it. For example, since Spring 2014 Rockwell Collins has provided $50,000 toward Gao's Advanced Satellite Navigation Laboratory. She has used the funding to purchase quadrotor Unmanned Aerial Vehicles and positioning sensors for a new course on Advanced Satellite Navigation, and state-of-the-art GPS receivers with carrier-phase capabilities for an advanced GPS course.

Gao

Gao's courses attract students of many engineering disciplines, including AE, Electrical and Computer Engineering, Mechanical Science and Engineering, Industrial and Enterprise Systems Engineering, and Computer Science. Students who helped contribute to Gao's nomination for the Everitt Award said she has made sure course content is applicable to each of the students' majors.

Her approach to final presentations also has been popular, extending grading privileges to the entire class. Students watch their peers' presentations and rank each project by text messaging, which Gao collects in real time.

Undergrad Labs, Projects Gain from Space Realignment



Supersonic wind tunnel

Reconfiguration of existing space within Talbot Laboratory and new equipment purchases will gain for Aerospace Engineering at Illinois undergraduates more opportunities for hands-on experience and better space for student projects.

Meanwhile, the rearrangement frees office space that the growing AE faculty need. The Department added eight new faculty in the past two years.

"These improvements will upgrade our laboratory education in the area of propulsion to the same high standards that we have had for many years in aerodynamics."

Three rooms in Talbot's basement have been designated for undergraduate laboratories, and will feature three wind tunnels and a jet engine, said Dr. Brian Woodard, AE Undergraduate Program Director and Laboratory Manager.

Two of the wind tunnels, capable of reaching subsonic speeds around Mach 0.1, were previously in AE's possession and were relocated to the new space. With AE Professors Greg Elliott and Craig Dutton, Woodard is also refurbishing a supersonic wind tunnel that will be used in the undergraduate laboratory curriculum and will be in place for the Fall 2015 semester. The supersonic wind tunnel allows students to gain experience with compressible flow phenomena with Mach numbers approaching Mach 3.

Elliott and Woodard also worked together to fund the purchase of an instrumented turbojet engine that the labs will use in the Fall. Woodard said seniors taking AE 460, Experimental Aerodynamics, will gain a better understanding of thermodynamics and propulsion by using the new jet engine in lab exercises.

"These improvements will upgrade our laboratory education in the area of propulsion to the same high standards that we have had for many years in aerodynamics," Elliott said.

The equipment additions "give the students a greater range of experiments," Woodard maintains.

A fourth room is now designated for student projects. AE has encouraged the growth in student group numbers and activities, and the space supports this emphasis.

"Now where the students keep their projects is right next to the labs where they work on them," Woodard said.

He added that, when the groups worked in other places, they had to furnish their own tools. "The Department owns a bunch of tools and students can have easy access to those now. (The groups) can spend the money they raise on their actual projects now and the Department can support the infrastructure.

"Because the groups want to do all these very ambitious projects, we wanted to support them as best we could."

Previously, the student groups worked from an overcrowded, compact office on Talbot Lab's third floor. That area will be used for faculty office space.

Brian Woodard with the new jet engine.

New Freshmen Course Focuses on Broad View of AE, Communications Skills

Curriculum will emphasize communication skills in a new freshmen program intended to give students a broad view of Aerospace Engineering at Illinois.

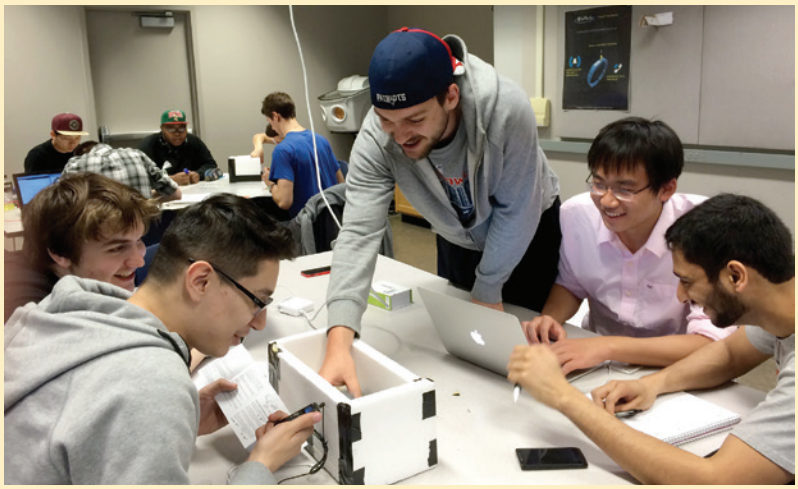
For years, incoming freshmen could choose whether their AE 100 introductory course focused on building a remote control airplane or a rocket (last spring, they also had the choice of launching a payload using a high altitude balloon). This fall, with support from a $51,000 College of Engineering Strategic Instructional Innovations Program (SIIP) grant, the students can choose a pathway that combines aeronautics, astronautics, and more.

"The field is so much more diverse than just airplanes and rockets," maintains Dr. Brian Woodard, AE undergraduate program director.

"Our SIIP team will put greater emphasis on the students' communications skills. To improve those skills in writing and presenting—which they will have to use their entire careers—we will have them do more individual research with mini presentations about any area of AE that interests them."

The new curriculum will also feature hands-on experiences. "Students (in the SIIP section) will still do a big project. The class in total will build several rockets and several airplanes," Woodard said.

This fall, AE expected a very large freshmen class of 138 students. Woodard expects that number to be divided evenly among the traditional airplane and rocket focuses, and the SIIP section, depending upon the interests of individual students.



AE's SIIP team, composed of Woodard, Prof. Vicki Coverstone, Associate Prof. Tim Bretl, Assistant Prof. Phil Ansell, Lecturer Steve D'Urso, and Undergraduate Coordinator Laura Gerhold, will advise Woodard on teaching the SIIP section this fall. The grant helps to pay for teaching assistant Vishwa Shah.

The SIIP curriculum is another effort of the AE Department to create an exceptional undergraduate experience. "It's great to pull in a lot of specialties and expertise," Woodard said. "We have a really good group of faculty here, and we want to show the diversity of AE."

As part of the College's AE3: Academy for Excellence in Engineering Education initiative, SIIP competitively awards education-innovation grants to faculty teams using a model similar to research-grant funding. The motivating vision for education innovation is to teach like we do research, meaning that teaching can and should involve collaboration, creativity, excitement, measurement, perseverance, and continual improvement, as do high-quality research programs at Illinois. Now in its third year, SIIP has achieved marked success by bringing aspects of Illinois' outstanding research culture to teaching, including an engaged community, collaborative projects, faculty-led innovation, rigorous evaluation, and a scholarly approach to pedagogical methods.

"To improve those skills in writing and presenting—which they will have to use their entire careers—we will have them do more individual research with mini presentations about any area of AE that interests them."

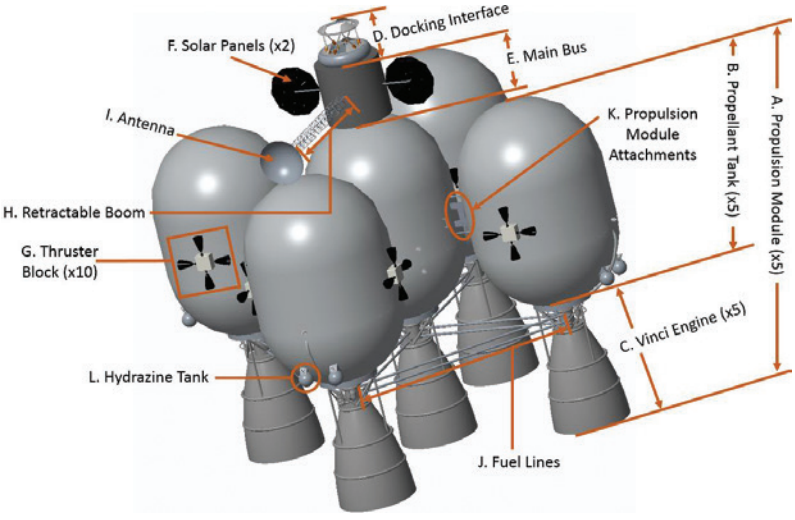
Five Years Running, AE Team Is AIAA Space Design Champ

For the fifth year in a row, an Aerospace Engineering at Illinois team is the national champ in designing a space transportation vehicle.

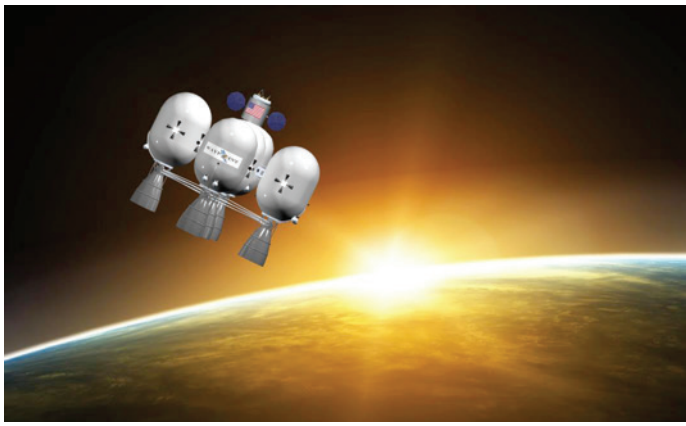
This year, the American Institute of Aeronautics and Astronautics (AIAA) Foundation challenged Undergraduate Team Space Transportation Design competitors to design a re-usable orbital transfer vehicle. The craft had to be capable of delivering 50,000 lbs. of payload from Low Earth Orbit (LEO) to Earth-Moon Lagrange (EML) points 1 and/or 2. EML are locations in space between the Earth and Moon where gravitational effects of both bodies act on an object equally, creating a stable equilibrium point for orbit.

Additionally, the vehicle needed to be capable of remaining at one of the Lagrange points for at least 30 days, then to bring back to Lower Earth Orbit 15,000 lbs. of payload.

WayPoint, AE's winning team, came up with Hermes, an axisymmetric modular design with five propulsion modules, a main bus unit, solar panels and an antenna. The five modules were to be made of a propellant tank and Vinci Engine.



Hermes conceptual graphic.



"The five-engine design promotes reliability of the vehicle, and all systems boast redundant components," according to Kevin Kim, the team's Lead Systems Engineer. "Solar panels harvest enough energy from the Sun to power the vehicle during shaded flight. Hermes is capable of transporting both to EML1 and 2, with increased capacity than the required 50,000 lbs. to EML1."

Faculty advisor for this year's champion was, again, AE Adjunct Prof. David Carroll. "The tradition of success of the Illinois teams can be largely attributed to my predecessor instructors who created a superb course structure to follow, and the teaching assistants who interact so diligently with the students every year," Carroll said. "And, of course, the students themselves earn the awards because they pour their heart and soul into creating their designs while incorporating our critiques (sometimes brutal with lots of red ink!) throughout the two-semester course."

In addition to Kim, WayPoint's team members were:

- David Brandyberry, Attitude Determination and Controls System Engineer
- Jake Dluhy, Power and Thermal Systems Engineer
- Peter Grega, Orbital System Engineer
- David Knourek, Propulsion System Engineer
- Matt Kosky, Structures System Engineer
- Evan White, Launch and Docking Systems Engineer
- Meghana Veeramachaneni, freshman assistant.

Student Competitions

ISS Team Competes in Designing Tool for Use in Asteroid Exploration

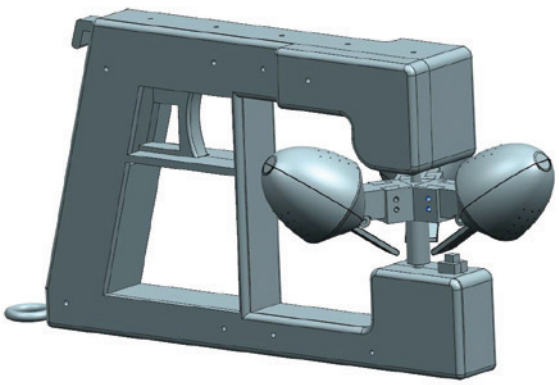
An Illinois Space Society team designed a tool to collect surface rocks in microgravity as part of a National Aeronautics and Space Administration (NASA) competition.

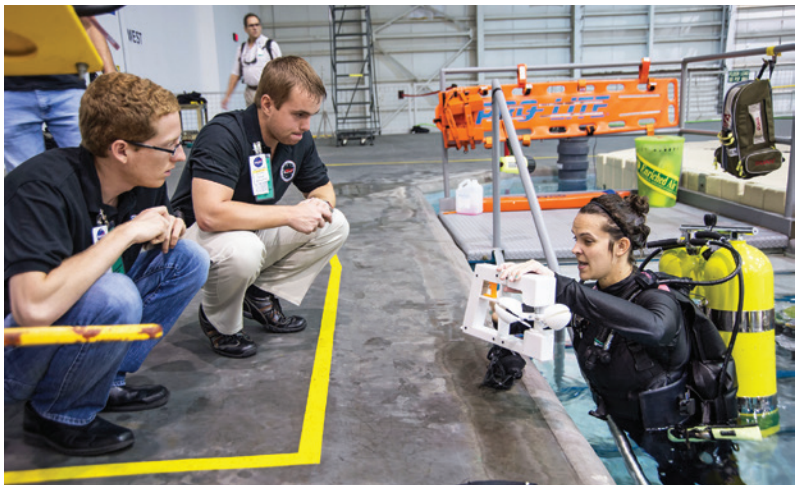
The team participated in Microgravity University's Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) program. Specifically, the team was chosen to compete in August in the Float Sample Grabber Challenge to design the tool NASA could use as part of manned missions to explore asteroids beyond Low Earth Orbit.

The contest required the mechanisms be manually operated using a single hand. The ISS team built the Cronus Sample Collection Tool, a 100 percent mechanical device composed of three containment chambers attached to a rotating exchanger. The three containment chambers were designed to isolate and collect three individual samples. The team built the tool so that its tripod would spin around using a trigger, and open and close using a push button on the top of the rear face of a grip. The main trigger used a gear system and the push button used a piston-pulley system.

Teams' designs were tested in the NASA Johnson Space Center Neutral Buoyancy Laboratory. Team Leader Christopher Lorenz said divers liked the AE team tool's simplicity, as well as how it conformed to their heavily constrained hand motions. The tool was able to successfully collect four types of samples.

"The biggest learning experience from the event was a better understanding of how real testing of space hardware occurs," Lorenz said.





From left, AE students Christopher Lorenz and Alexander Case speak with a diver about the performance of the Cronus Sample Collection Tool.

ISS team members were:

- Christopher Lorenz, Microgravity Team Lead
- Alexander Case, Mechanical Design Specialist
- Steven Macenski, Additive Manufacturing Specialist
- Paul DeTrempe, Design and CAD Specialist
- Michelle Jim, Materials Specialist (Electrical Engineering)
- William Asher, Educational Outreach Lead
- AE Assistant Prof. Grace Gao, Faculty Advisor

AE Undergrads Gain Rocketry, Robotics Knowledge from NASA Launch Challenge

With many members gaining first-time experience in rocketry and robotics, an Aerospace Engineering at Illinois team was pleased with its performance in the Spring 2015 NASA Student Launch (SL).

"The majority of our members were freshmen or sophomores, so essentially everything about building high-power rockets and robotics was completely new to them," said team leader David Knourek.

The Maxi-MAV challenge competition took place in Alabama in April. The challenge involved robotically capturing simulated Mars soil samples, loading the samples into a rocket, launching the high-powered

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The team prepares the rocket for launch.

rocket to 3,000 feet, and ejecting and returning the soil sample to Earth.

"For the challenge, we had to build an autonomous system to pick up a simulated soil sample, which was a small pvc pipe filled with sand for weight," Knourek said. "The system then had to place the sample into the rocket, and somehow seal the vehicle. We used a hinged door secured with magnets, which was closed by the robotic arm. Then the system had to lift the rocket to a vertical launch position, and insert the igniter. All of this had to be done without any human intervention. Then the launch controller launched the rocket, which ejected the container holding the sample payload at 1,000 feet above the ground during descent.

"The launch was very successful, the rocket flew exactly as we expected and landed safely," Knourek continued. "It flew to 3,500 feet, which was above the 3,000-foot target altitude, but due to competition rules we weren't able to modify our rocket after our test flight, and we knew that would happen.

"We had a very minor issue with the robotic arm which meant we had to close the gripper around the sample manually instead of autonomously. Other than that, the robotic system worked as designed."

In addition to exposure to rocketry and robotics, AE team members gained experience with technical writing from participating in the challenge. "The competition involved three full-scale design reports (several hundred pages in length) describing every detail of the system and why it was designed," Knourek said. "This experience will hopefully be a great help to the younger team members when they reach their Senior Design course."

In addition to Knourek, team members were:

- Christopher Lorenz—Team Leader at Launch
- Jacqueline Dbila—Structures and Recovery Team leader
- Brian Hardy—Structures and Recovery Team
- Alli Whitfield—Structures and Recovery Team
- Andrew Koehler—Structures and Recovery Team
- Ian Charter—Autonomous Ground Support Equipment Team leader
- Ben Collins—Autonomous Ground Support Equipment Team
- Lui Suzuki—Autonomous Ground Support Equipment Team
- Alexandra Bacula—Autonomous Ground Support Equipment Team

IRIS Team Takes First for Mining Competition Paper

AE's Illinois Robotics in Space (IRIS) student organization took first place for its Systems Engineering Paper in the National Aeronautics and Space Administration's (NASA) Robotic Mining Competition.

Each university team in the sixth annual competition, held in May at the Kennedy Space Center in Florida, designed and built a mining robot to traverse a simulated Martian chaotic terrain, excavate Martian regolith, and deposit the regolith into a collector bin within 10 minutes.

The team's 20-page technical paper described a systems engineering framework that the team took to developing its mining robot. Through the design process, the IRIS team took into consideration risk assessment and mitigation, interface control, configuration management, manufacturing planning, and verification and validation.

IRIS-V, the AE team's robot, placed 14th of 46 teams in the mining part of the competition. IRIS-V was the first robot in school history to successfully mine, traverse the arena, and dispense regolith.

The Mechanical Team Lead was responsible for the overall design and manufacturing of the robot. The Autonomous Team Lead led the team responsible for both the manual and autonomous code for the

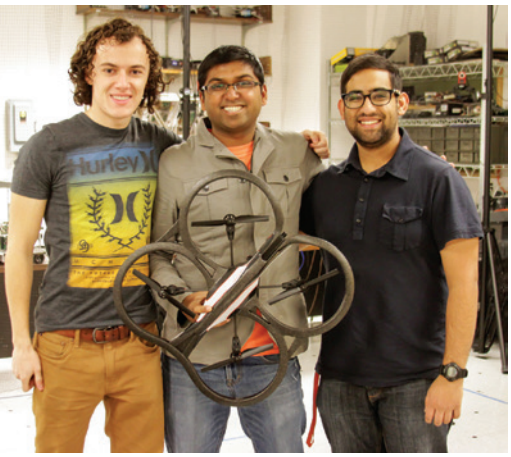
robot. The electrical team lead was responsible for all electrical components on the robot, include batteries, motors, and all wiring.

- Adana Pappas: Project Manager
- Dayne Rogers: Chief Engineer
- Peter Grega: Systems Engineer
- Andrew Myrna: Mechanical Team Lead
- Raj Vinjamuri: Electrical Team Lead
- Nathan Havens: Autonomous Team Lead
- Prof. Brian Woodard (AE): Faculty Mentor
- Prof. Seth Hutchinson (ECE): Faculty Mentor
- Alexandra Bacula: Mechanical Team Member
- Robert (Grant) Brucker: Mechanical Team Member
- Patchara Choakpichitchai: Autonomous Team Member
- Christina Choi: Electrical Team Member
- Weiping Dang: Autonomous Team Member
- Anthony De Roo: Electrical and Autonomous Team Member
- Evan Defend: Autonomous Team Member
- Cassandra Dickey: Mechanical and Systems Team Member
- Jake Dluhy: Autonomous and Systems Team Member
- Jacob Drewniak: Mechanical Team Member
- Leon Frickensmith: Autonomous Team Member
- Zhongzhu Guo: Autonomous Team Member
- Pranika Gupta: Electrical Team Member
- Rohit Gupta: Mechanical Team Member
- Byron Hopps: Electrical and Systems Team Member
- Bohan (Bruce) Hu: Electrical Team Member
- Malhar Jere: Electrical Team Member
- Gooyoung Jung: Mechanical Team Member
- Jordan Konick: Mechanical Team Member

IRIS team in the NASA Robotic Mining Competition.

- Deepa Kote: Mechanical and Systems Team Member
- Joe Lasser: Mechanical Team Member
- Gyanyang Luo: Autonomous Team Member
- Steven Macenski: Mechanical Team Member
- Austin Martinovich: Autonomous Team Member
- Caleb Perkinson: Autonomous Team Member
- Kaushik Ponnapalli: Mechanical Team Member
- Josh Rabinowitz: Electrical Team Member
- David Rubrecht: Electrical Team Member
- Matthew Schmidt: Electrical Team Member
- Samyak Shah: Autonomous Team Member
- Gil Shohet: Autonomous and Systems Team Member
- Hannah Smith: Electrical Team Member
- Patrick Sprung: Mechanical Team Member
- William Tadekawa: Autonomous Team Member
- Rahul Talari: Autonomous Team Member Alex Thompson: Team Member
- Erik Torres: Electrical Team Member
- Yuping Wang: Autonomous Team Member
- Daniel Woodall: Systems Team Member
- Bo-Yi (Randy) Yang: Autonomous Team Member
- Zhendong (Mike) Yang: Electrical and Systems Team Member
- Lian Yu: Electrical Team Member
- Tianyang (Jeremy) Zheng: Electrical Team Member

Student Startups



FreeSkies founders: Andrew Putch, Jay Mulakala, and Ankur Mehta.

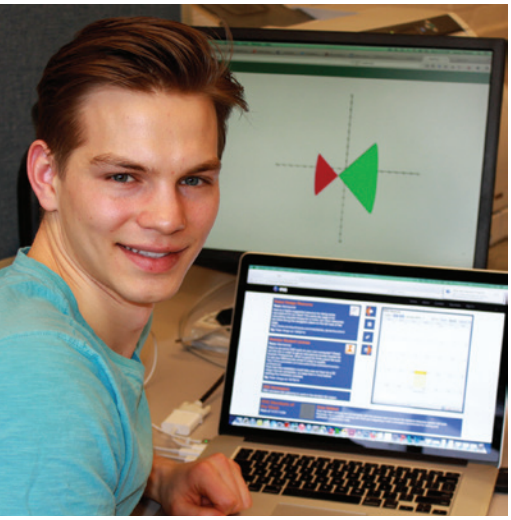
FreeSkies: AE students' startup for controlled drones in filmmaking

Three Aerospace Engineering at Illinois seniors have applied their penchant for entrepreneurship to develop FreeSkies, a startup company aimed at using drones in filmmaking.

Working in AE Associate Prof. Tim Bretl's laboratory, Jay Mulakala, Ankur Mehta, and Andrew Putch created the software program to provide directors an ease of control in filming difficult shots, while reducing the costs associated with the work.

FreeSkies is intended to make optimum decisions for the user based on data onboard sensors collect. A quadcopter drone "will be able to correct itself and enable maneuver procedures very accurately; filmmakers can say precisely what they want," Mulakala maintains.

Wearing a Myo armband device connected wirelessly to the drone, the user simply would wave a hand to establish a path. Points on the path would be stored on a three dimensional grid FreeSkies would create from the targeted space, and the program would instruct the drone to move to those points.



HigherEd founder Jake Dluhy.

"The idea is to limit the learning curve as much as possible," said Mulakala, whose job has been creating an intuitive user interface.

Mehta's work has been in applying simultaneous localization and mapping (SLAM) algorithms as a point-locating device in FreeSkies, as opposed to using Global Positioning Systems (GPS). In a localized grid, said Mehta, SLAM can identify a point within a few centimeters; GPS allows a margin of up to three feet from a specified location.

Putch works on the software's ability to correct itself as well as accommodate for outdoor wind and weather.

Drones currently are used in the film industry, but they depend on experienced operators to control the flight, Mulakala said. "The film that's envisioned is left in the operator's hands rather than the filmmaker's. They have to take many shots for the same scene, and that can get expensive depending on what they want in the scene."

When not using drones, high-angle shots can require equipment such as a large rig with very steady rollers to avoid shaking the camera, or technocranes needing operators and a truck and trailer—all very expensive items that can take hours for setup, tear-down and use.

Seeing Equals Learning: Student's Startup Features Visual Mathematics

Visualizing mathematics can be a big step toward understanding it, Aerospace Engineering at Illinois student Jake Dluhy knows. That concept has been the basis for his start-up company, HigherEd, geared as a learning aid for mathematics and calculus.

"I tutored at Grainger (Engineering Library), and that's one of the things I would always do when students would come in with questions," said the recent graduate from Riverside, Illinois. "I would ask, 'Have you drawn the picture, do you know what this looks like?'"

Dluhy created an interactive website integrating visualization tools with mathematics problems. For example, when an equation is entered, a plot is shown on an adjacent grid, then the object is rotated to show how the shape would appear in three dimensions.

Dluhy believes future concepts such as Higher Ed could become the preferred method for teaching mathematics to high school and undergraduate students.

"As far as calculus goes, I don't see textbooks being useful. They're good for samples, homework problems and pictures, but I don't know whether I've encountered a single student that's read a calculus textbook all the way through."

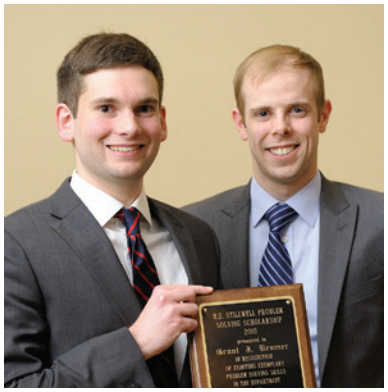
Congratulations AE Students!

AE recognized several of the Department's undergraduate and graduate students in Spring 2015 with awards for their scholastic achievement and other contributions.

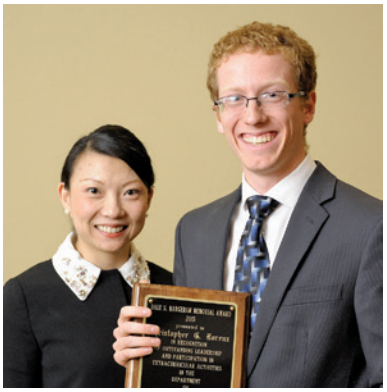
AIAA Scholastic Achievement Award—David R. Brandyberry of Champaign, IL; Jacob R. Dluhy of Riverside, IL; Prof. Craig Dutton; and David S. Knourek of Mokena, IL

Robert W. McCloy Memorial Award—Prof. Deborah Levin; and Jacob N. Denton of St. Elmo, IL

H.S. Stillwell Memorial Award—Manue Martinez of Chicago, IL; Prof. John Lambros; and Michael S. Miller of Decatur, IL



Stillwell Problem-Solving Scholarship—Grant J. Kramer of Naperville, IL; and Assistant Prof. Phil Ansell



Dale Margerum Memorial Award—Assistant Prof. Grace Gao; and Christopher G. Lorenz of Roselle, IL

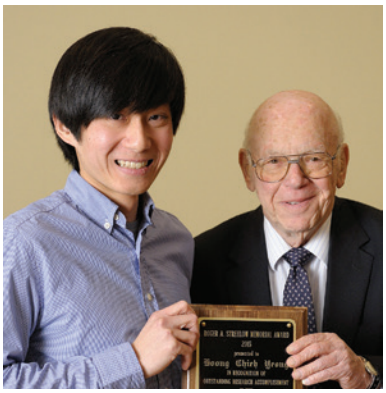
Jo Ann Haynes Platt & Daniel Wall Platt Memorial Award—Kelsey R. White of Downers Grove, IL; and Department Head Philippe Geubelle

Lee H. Sentman III Scholarship—Patrick D. Drew of Clarendon Hills, IL; Assistant Prof. Phil Ansell; and Yukti Kathuria of Sonepat, India

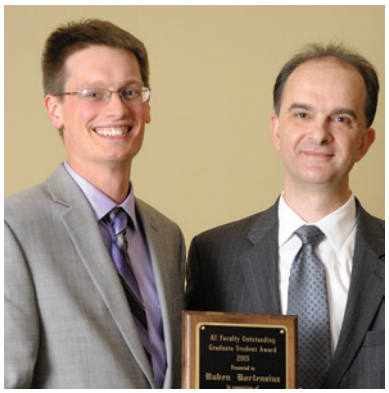
Illinois Space Grant Scholarships—Brandon L. Litherland of Allendale, IL; Jacob R. Dluhy of Riverside, IL; and Manue Martinez of Chicago, IL

H. Everett Sutter Passion for Flying Scholarship—Kyle A. Weiskircher of Montgomery, IL; and Department Head Philippe Geubelle

Roger A. Strehlow Memorial Award—Marta B. Elleby of Charleston, SC; and Prof. Scott R. White



Roger A. Strehlow Memorial Award—Hoong Chieh Yeong of Negeri Sembilan, Malaysia; and Emeritus Prof. Harry H. Hilton



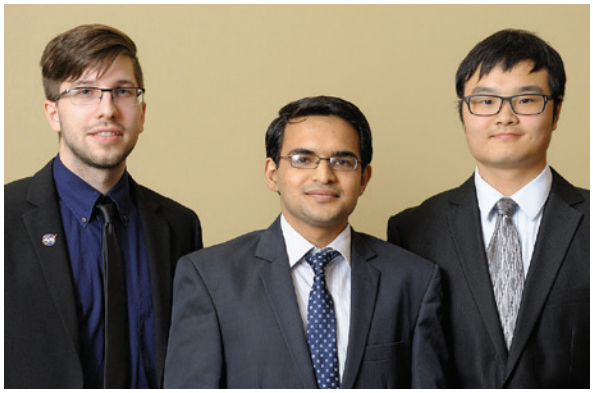
Faculty Outstanding Graduate Award—Ruben Hortensius of Massey, MD; and Prof. Ioannis Chasiotis

Kenneth Lee Herrick Memorial Award—Prof. Ioannis Chasiotis; Pavan V. Kolluru of Hyderabad, India; and Daniel J. Morgan of Madison, WI (not pictured)

AE Alumni Advisory Board Fellowship—Kevin R. Hart of Racine, WI; and Prof. Scott R. White

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

Illinois Space Grant Fellowship—Joseph F. Gonzalez of Chicago, IL; Department Head Philippe Geubelle; and Robyn L. Macdonald of Champaign, IL (not pictured)



H.S. Stillwell Fellowships—Joshua D. Aurich of Henderson, NV; Shripad Gade of Mumbai, India; Fan Yang of Guangdon, China; and Derek Chen of Edison, NJ (not pictured)

Other awards:

AE Boeing Scholarship–Jessica A. Hart of Rylesville, MD

Bronze Tablet Awards—David Brandyberry of Champaign, Illinois; Jacob Dluhy of Riverside, Illinois; David Knourek of Mokena, Illinois; and Gil Shohet of Acton, Massachusetts

Harold and Ruth Hayward/Tau Beta Pi Scholarship—Craig C. Babiarz of Rolling Meadows, Illinois

Journal of Guidance, Control, and Dynamics List of Most Downloaded Papers for the Past 12 Months for "Near-Optimal Feedback Strategies Synthesized Using a Spatial Statistical Approach—Pradipto Ghosh of Champaign, Illinois

Mavis Fellowship—Ryne T. Beeson of Lake Forest, Illinois; and Gavin K. Ananda Krishnan of Kuala Lampur, Malaysia

National Defense of Science and Engineering Graduate Fellowship—Robyn L. Macdonald of Champaign, Illinois

2015 National Science Foundation (NSF) Graduate Research Fellowship—David R. Brandyberry of Champaign, Illinois; and Gabrielle E. Wroblewski of La Salle, Illinois

Robert M. Stephens Engineering Scholarship—Sara E. Kochanski of Bensenville, Illinois

Silicon Valley Bank Trek—Andrew G. Putch of Oakton, Virgina

University Achievement Scholarship—Peter J. Grega or Ramsey, Minnesota

William T. Pascoe III Memorial Engineering Scholarship—Katherine I. Limes of Centennial, Colorado

National Aeronautical and Space Administration (NASA) Space Technology Researcher Fellowships (NSTRF)—Rebecca Foust, Columbia, MD

College of Engineering at Illinois Ambassador's Inaugural Speaking Competition, 1st Place—Je Won Hong, of Bundang, Korea

U.S. Department of Defense (DOD) National Defense Science and Engineering Graduate (NDSEG) Fellowship—Robyn Macdonald, of Champaign, IL

Gao Group's GPS Work Earns Best Presentation Awards

Two papers from Assistant Prof. Grace Gao's group garnered Best Presentation of the Session Awards at the Institute of Navigation Global Navigation Satellite System (ION GNSS+) conference. Gao and her students are developing technology to improve the robustness of the Global Positioning System (GPS) with applications to the cybersecurity of the power grid.

Gao's graduate student Daniel Chou presented the first award-winning paper on "Robust GPS-Based Timing for Phasor Measurement Units, A Position-Information-Aided Vector Tracking Approach."

Gao's group has counteracted GPS robustness and reliability vulnerabilities through a technique called Position-Information-Aided (P.I.A.) Vector Tracking. This approach utilizes the fact that GPS receivers in PMUs are stationary in position. A vector tracking method is used to predict GPS code and carrier measurements by projecting the positions and velocities of GPS satellites on their line-of-sight directions to enhance tracking performance. In a field test, Gao and her students have demonstrated improved robustness against noise and jamming, as well as the ability to successfully detect record-and-replay spoofing attacks.

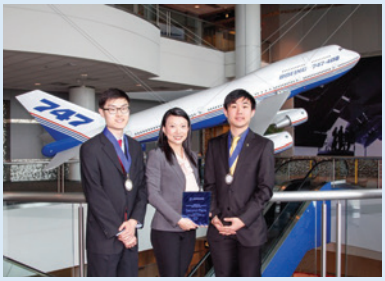
Gao's postdoctoral research associate, Liang Heng, and Chou as second author presented the group's second award-winning paper on "Cooperative GPS Signal Authentication from Unreliable Peers."

This paper introduces a signal authentication architecture based on a network of cooperative receivers. A receiver in the network cross-checks its signal with those received by others in the network to detect spoofing attacks. The approach explores both the network and the geographical redundancy of the networked GPS receivers.

Assistant Prof. Grace Gao and her group at the ION GNSS+ Conference.

Chen places second at Boeing IT Case Competition

AE graduate student Derek Chen earned second place in Boeing's IT Case Competition, a yearly intercollegiate competition that showcases student information technology talent.



From left, Illinois undergraduate student Anselmo Shim, AE Assistant Prof. Grace Gao and Chen.

Students were asked to recognize and identify 3D objects within a 3D Light Detection and Ranging (LIDAR) scan of Mt. Rainier and were judged on accuracy, efficiency and clarity of the program they wrote. LIDAR data is a laser scan of a particular landscape represented as point cloud data in 3D space. Participants were given five 3D models of various objects scattered randomly across the landscape and required to develop an application that could decipher between the 3D models and the landscape point cloud and identify the location of the objects.

Chen said this type of competition is important to Boeing because they often collect data like this, but need the ability to quickly identify common shapes, or shapes obstructed by the terrain, such as silos, skyscrapers or military tanks.

Chen took a unique approach to solving the problem by matching 3D points into an image grid that allowed them to process and manage the 3D points, enabling them to search for 3D points in a nearby space in a quick manner. Chen's approach allowed for a search of nearby points to identify the 3D objects in a much quicker, less computationally expensive and more effective manner.

Chen worked with Assistant Prof. Grace Gao and undergraduate Anselmo Shim on the project.

Pomeroy Wins AIAA Orville and Wilbur Wright Graduate Award

AE student Brent Pomeroy has earned the 2015 Orville and Wilbur Wright Graduate Award, one of the top honors the American Institute of Aeronautics and Astronautics (AIAA) presents annually nationwide to two outstanding graduate students.

"To put it plainly, Brent is one of the best and most engaged graduate students that our PhD program has been fortunate to attract over the past decade," said AE Department Head Philippe Geubelle.

With Prof. Michael Selig advising, Pomeroy conducts a unique doctoral study on the effect of high-lift aerodynamic flow fields on airplane wing flaps.

Pomeroy works to understand burst wakes that airplane wing flaps can create. The wakes can detrimentally impact the efficiency of takeoff and landing. Burst wakes increase the drag and decrease the lift of an airplane wing (or airfoil), Pomeroy said.

In addition to his research, Pomeroy has created within the department curriculum that encourages undergrads to get involved with research. He also has worked with the Graduate Student Advisory Committee (GSAC) to improve the experience for his fellow graduate students.

Welcome to AE's Newest Alumni

Jensen Elected to AIAA Board of Directors

Aerospace Engineering at Illinois alumnus Daniel T. Jensen has been elected as a member of the American Institute of Aeronautics and Astronautics (AIAA) Board of Directors.

Jensen, BS 88, began his term May 7, and represents Region 3, covering Illinois, Indiana, Kentucky, Ohio, Michigan and Wisconsin.

Jensen is currently the Head of Engineering for Services at Rolls-Royce Corporation in Indianapolis. He is responsible for leading an Engineering function that includes Service Engineering, Life Cycle Engineering, Maintenance and Overhaul Engineering, Repair Engineering, Configuration Management and Strategic Engineering Sourcing Services.

Jensen has held positions in aircraft performance (Swissair); aircraft aerodynamics, stability and control, and propulsion installation (Boeing); and aircraft engine controls, mechanical design, Product Lifecycle Management and engineering management (Rolls-Royce). In 1999, he became the first American to be named Technical Assistant to the Director—Engineering and Technology for Rolls-Royce plc.

Jensen is a Lifetime AIAA Associate Fellow, former AIAA Indiana Section Chair, and currently serves as Chair of the AIAA Emerging Technologies Committee as well as a member of the AIAA Public Policy Committee and Gas Turbine Engines Technical Committee.

He holds two patents and has authored and co-authored a number of technical papers. He received the Distinguished Alumnus Award from AE at Illinois in 2013.

In addition to his AE degree, Jensen holds a Master of Science degree in Mechanical Engineering from the University of Notre Dame (1990) and a Master in Project Management from The Pennsylvania State University (2008).

Jensen

AE Honors Alumni Raymond, Hoch and Shaw

Raymond, Hoch, and Shaw

Boeing executive D. Christopher Raymond, Central Intelligence Agency (CIA) official Richard L. Hoch, and small engineering and composites company owner David A. Shaw are Aerospace Engineering at Illinois' 2015 alumni award winners.

D. Christopher Raymond, AE Distinguished Alumnus Award

Raymond, BS 1986, is Vice President of Business Development & Strategy for Boeing Defense, Space & Security (BDS). The 53,000-employee business is a broad-spectrum security provider for U.S. and international customers.

Within BDS, Raymond reports to the Chief Executive Officer and leads a team focused on listening to and serving customers' needs. His organization advocates customer views, helps develop and resource customer solutions, leads business capture efforts, drives strategic planning, and supports merger and acquisition work. The group also has responsibility for international defense-related sales activity and alliance work.

Prior to his current position, Raymond was a vice president in the company's Air Force Systems group. Before joining Business Development, he held leadership assignments in Engineering, Supply Chain Management, Program Management and Operations. He joined the company in 1986 as an engineer at its Long Beach, California, operation.

Raymond serves on the board for the Center for New American Security, as well as the National Defense Industrial Association. He also is an advisory board member of Defense Acquisition University. He chairs the BDS Senior Advisory Group and supports Boeing's business alliance with Cisco Systems.

He is a member of the Air Force Association, the Airlift Tanker Association, the Navy League, and the Association of the U.S. Army; an associate fellow in the American Institute of Aeronautics and Astronautics; and a fellow in the Royal Aeronautical Society.

In addition to his AE degree, Raymond is a Defense Acquisition University graduate, and holds a contract management certificate and a master's degree in business administration from the University of California-Irvine.

Richard W. Hoch, AE Distinguished Alumnus Award

Hoch, BS 1984, is the Director of the CIA's Directorate of Intelligence (DI). He leads the CIA's analytical branch, which is responsible for the production and dissemination of all intelligence analysis on key foreign issues, as well as the professional development of its analysts in the United States and abroad.

Hoch joined the CIA in 1991. His previous DI leadership positions have included the Deputy Director of the Directorate of Intelligence, Director of the Office of South Asia Analysis, Deputy Director of the Office of Terrorism Analysis, and Director of the Office of Transnational Issues in CIA's Counterterrorism Center.

Hoch has received several awards during his CIA career, including the Director's Award presented by CIA Director Leon Panetta, and the George H.W. Bush Award presented by the CIA's Counterterrorism Center.

Prior to his CIA service, Hoch worked as an aerospace engineer for Douglas Aircraft Company in Long Beach, California. In that position, he worked on transonic wing designs, and for the Naval Research Lab in Washington D.C., where he evaluated the flight characteristics of unmanned aerial vehicles.

Hoch was a Bronze Tablet recipient upon graduating from Illinois. He also earned a Master's in Aerospace Engineering from the University of Southern California.

David A. Shaw, Outstanding Recent Alumnus Award

Shaw, BS 1996, is owner of Flying-S Inc., a small engineering and composites company located in Palestine, IL.

Upon graduating from AE, Shaw gained valuable work experience at Cessna and Scaled Composites.

In 2001, after moving back to their family farm in southeastern Illinois, Shaw and his wife, Penny, started Flying-S. What began as an engineering consultancy business soon turned into a company with the ability to design and fabricate projects across the aerospace industry. Flying-S has worked on general aviation, UAV and space projects for companies like Cessna, Warrior Aero-Marine, Aurora Flight Sciences and NASA.

Shaw's education is complimented by his holding a commercial, multi-engine pilot rating. He is also a flight instructor and private glider pilot.

AE Alumni Share in New Horizons' Success

On July 14, 2015, the Earth was gifted with beautiful photos and plenty of data from the dwarf planet, Pluto, billions of miles away. That day—culminating over a decade of scientific work into great achievement—New Horizons became the first spacecraft to fly by Pluto, gaining detailed measurements and observations of the planet and its moons.

Aerospace Engineering at Illinois alumni Gabe Rogers, Stewart Bushman and Coralie Jackman all played key roles in the mission and its success. As New Horizons' Spacecraft Systems Engineer and Guidance and Control Lead, Rogers, BS 95, MS 97, has been with the mission since its inception in 2001. Rogers works at the Johns Hopkins University Applied Physics Laboratory with Bushman, MS 99, who has served as Propulsion Lead Engineer for New Horizons since 2005. Jackman, BS 11, dove into New Horizons right after graduating from Illinois. As the Lead Optical Navigation (OpNav) Engineer for the Space Navigation and Flight Dynamics Practice at KinetX, Inc., Jackman is responsible for coordinating the OpNav team's support analysis, development, planning and operations for New Horizons.

"The highlight for me was watching Pluto reveal its mysteries day-by-day, image-by-image," Jackman said. "Over the last several years we had been simulating images of the Pluto system for various analyses and operational readiness tests, but it turned out to be far more astounding, beautiful, and complex than we ever could have imagined."

AE alumnus Gabe Rogers

Plenty of challenges went into building the mission.

"We only had around 4 years from the proposal acceptance from NASA to getting the mission designed, built, tested, and launched. That is a really short amount of time for such a large, complex mission," Rogers said.

"Since then it has just been an extended sprint, despite the 9.5-year flight time," he continued. "We had to plan for an asteroid flyby in 2006, the Jupiter flyby in 2007, various science activities and rehearsals during the cruise phase, and conduct a 7-month science campaign in 2015. The spacecraft, by design, is performing unique observations for each of these that required a lot of planning and testing ahead of time. Also to save on cost we had a really small team, and each team member was not exclusively working New Horizons."

"The highlight for me was watching Pluto reveal its mysteries day-by-day, image-by-image."

The fly-by day, itself, went spectacularly.

"We were on console when the first signals came back after the closest approach, and everyone was holding their breath, even though we knew our little rock star of a spacecraft would be just fine, and there was the data in all greens (green good, red bad)," Bushman said. "From the propulsion perspective, everything has been practically clockwork since launch. (Principal Investigator) Alan Stern eventually took to calling me the Maytag Man."

While the mission has significantly impacted the careers of all the alumni, Rogers has been particularly invested.

"It has pretty much been my career, being it has been such a long mission. I started working New Horizons four years out of college, and plan to work on it until we turn the lights out in the control center," he said. "It has afforded me the opportunity to grow as an engineer, as I have taken the lessons learned and applied them to other missions."

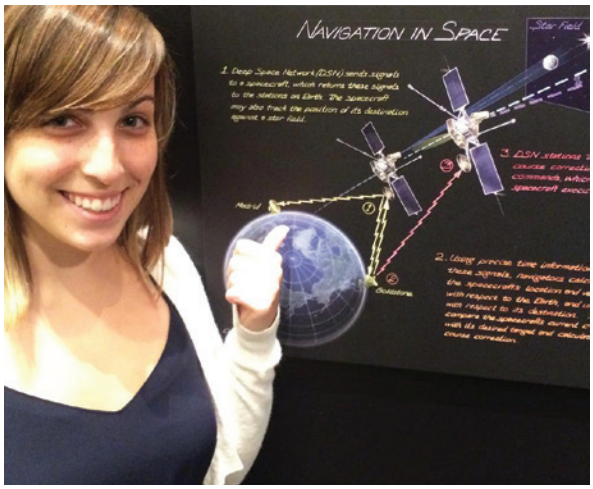
Each of the alumni awarded credit for the lessons they had learned while AE students, as well as to the faculty who had taught them, including Profs. Vicki Coverstone, Sri Namachchivaya, Associate Prof. Soon-Jo Chung, and Emeriti Profs. Bruce Conway, Wayne Solomon, John Prussing and Rod Burton.

They also each had advice to offer current students:

"Branch out! Get active in the awesome student organizations in the department. It's never too early to start networking, going to conferences and on student trips," believes Jackman.

Said Rogers, "Find a niche that you really like and aggressively pursue it. Interesting work follows hard work, by which I mean that the really interesting projects (e.g New Horizons) are given to those who work hard at the seemingly boring projects (e.g testing flight software for sub-orbital launch vehicles)."

AE alumnus Stewart Bushman



AE alumna Coralie Jackman

And, offered Bushman, "Once you're out working you'll find that the aerospace field is pretty small. Remember your older classmates and TAs; they may be in the position to help you get hired someday."

Muellner Elected to National Academy of Engineering

Muellner

Aerospace Engineering at Illinois alumnus George K. Muellner has been elected to the National Academy of Engineering.

Election to the NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Muellner, vice chairman of the board of The Aerospace Corporation in El Segundo, California, was selected for leadership in the research, design, and development of advanced air and space vehicles.

Muellner, BS '67, has also served as Chairman of the Board for the Air Force Association. He is a Life Member of the AFA and has previously served as the Vice Chairman for Aerospace Education, a National Director and as a member of the Aerospace Education Council.

Muellner, who retired from the Boeing Company in February 2008, was president of Advanced Systems for the Integrated Defense Systems business unit. Prior to this assignment Muellner was senior vice president-general manager of Air Force Systems, responsible for all domestic and international Air Force programs. He was appointed to this position in July 2002. Prior to that, Muellner was president of Phantom Works, Boeing's advanced research and development unit.

Muellner served 31 years in the U.S. Air Force, retiring as a lieutenant general in 1998 from the position of principal deputy for the Office of the Assistant Secretary of the Air Force for Acquisition in Washington, D.C., to which he was assigned in 1995.

From 1993 to 1995, he served as director and program executive officer for the Joint Advanced Strike Technology program, now the Joint Strike Fighter program. He earlier served as mission area director for tactical, command, control and communications, and weapons programs. In 1992, he became deputy chief of staff for requirements for the Headquarters Air Combat Command at Langley Air Force Base, VA. A highly decorated veteran, Muellner spent most of his career as a fighter pilot and fighter weapons instructor, test pilot and commander. He flew combat missions in Vietnam and commanded

the Joint STARS deployment during Operation Desert Storm.

Muellner is a Fellow of the Society of Experimental Test Pilots, a Fellow of the Royal Aeronautical Society, a Fellow and Past-President of the American Institute of Aeronautics and Astronautics (AIAA). In 2014, the AIAA selected Muellner as an Honorary Fellow, AIAA's highest distinction.

He is also a trustee of the USAFA Falcon Foundation and serves on the University of Illinois at Urbana-Champaign's College of Engineering Board of Visitors of the University of Illinois.

In addition to his bachelor's degree in AE at Illinois, Muellner holds a master's degree in aeronautical systems management from the University of Southern California, a master's degree in engineering from California State University and a master's degree in business administration from Auburn University. He also completed the Air War College and the Defense Systems Management College.

Muellner has received Distinguished Alumni Awards from both AE at Illinois and the College of Engineering, and serves on the AE at Illinois Alumni Board. He and his wife, Vicki, live in Huntington Beach, California.

"We are delighted to see George's outstanding contributions to aerospace engineering recognized by this prestigious award," said AE Department Head Philippe Geubelle. "We in AE have for many years benefited from his involvement with the Department, through insightful advice provided during his many visits on campus and his generous contribution to student scholarship funds."

Bragg Honored with College Alumni Award

As an educator, innovator and leader, former Aerospace Engineering at Illinois Department Head Mike Bragg has left an indelible mark on the University of Illinois and the aerospace industry.

His contributions were recognized when he was called to return to the Urbana campus April 18 to receive the College of Engineering Alumni Award for Distinguished Service. An AE alumnus, Bragg was cited "for his role as a visionary educator in the field of aerospace engineering and a proven leader in the College of Engineering at the University of Illinois at Urbana-Champaign."

Bragg currently serves as the Frank & Julie Jungers Dean of Engineering for the University of Washington in the hub of the aerospace community. Much of his prior academic career as both a student and a faculty member was spent at Illinois. He earned his BS (1976) and MS (1977) degrees in AE, before earning his PhD (1981) from The Ohio State University, where he served as an assistant and, later, an associate professor. Bragg returned to Illinois in 1990 as an associate professor and was named a full professor in 1995.

In 1999, Bragg was named Head of the AE Department. While an administrator and faculty member of the department, Bragg had more than $15 million in externally funded research and published many research papers. More than 50 graduate students and five post-doctoral researchers received advanced degrees under Bragg's guidance. Bragg earned the Stanley H. Pierce Teaching Award from the College in 2004, the same year he was named a fellow in the American Institute of Aeronautics and Astronautics (AIAA).

He served as Department Head until being appointed associate dean for research and administrative affairs for the College of Engineering in 2006. His administrative duties included four years as executive associate dean for academic affairs and a year as interim dean for the College. He was instrumental in curriculum innovation and improvement to student resources. He supervised the Technology Entrepreneur Center on campus, under which he co-founded a pair of start-ups, Bragg and Associates, Inc., and CU Aerospace.

Passionate about hypersonics, aerodynamics, wind turbines, flight mechanics and sonic boom mitigation, his research has advanced those areas of study. Bragg is best known as an international expert and consultant on the affect of ice accretion on aircraft aerodynamics and flight safety. He was a designer of the vortex generators for the Voyager aircraft, which performed the first unrefueled flight around the world. Bragg earned NASA's Turning Goals Into Reality (TGIR) award to "revolutionize aviation" in both 2001 (AGATE Icing Research Team) and 2002 (Aircraft Alliance Project Team).

A native of nearby Atwood, Bragg had a passion for airplanes growing up, earning his pilot's license at age 17, and enrolling at Illinois in 1972.

Bragg

Big Ten Honors Hopkins

Hopkins

The Big Ten has honored astronaut Michael Hopkins with its Ford-Kinnick Leadership Award, which recognizes former conference football players for their post-college achievements.

Hopkins was a four-year letter winner for the Illini and a team captain in 1991, earning the Big Ten Medal of Honor while completing an undergraduate degree in 1992 in Aerospace Engineering at Illinois. A distinguished graduate of the Reserve Officers Training Corps, Hopkins earned a Masters of Science in Aerospace Engineering from Stanford University in 1992.

That same year, he was commissioned as a second lieutenant in the United States Air Force, working in advanced space system technologies. Hopkins entered the flight test engineering course in 1996, graduating the following year. After posts in Canada and Italy, Hopkins was assigned to the United States Air Force Rapid Capabilities Office at the Pentagon in 2005, serving as a project engineer and program manager.

He was selected for Astronaut Candidate Training at NASA in 2009 and graduated in 2011. Two years later, he served as a flight engineer on Expedition 37/38, a 166-day mission to the International Space Station (ISS), during which Hopkins completed 2,656 orbits of the Earth and traveled more than 70 million miles. In October 2013, while aboard ISS, he participated in an event featuring his live chat with a large audience of AE students. Several months later, he was chosen to deliver the Spring 2014 Commencement address at Illinois.

Hopkins has risen to the rank of colonel during a decorated career in the Air Force, earning numerous medals for aerial achievement and meritorious service.

Fellow Alumni, Students, and Faculty

These are exciting times for the Aerospace Engineering Department. Over the past several years the Department has been very progressive with numerous initiatives to improve the educational opportunities for students and grow the Department. Facilities are being upgraded and new laboratories are being built, online course offerings have been initiated, and several outstanding faculty members have been added to the Department. As a result, student educational experiences have consistently improved and student enrollment is at an all-time high.

Our AE Department Faculty and leaders have done an excellent job over the years working with the AE Alumni Advisory Board to upgrade the quality of education in the Department and better prepare graduating students for the challenges associated with industry careers. The Advisory Board is looking forward to this Fall's annual board meeting and visit to the campus. The main focus of our meeting will be on strategic planning for the future of the Department. The University of Illinois has made recent announcements on the desire to increase student enrollment even more, so we will discuss professional trends and projections throughout our industry, and develop recommendations to shape the AE Department looking out to the year 2025. We will also engage with students and faculty in the Open House, honor the life and contributions of Professor Al Ormsbee, and tailgate with everyone at the Illini football game.

We are always looking for ideas and opportunities to continuously improve the Department and one of the best sources of those ideas is from all of our distinguished Alumni. So if you're not already, I encourage all Alumni to become involved in Department activities and help contribute financially with your donations.

Thank you and let's have another great year in Aerospace Engineering!

Blaine Brown, AAE 1981
President, Alumni Advisory Board

Class Notes

Larry J. Howell, BS 66, MS 68, PhD 71, and his wife, **Katherine, BA 65, Teaching of French,** celebrated their 50th wedding anniversary on August 28. The couple met while they were students at Illinois. Larry retired from General Motors as Executive Director of the Research & Development Center. Katherine retired as a secondary teacher and preschool director.

David L. Carroll, BS 85, MS 86, PhD 92, has been elected a Fellow of the International Society for Optics and Photonics (SPIE). SPIE advances an interdisciplinary approach to the science and application of light. Members earn the distinction of Fellow when they have made considerable technical and scientific contributions in optics, photonics, optoelectronics, and imaging. Carroll was cited for achievements in high-energy lasers and photonics, as well as the education of scientists and engineers. In addition to his work as an Aerospace Engineering at Illinois Visiting Professor, Carroll is the President and co-founder of a small aerospace company, CU Aerospace, located in Champaign, Illinois.

Craig M. Gummer, BS 95, is Commanding Officer of the USS Alaska, an Ohio class ballistic missile submarine out of Naval Submarine Base Kings Bay in Georgia. Gummer's at-sea assignments have included deployments to the Northern Atlantic, the Mediterranean, and the Persian Gulf during his division officer tour about the USS Springfield, the Western Pacific as weapons officer aboard the USS Jefferson City, and three strategic deterrent patrols as executive officer aboard the USS Henry M. Jackson.

Christopher Zeller, BS 97, has been selected as an Associate Fellow of the American Institute of Aeronautics and Astronautics. Zeller is a Principal Systems Engineer for Ball Aerospace & Technologies Corp. He is Ball's requirements and verification lead for the National Oceanic and Atmospheric Administration (NOAA)/National Aeronautics and Space Administration (NASA) Joint Polar Satellite System spacecraft; and Ball's lead telecom engineer for NASA's Green Propellant Infusion Mission. He has been active in the AIAA since 2005 as chair of the Rocky Mountain section; chair of the Northern Colorado section; and chairman for programs. Zeller joined Ball in 2003 and was honored with the NASA Teach Achievement Award for his work on the CloudSat mission in 2012.

Joyee Zhu, PhD 01, has been honored with an Edison Pioneer Award from GE. The award recognizes mid-career technical excellence and customer impact of GE technologists from seven businesses within the company. Zhu, PhD 01, represents GE Power & Water.

Robert Deters, MS 03, PhD 14, is an assistant professor at Embry-Riddle Aeronautical University.

Richard L. Brophy, BS 02, has been a made a partner in the St. Louis-based law firm of Armstrong Teasdale LLP. Brophy is a member of the firm's intellectual property practice group, representing clients in US state, federal and appellate courts. His practice encompasses civil litigation including patents, copyrights, trademarks, antitrust and unfair competition.

Amir Isfahani, MS 05, PhD 11 (Theoretical and Applied Mechanics), is Vice President of Sales and Business Development at Flow Science, Inc., a computer software company in Santa Fe, New Mexico.

Ian Kaufman, BS 06, is a senior system engineer for Northrop Grumman Corporation in Tucson, Arizona.

Ethan Chew, BS 07, is an engineer at Alpha CubeSat in Mojave, California. His team's goal is to win the NASA Cube Quest Challenge in developing and launching a 6U cubesat for a deep space and lunar exploration mission to demonstrate flight, navigation, and communications capabilities.

Andres Ortiz, MS 07, PhD 12, is a UAS Engineer at AeroVironment, Inc., in Simi Valley, California.

Jeremy Alonso, BS 09, is the Technical Lead for Northrop Grumman Corporation in Abu Dhabi, United Arab Emirates. He serves as the primary in-country technical point of contact, supporting all current Northrop Grumman capture activities and exploring future programs in the country. Previously, he worked as systems architect for the company in Redondo Beach, California.

Joe Battalla, BS 09, MS 11, is a First Officer at SkyWest Airlines in Broomfield, Colorado.

Joe Sheahan, BS 09, is a nuclear submarine officer at United States Strategic Command at the Offutt Air Force Base near Omaha, Nebraska.

Brian Schmidt, BS 10, MS 16, is a manufacturing engineer manager at The Morey Corporation in Melrose Park, Illinois. He oversees a team of engineers dedicated to production process development, continuous improvement, and new product introduction. Currently, he is responsible for the company's Manufacturing Assembly Engineers, the Wire & Harness Assembly Engineers, and the Machine Shop.

Jared Daum, 11, works as an aerospace engineer for the National Aeronautics and Space Administration (NASA). His recent project has been on the capsule parachute assembly system hardware team that launched the unmanned Orion Multi-Purpose Crew Vehicle. NASA has used Orion in an eventual goal to send a craft beyond lower Earth orbit, to the Moon or an asteroid or even to Mars.

Matt O'Brien, BS 11, is a regional sales manager at Southeast at Sicame Corp., an electronic manufacturer in Wood Dale, Illinois.

Naja Edwards, BS 12, is a Propulsion Engineer at Boeing in the Greater Los Angeles area.

Nihar Gandhi, BS 12, is a UAV Flight Controls Engineer at Airware in the San Francisco area.

Kapil Varshney, BS 12, is co-founder at Bazaar-E-Khaas, an online grocer in Bengaluru, Karnataka, India.

Gary Weber, BS 12, is Global Head of Strategy & Operations for the Business Leadership Program (Global Sales) at LinkedIn in San Francisco, California. He manages analysts to support critical decision-making, stakeholder communications, and various strategy/operations questions for business partners across North America, Europe, and Asia Pacific.

Pradipto Ghosh, PhD 13, is an astrodynamics engineer at AGI in Philadelphia. He develops and implements astrodynamical algorithms related to Space Situational Awareness.

Justin Indelicato, BS 13, is a Flight Test Engineer at Rolls-Royce Corporation in Patuxent, Maryland.

Mahmoud Mamlouk, MS 13, is a Manager of Qualitative Analysis for Risk Capital Stress Testing financial services in Chicago.

Mario Suarez Ortiz, BS 13, is Program Coordinator at UI LABS, a micro and nanotechnology laboratory in the Chicago area.

Laura Richardson, BS 13, MS 15, is a Professional Development Program Engineer at Northrop Grumman Corporation in Chicago.

Kevin Skender, BS 13, is a Solutions Engineer for Uptake, a computer software company in the Chicago area.

Hong-Bin Yoon, BS 13, MS 14, is a design engineer for Flight Safety International in Champaign, Illinois.

Gustavo Fujiwara, MS 14, is a graduate research assistant for the University of Washington Aeronautics & Astronautics Department.

Robert Kaminski, BS 14, is a Systems Engineer at Boeing in Seattle, Washington.

Richie Orozco, BS 14, is a Quality Engineer for Boeing in the Chicago area.

Ashley Sng, BS 14, works in Flight Operations for the International Air Transport Association in Montreal, Canada.

Erin Ahern, BS 15, is a structural engineer for Boeing.

Michael Alger, BS 15, is in the Air National Guard.

Derek Awtry, BS 15, is an engineer for Exelis in Rochester, New York.

Craig Babiarz, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Brian Binder, BS 15, is a project engineer for Wilden of Dover Corp., in Grand Terrace, California.

David Brandyberry, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Yu Cai, BS 15, is continuing in graduate school in aerospace engineering at Georgia Institute of Technology.

Stephanie Camello, BS 15, is continuing in graduate school in aerospace engineering at the University of Washington.

Rosemary Chapple, BS 15, is a flight controls design engineer a Boeing.

Min-Yee Deng, BS 15, is an aerospace engineer in Lexington Park, Maryland.

Jacob Dluhy, BS 15, is a software engineer at Spiceworks in Austin, Texas.

Eric Eiler, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Elizabeth Feeney, BS 15, is an engineer for NAVAIR in California.

Mohammad Fuheem Dar, MS 15, is an Applications Engineer working on turbochargers for Honeywell Aerospace.

Zhenyu Gao, BS 15, is a graduate student at the Georgia Institute of Technology.

Peter Grega, BS 15, is a systems verification engineer for Controls and Data Services.

Tucker Gritton, BS 15, is a propulsion system design engineer for ULA in Centennial, Colorado.

Vaclav Grym, BS 15, is a project engineer for MGA Research Corp. in Harvard, Illinois.

Michael Hardisty, BS 15, is in graduate school studying quantum finance at the Georgia Institute of Technology.

Brishen Hawkins is continuing in graduate school in Aerospace Engineering at Illinois.

Adam Hong, is an engineering intern at Horizon Hobby.

Li Huang, MS 15, is pursuing a PhD in electrical and computer engineering at the University of Houston.

Kazuaki Iida, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Kevin Kang, BS 15, is a systems engineer for Rockwell Collins in Cedar Rapids, Iowa.

David Knourek, BS 15, is an engineer for Orbital ATK in Salt Lake City, Utah.

Matthew Kosky, BS 15, is a manufacturing engineer for Northstar Aerospace in Chicago, Illinois.

Jessica Lauzon, BS 15, is continuing in graduate school in aerospace engineering at Stanford University.

Nathan Liang, BS 15, is a commissioned officer for the U.S. Air Force.

Kevin Lohan, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Richard Lucchetti, BS 15, is a manufacturing engineer for TC Industries.

Manue Martinez, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Ankur Mehta, BS 15, is a co-founder of the Free Skies start-up company.

Dominik Miaso, BS 15, is a manufacturing engineer for Rolls-Royce in Indianapolis, Indiana.

Ronald Moravek, BS 15, is an aerospace engineer for Rolls-Royce in Indianapolis, Indiana.

Daniel Morgan, PhD 15, has taken a position with SpaceX.

Mruthyum Mulaka, BS 15, is a co-founder of the Free Skies start-up company.

Parth Patel, BS 15, is a design engineer for GE Aviation in Cincinnati and the Ohio State University.

Eric Pauli, BS 15, is a pads research and development technician for Cabot Microelectronics.

Timothy Pekau, is a systems engineer for Rockwell Collins in Cedar Rapids, Iowa.

Aaron Perry, BS 15, is continuing in graduate school in Aerospace Engineering at Illinois.

Kyle Pieper, BS 15, works for the federal government on the East Coast.

Andrew Putch, BS 15, is a co-founder of the Free Skies start-up company.

Kevin Reyes, BS 15, is a composite manufacturing engineer for Boeing in St. Louis, Missouri.

Amal Sahai, MS 15, is continuing doctoral studies at Aerospace Engineering at Illinois.

Samip Shah, BS 15, is a systems engineer for Northrop Grumman in Rolling Meadows, Illinois.

Gil Shohet, BS 15, is continuing in graduate school in aerospace engineering at Stanford University.

Matthew Tomaw, BS 15, is an aerospace engineer for Liberty Partners in Tulsa, Oklahoma.

James Toothaker, BS 15, is a systems engineer for Rockwell Collins in Cedar Rapids, Iowa.

Ronald Tyson, BS 15, is a systems engineer for Rockwell Collins in Cedar Rapids, Iowa.

Raj Vinjamuri, BS 15, is an Electrical Design Engineer for Orbital ATK in the Minneapolis-St. Paul area, and has co-founded Corvae, a startup that uses real-time analytics, intuitive visuals and wireless connectivity to aid heart disease patients in seeking treatment.

Taylor Watts, BS 15, is an aeronautical engineer for Frasca International in Urbana, Illinois.

Evan White, BS 15, is a software engineer for Conversant in Chicago, Illinois.

Ross Wuestenfeld, BS 15, is a program manager for Heizer Aerospace in St. Louis, Missouri.

Deaths

Matthew A. Medick, BS 48, died at the age of 87 on January 30, 2014, in Brooklyn, Kings, New York. Having earned a doctorate in theoretical and applied mechanics from Columbia University in 1958, Medick was a professor of mechanical engineering at Michigan State University from 1962 until his retirement in 1999. His research specialities were engineering mechanics, mechanical vibrations and shock waves, theory of waves and vibration and engineering science. Medick was a member of the American Society of Mechanical Engineers, the Society of Engineering Science, the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. He also wrote several publications on Wave Propagation and Vibrations, serving as a consultant to Lawrence Radiation Laboratory at the University of California.

Karen S. Mackall, BS 76, died June 14, 2014, at the age of 61. She and her husband, Dale Mackall, both worked for NASA Armstrong Flight Research Center in California.

David E. Craig, BS 63, died January 28, 2014, at the age of 81, in Sandy Springs, South Carolina. Craig was a retired U.S. Air Force lieutenant colonel and had served during the Vietnam War. As a forward air controller, he earned numerous military awards, including the Silver Star. Upon retiring from the Air Force after 23 years, he worked at Michelin.

Harold H. Meyer, BS 49, died January 19, 2014, at the age of 89, in Centennial, Colorado. He had worked on the design of the "Connie" aircraft for Lockheed, then, in 1952, went to work as a pilot for United Airlines. He retired in 1985. He later bought a Piper Arrow Turbo-Charged Airplane and became active in the Colorado Pilots Association.

Thanks to Our Donors

The alumni and friends listed here contributed to Aerospace Engineering during Fiscal Year 2015 (between July 1, 2014 and June 30, 2015). Thank you for your gifts! (All degrees are in AE unless otherwise indicated.)

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Gregory D. Holm, BS 78
Michael L. Hutches, BS 08, MS 09
Arthur A. Ibers, BS 84
Arthur Ignatiadis, MS 85

Why I Give...

The heart of my commitment to donate comes from recognition of what I received through my undergraduate education, although I must admit, I did not recognize the value of what the degree meant to me and for me until years later. I came to the U of I as a transfer student from a junior college on the south side of Chicago, having been fortunate enough to have received an Illinois State Scholarship (I don't think they exist anymore) to cover my tuition. I'm not sure I would have been able to continue without it.

There was no doubt in my mind that I wanted to be an Aerospace Engineer. The space race was in full swing and the nation was preparing to send men to the moon. It took me 2½ years to finish my degree and reach that goal, and then it was off to the US Air Force. The Air Force was supposed to be a stopgap to a job in the aerospace industry, but on the way it became a career. I applied the basic tenets of engineering and the details I learned in both aeronautical and astronautical engineering classes to both aircraft and space development/operational assignments. Twenty-six years later I eventually found that job in the aerospace industry. In each of the assignments I found that the background I received in my years at the U of I paid dividends beyond what I could have envisioned back in 1971.

Early after graduation, I had joined the Alumni Association. It became clear that the gift I received in my education needed some payback, so that others like me could achieve their goals. I began to donate to the Aerospace Department. It wasn't much at the beginning but over the years, I was able to give a little more and, once I was in the private sector, there were options to get matching gifts to further leverage my giving. I realized that was a very powerful option and found out it was available even in retirement.

Gifts such as the one I received in the form of a scholarship from the State are all but non-existent today. All the departments are seeking ways to attract the best and brightest and provide a quality education at an affordable price. I look back often at the scholarship I received with full knowledge now of what it has meant to me. I am hoping my small contributions over the years have been able to enrich the student educational experience and in some small part provide for those who are in need. I encourage all who have made Illinois their choice to consider the opportunity to further the education of our future U of I Aerospace Engineering alumni.

David S. Brach
AAE '71

Fred C. Kaiser, BS 71
Emma E. Kress-Israel, BS 10
Richard J. Krones, BS 95
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Mark R. Lawson, BS 72, MBA 74, and Paula J. Lawson, BS 73 Psychology, MS 74 Psychology
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Kelly Griswold, BS 03, and Ryan Schable
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Kevin M. Stephens, BS 78
Josephine A. Stieglitz, BS 87
Andrew Supinie, BS 81, and Lori A. Supinie, BS 81 Education
James R. Sutton, BS 49
Raymond L. Thompson, BS 64, and D. Eilene Thompson
Donald W. Tuegel, MS 90
William K. Van Moorhem, BS 66
Richard D. Willy, BS 65, BS 65 Finance, MBA 66 Business Administration, and Mary C. Willy, BS 63 Home Economics, MS 67 Home Economics
John F. Winkler, MS 93, PhD 96

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In addition to the individual alumni and friends who contribute to AE, we are pleased to recognize the corporations and organizations that give to our research and ongoing programs. This support enables us to maintain our standing among the top undergraduate and graduate aerospace engineering programs in the nation.

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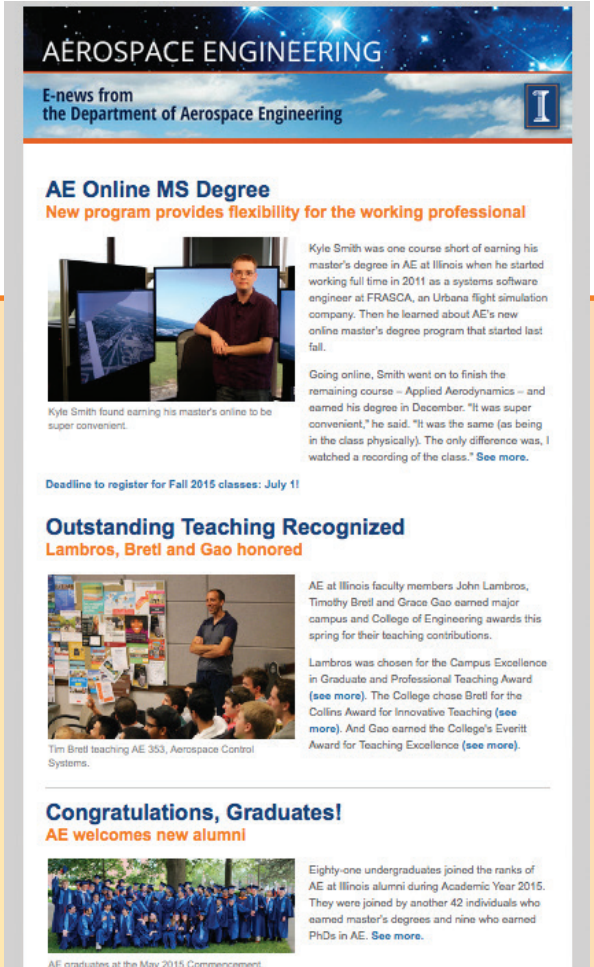

AEROSPACE ENGINEERING

E-news from
the Department of Aerospace Engineering

AE Online MS Degree

New program provides flexibility for the working professional

Kyle Smith found earning his master's online to be super convenient.

Kyle Smith was one course short of earning his master's degree in AE at Illinois when he started working full time in 2011 as a systems software engineer at FRASCA, an Urbana flight simulation company. Then he learned about AE's new online master's degree program that started last fall.

Going online, Smith went on to finish the remaining course – Applied Aerodynamics – and earned his degree in December. "It was super convenient," he said. "It was the same (as being in the class physically). The only difference was, I watched a recording of the class." **See more.**

Deadline to register for Fall 2015 classes: July 1!

Outstanding Teaching Recognized

Lambros, Bretl and Gao honored

Tim Bretl teaching AE 353, Aerospace Control Systems.

AE at Illinois faculty members John Lambros, Timothy Bretl and Grace Gao earned major campus and College of Engineering awards this spring for their teaching contributions.

Lambros was chosen for the Campus Excellence in Graduate and Professional Teaching Award **(see more)**. The College chose Bretl for the Collins Award for Innovative Teaching **(see more)**. And Gao earned the College's Everitt Award for Teaching Excellence **(see more)**.

Congratulations, Graduates!

AE welcomes new alumni

AE graduates at the May 2015 Commencement

Eighty-one undergraduates joined the ranks of AE at Illinois alumni during Academic Year 2015. They were joined by another 42 individuals who earned master's degrees and nine who earned PhDs in AE. **See more.**