ÆE Illinois

2008 Annual Report of the Department of Aerospace Engineering University of Illinois at Urbana-Champaign

Craig Dutton

I am pleased to introduce *AE Illinois*, the first Aerospace Engineering annual report that I have overseen since being appointed Head in September 2007.

For those of you unfamiliar with the Department, or who have been out of contact with it for awhile, the last decade has been one of steady growth. We now have an undergraduate student enrollment of approximately 400, and about 90 graduate students. AE has 20 tenured or tenure-track faculty, with many more affiliate, adjunct, and emeritus faculty active in the Department's affairs. The addition of four new faculty members over the past two years has brought to AE new research emphases in motion planning, robotics, control systems, information technology, aeroacoustics, and high-speed flows that add to our program's depth and diversity. Our annual research expenditures currently exceed $7M, and are spread across our three major research groups: aerodynamics/propulsion; controls/dynamical systems; and materials/mechanics.

Much of the credit for these gains belongs to my immediate predecessors, Mike Bragg, who is now Executive Associate Dean in Illinois' College of Engineering, and Rod Burton, who served as Interim Head during the search for the new Head. They have done an outstanding job of managing the Department over the last several years, and leave me in the happy position of building upon their success.

The following pages will give you a glimpse of the research activities and accomplishments of our exceptionally active faculty and students. Research on supersonic inlet performance is the focus of one new project funded by Gulfstream, Rolls Royce, and NASA, with the eventual goal being development of a new supersonic business jet. The fascinating potential of autonomic/self-healing materials, the work of Scott White and his colleagues over the past decade, is the focus of another. We also proudly report the research activities and accomplishments of some of our newest faculty: Joanna Austin, Dan Bodony, Tim Bretl, Ioannis Chasiotis, and Cedric Langbort. Last, but certainly not least, are some brief descriptions of recent honors and awards that our senior faculty, Mike Bragg and Philippe Geubelle, and graduate students, Heather Arneson and Mohammad Naraghi, have earned.

So, read and enjoy. We look forward to your comments; our contact information is readily available on our website at: http://ae.engr.uiuc.edu/.

Sincerely,

Craig Dutton
Bliss Professor and Head

Tenured/Tenure Track Faculty

Joanna M. Austin
Lawrence A. Bergman
Daniel J. Bodony
Michael B. Bragg
Timothy W. Bretl
Rodney L. Burton
Ioannis Chasiotis
Bruce A. Conway
Victoria L. Coverstone
J. Craig Dutton
Gregory S. Elliott
Jonathan B. Freund
Philippe H. Geubelle
John Lambros
Cedric Langbort
Ki D. Lee
Eric Loth
N. Sri Namachchivaya
Natasha A. Neogi
Michael S. Selig
Petros G. Voulgaris
Scott R. White

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Harry H. Hilton
Allen I. Ormsbee
John E. Prussing
Lee H. Sentman
Kenneth R. Sivier
Wayne C. Solomon
Shee Mang Yen
Adam R. Zak

Affiliate/Adjunct Faculty

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Naira Hovakimyan
Thomas L. Jackson
Arif Masud
Karel Matous
George H. Miley
James W. Phillips
Nancy R. Sottos
Alexander F. Vakakis

Editors
Kathy Gray
Susan Mumm

Writer
Susan Mumm

Photographer
Jerry Thompson, Thompson and McClellan Photography

Designer
Gretchen Wieshuber, Studio 2D

Highlights

Corporate partnerships

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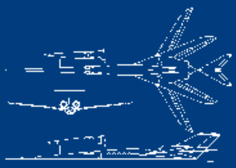
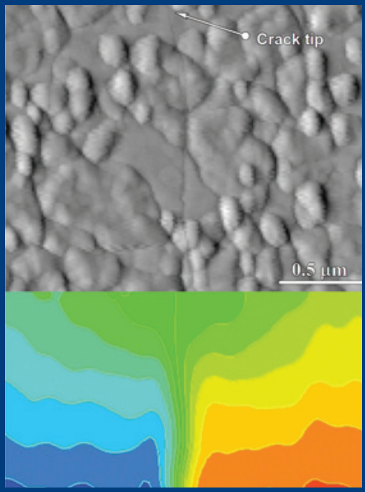
Rolls-Royce

Gulfstream
A GENERAL DYNAMICS COMPANY





Best journal papers

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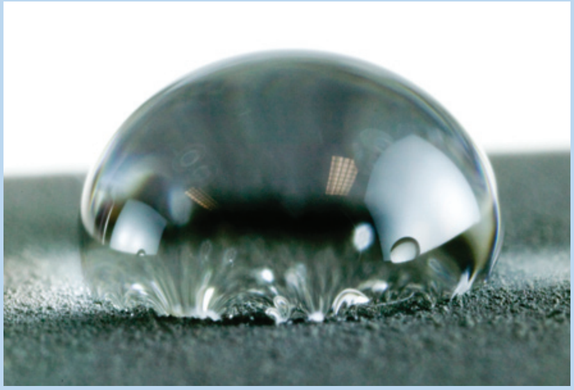
Incredible images



The Imaging Technology Group at the Beckman Institute for Advanced Science and Technology chose this image in April 2008 as their “image of the week.” AE Prof. Eric Loth’s research group produced the photograph. The image is a water droplet on a nanocomposite superhydrophobic surface. The National Science Foundation’s Center for Compact and Efficient Fluid Power funded the research.

Experiments in space

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Innovations in self-healing research

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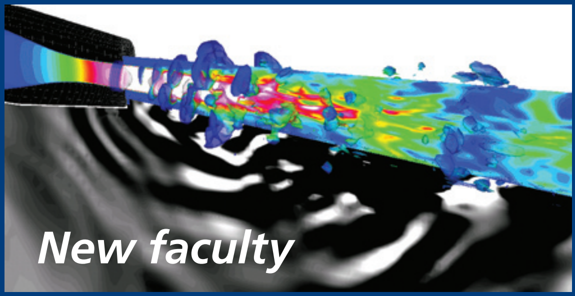

New faculty

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Service in aerospace engineering

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AIAA
The World’s Forum for Aerospace Leadership

Student achievements

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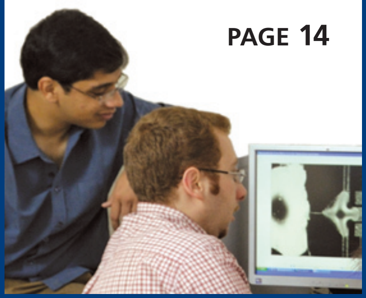


AE works with Gulfstream, Rolls-Royce on supersonic business jet development

Aerospace companies Gulfstream Aerospace, a subsidiary of General Dynamics, and Rolls-Royce Deutschland have entered into an agreement with Aerospace Engineering at the University of Illinois at Urbana-Champaign to conduct research relevant to the potential development of a supersonic business jet.

"Illinois is involved in research to mitigate the sonic boom from supersonic business jets," said Michael B. Bragg, AE Professor and Executive Associate Dean for Academic Affairs in the College of Engineering.

"This is the largest industrial research agreement for the Aerospace Engineering Department. While specific details of the agreement are commercially confidential, we have signed a five-year research agreement with funding for the first three years," Bragg said.

AE engineers involved in the research include Bragg, Assistant Prof. Joanna M. Austin, Prof. Gregory S. Elliott, Associate Prof. Jonathan B. Freund, Prof. Eric Loth, and Department Head J. Craig Dutton, as well as a half-dozen or more graduate students.

Bragg said the companies' investment will provide research funding that will support the faculty and students as well as provide for some special facilities to do computational and experimental work. Illinois researchers will focus on the engine's intake and exhaust systems with a goal of reducing sonic boom and increasing propulsive efficiency.

Joined by Loth, Bragg and Elliott will lead research on by-pass air that travels around the outside of the engine core. The main objective of this research is to explore and investigate methods to attenuate the sonic boom strength of a potential supersonic business jet.

One of the proposed methods is to introduce a region within the engine nacelle where air would be drawn from the engine inlet, bypass the engine core before exiting the nacelle together with the combusted exhaust from the core. To understand the performance of the bypass air on the overall performance of the propulsion system and the aircraft, an experimental and computational study is underway to evaluate the bypass flow and investigate improved bypass flow designs. The experimental program will modify an existing open return wind tunnel to drive a simulation of the bypass flow path. A companion program will use computational fluid dynamics to help optimize the flow paths and to provide insights into full-scale flight conditions.

Loth will lead the inlet research, joined by Bragg, Elliott and Dutton. This study will design and develop a large-scale supersonic low-boom inlet for later testing in the NASA Glenn Research Center 8′ × 6′ wind tunnel in Cleveland, Ohio. To provide low-boom characteristics, the inlet will be a relaxed-compression axisymmetric design with a free-stream Mach number of 1.7, and will incorporate and investigate micro-ramp flow control to improve overall flow efficiency. The inlet also will be designed to allow detailed flow visualization and state-of-the-art diagnostics to identify the primary flow features and performance parameters.

Austin, Freund, and Elliott will carry out research on the acoustics of the exhaust system. According to Austin, sonic boom suppression requirements are expected to affect many aspects of the propulsion

Illinois researchers will focus on the engine's intake and exhaust systems with a goal of reducing sonic boom and increasing propulsive efficiency.

Michael B. Bragg

Joanna M. Austin

Gregory S. Elliott

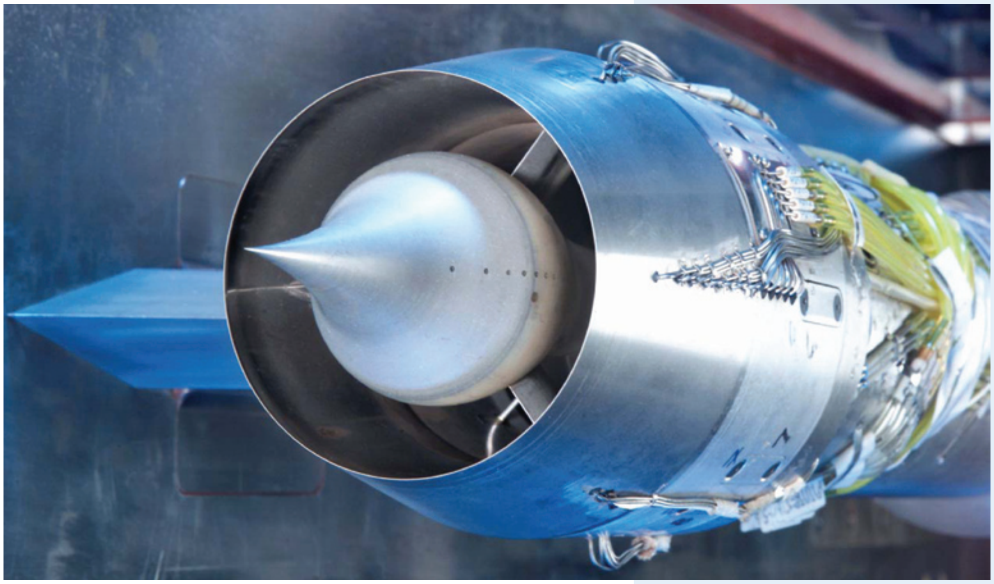
Jonathan B. Freund

Eric Loth

J. Craig Dutton

system, including the nacelle design, the nozzle geometry, and the engine placement. As designs are refined to mitigate cruise boom, two critical questions emerge: will the jets be quiet enough to meet take-off standards and what are the implications of sonic boom suppression configurations on the jet noise? Jet noise levels can be quite sensitive to nozzle configurations and many current aircraft operate close to FAA and other noise restriction levels.

The group is studying jet exhaust at take-off conditions. An anechoic chamber facility is being constructed for coupled acoustic and velocity field measurements. Nozzle geometries and engine-airframe integration configurations are being investigated to understand the fundamental physics of the flow field and minimize noise levels.



Supersonic inlet located in the NASA Glenn Research Center 1'x1' supersonic wind tunnel. The current work between NASA, Gulfstream, Aerojet and the University of Illinois will develop a larger more realistic inlet for the 8'x6' supersonic wind tunnel where the new inlet will also use micro-ramp flow control to help reduce sonic boom levels.

"Current Federal Aviation Administration (FAA) regulations prohibit supersonic flight over land," said Bragg. "One of the prime objectives of this research is to show the FAA and environmentalists that the sound produced by a jet flying at supersonic speeds over land can be reduced to an acceptable level."

Rolls-Royce Deutschland supplies engines for aircraft built by Gulfstream, headquartered in Savannah, Georgia. AE alumnus Preston Henne, BS 69, provided assistance in the companies reaching an agreement with the Department. Henne is Senior Vice President, Programs, Engineering and Test at Gulfstream.

Rolls-Royce announces new partnership with Illinois

Rolls-Royce, a world-leading provider of power systems and services for use on land, at sea and in the air, has announced broad plans to grow its partnership with the University of Illinois. This new relationship, which could evolve into Rolls-Royce establishing a university technology center here, holds many opportunities for students and faculty in units across campus, including Aerospace Engineering.

To kick off this new era, Rolls-Royce this spring provided two, $10,000 annual scholarships for students studying in a science or technology-related field at the University of Illinois. The scholarships will recognize students of all backgrounds who demonstrate outstanding academic achievement and reflect the core values of Rolls-Royce: reliability, integrity and innovation.

A University of Illinois scholarship committee will select scholarship winners each year. The 2008 winners were Luis J. Mendez, a freshman studying computer science; and Ernest L. Baker, a sophomore studying accountancy.

Norm Egbert, Vice President of Engineering and Technology for Rolls-Royce Corporation said: "Our congratulations go out to Luis and Ernest for their academic success. These scholarships underpin our commitment to fostering an interest in science and technology in young people with a view towards opening the door on future careers in these areas."

"These scholarships are an example of the important relationship that exists between Rolls-Royce and the University of Illinois, who we've chosen to partner with because of their world-class research capabilities, effective training programs and talented students."

Mike Bragg, Aerospace Engineering professor and Executive Associate Dean in the College of Engineering, said of the new development: "Our growing relationship with Rolls-Royce has the potential to impact many students in Engineering and across campus. Research grants, scholarships and fellowships, internships and co-ops are all areas where we hope to increase our interaction."

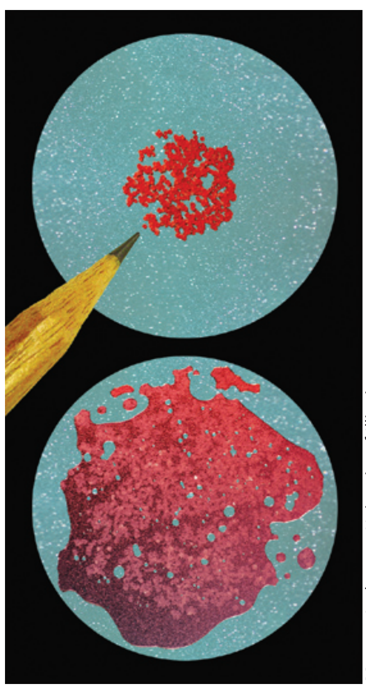
Company executives shared their ideas for an expanded relationship with the University of Illinois during a banquet they hosted earlier this spring at the Alice Campbell Alumni Center. Among invited guests were Vice Provost Ruth Watkins and Vice Chancellor for Research Chip Zukoski, as well as several administrators from the colleges of Business and Engineering, including Aerospace Engineering faculty and staff. Joining the guests were company officials that included Egbert and John Gill, Vice President of Human Resources.

Aerospace Engineering researchers continue advances in self-healing materials

In the same manner that a cut in the skin triggers blood flow to promote healing, a crack in these new materials will trigger the flow of healing agent to repair the damage.

The next generation of self-healing materials, invented by researchers at the University of Illinois at Urbana-Champaign including Aerospace Engineering Prof. Scott White, mimics human skin by healing itself time after time. The new materials rely upon embedded, three-dimensional microvascular networks that emulate biological circulatory systems.

Recent developments in this research also have evolved so that the material system is now catalyst-free. This results in a far less expensive and more practical way of repairing composite materials used in structural applications that range from airplane fuselages to wind-farm propeller blades.



Magnus Andersson, University of Illinois

RELEASE OF HEALING AGENT FROM MICROCAPSULES: Urea-formaldehyde microcapsules used in self-healing polymers (left). Red healing agent (dyed for clarity) is released when microcapsules rupture under pressure applied to a glass slide (right). The tip of a lead pencil is pictured for a size reference.

In the same manner that a cut in the skin triggers blood flow to promote healing, a crack in these new materials will trigger the flow of healing agent to repair the damage, said Nancy Sottos, a professor of Materials Science and Engineering and affiliate AE professor.

"The vascular nature of this new supply system means minor damage to the same location can be healed repeatedly," said Sottos, a Donald Biggar Willett Professor in the College of Engineering, and a researcher at the Beckman Institute.

In the researchers' original approach, self-healing materials consisted of a microencapsulated healing agent and a catalyst distributed throughout a composite matrix. When the material cracked, microcapsules would rupture and release healing agent. The healing agent then reacted with the embedded catalyst to repair the damage.

With repeated damage in the same location, however, the supply of healing agent would become exhausted, said White, a Willett Professor in AE and also a researcher at the Beckman Institute. "In our new circulation-based approach, there is a continuous supply of healing agent, so the material heals itself indefinitely."

To create their self-healing materials, the researchers begin by building a scaffold using a robotic deposition process called direct-write assembly. The process employs a concentrated polymeric ink, dispensed as a continuous filament, to fabricate a three-dimensional structure, layer by layer.

Once the scaffold has been produced, it is surrounded with an epoxy resin. After curing, the resin is heated and the ink—which liquefies—is extracted, leaving behind a substrate with a network of interlocking microchannels.

In the final steps, the researchers deposit a brittle epoxy coating on top of the substrate, and fill the network with a liquid healing agent.

In the researchers' tests, the coating and substrate are bent until a crack forms in the coating. The crack propagates through the coating until it encounters one of the fluid-filled "capillaries" at

1. Philippe Geubelle; 2. Jeff Moore; 3. Scott White; 4. Paul Braun; 5. Nancy Sottos; 6. Quilong Shen; 7. Jessica Cole; 8. Mary Caruso; 9. Andrew Hamilton; 10. Ben Blaiszik; 11. Henghua Jin; 12. Doug Davis; 13. Willie Wu; 14. Yuxiang Liu; 15. Aaron Jackson; 16. Cassandra Kingsbury; 17. Brian Kozola; 18. Amit Patel; 19. Raj Ramanchandramoorthy; 20. Chris Hansen; 21. Jericho Moll; 22. Jinglei Yang; 23. Vinay Natrajan; 24. Pierre-Yves Jullin; 25. Solar Olugebefola; 26. Alejandro Aragon; 27. David McIlroy; 28. John Fettig; 29. Keith Porter

the interface of the coating and substrate. Healing agent moves from the capillary into the crack.

Previously, the healing agent would interact with catalyst particles. More recently, the researchers have developed a system that incorporates chlorobenzene microcapsules, as small as 150 microns in diameter, as an active solvent. The expensive, ruthenium-based Grubbs' catalyst, which was required in the researchers' first approach, no longer is needed.

"By removing the catalyst from our material system, we now have a simpler and more economical alternative for strength recovery after crack damage has occurred," said Jeffrey Moore, the Murchison-Mallory Professor of Chemistry at Illinois, and a Beckman researcher. "Self-healing of epoxy materials with encapsulated solvents can prevent further crack propagation, while recovering most of the material's mechanical integrity."

In this new approach, when a crack forms in the epoxy material, microcapsules containing chlorobenzene break.

In fracture tests, self-healing composites with catalyst-free chemistry recovered as much as 82 percent of their original fracture toughness. The new catalyst-free chemistry has taken down the barriers to cost and level of difficulty, Moore said. "From an economics and simplicity standpoint, self-healing materials could become part of everyday life."

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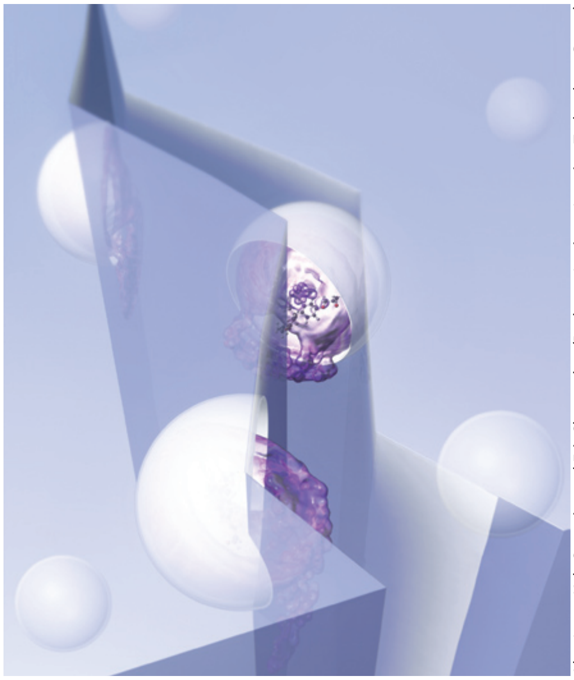


Alex Jerez, Kyle Scoggin, and Eric Shoemaker (Beckman Institute Imaging Technology Group)

ECONOMICAL, GREEN SELF-HEALING: An improved solvent-based self-healing system has been developed with complete recovery of fracture toughness (100% healing efficiencies). Microcapsules containing epoxy monomer and solvent have been incorporated into epoxy resin matrices and rupture upon crack damage. More environmentally-friendly solvents such as ethyl phenylacetate have proven successful alternatives to a chlorobenzene-based system.

SciAm 50 list recognizes White, Sottos

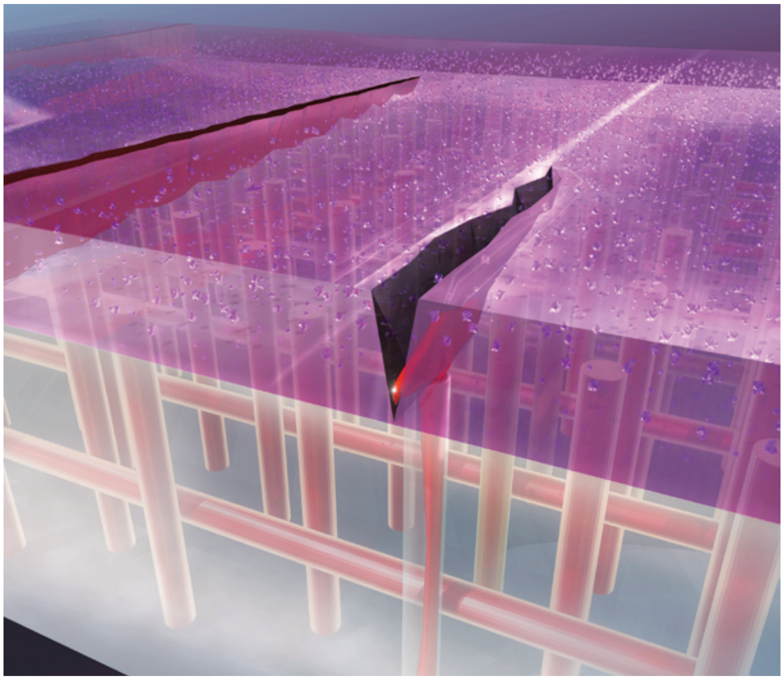
Aerosopace Engineering Prof. Scott R. White and affiliate Prof. Nancy R. Sottos were included in the SciAM 50 for 2007, a distinct honor that appears in the January 2008 edition of *Scientific American* magazine.

The awards list recognized 50 individuals, teams, companies and other organizations whose accomplishments in research, business or policymaking during 2006-2007 demonstrate outstanding technological leadership. The SciAM 50 honorees were celebrated for their contributions to areas including biotechnology, microelectronics, energy and genetics.White and Sottos, of Materials Science and Engineering, were recognized for their development of self-healing materials. Both White and Sottos are Donald Biggar Willett Professors in the College of Engineering.

White was also recognized for this research by the Champaign County Economic Development Corp. and several University of Illinois groups when they honored him with the Innovation Discovery Award in February. These awards are designed to encourage technological development in Champaign County, Illinois.

For years, research in White's labs has been directed toward the creation of new materials systems that exhibit autonomy—the ability to achieve adaptation and response in an independent and automatic fashion. White leads the Autonomic Materials Group of which this research is a central part.

In addition to White, Sottos and Moore, Jennifer Lewis, the Thurnauer Professor of Materials Science and Engineering and director of the Frederick Seitz Materials Research Laboratory, is also involved in the research. White, Sottos and Moore co-invented self-healing plastic; Lewis and White pioneered direct write assembly of three-dimensional microvascular networks. The work was funded by the U.S. Air Force Office of Scientific Research and the Beckman Institute.



Janet Sinn-Hanlon (Beckman Institute Imaging Technology Group)

HEALING MICROVASCULAR EPOXY: A structural epoxy beam with surface cracks that have been healed through supply of healing agent from the underlying vascular bed. In testing at the University of Illinois surface cracks were repeatedly healed up to seven consecutive times with no loss in healing efficiency.

Meet our new faculty members Daniel Bodony, Timothy Bretl, and Cedric Langbort

BODONY

Aeroacoustics and Unsteady Flow Physics

Joining the AE faculty in October 2006, Daniel J. Bodony already has contributed to the Department's research into aeroacoustics and unsteady flow physics, and has made an impression upon AE's students.

Bodony's research has particular emphasis on flows that generate sound—also called aeroacoustics—using large-scale simulations (large-eddy and direct numerical simulations) and analytical methods. In high-speed flows he is currently investigating how, using plasma actuators, to reduce the noise generated by supersonic turbulent engine exhaust (supported by NASA and joint with Prof. Jonathan B. Freund), how to model supersonic jet noise (supported by NASA), and how to reduce the noise inside the jet engine exhaust duct using acoustic liners (supported by AeroAcoustics Research Consortium). Bodony is also investigating how the combustor interacts with the turbine in gas turbine engines to create sound (supported by NASA). In low speed flows he is developing the required numerical techniques to predict, from first principles, the human voice, including models of the larynx, mouth, tongue, and nasal cavities. Under support from the Air Force Research Laboratories through the University's Midwest Structural Sciences Center, he and Prof. Philippe H. Geubelle are developing the computational tools and analyzing the physics involved in the interaction of a compressible fluid with mechanically and thermally compliant structures, such as are expected to be found in future, reusable hypersonic vehicles.

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Daniel J. Bodony

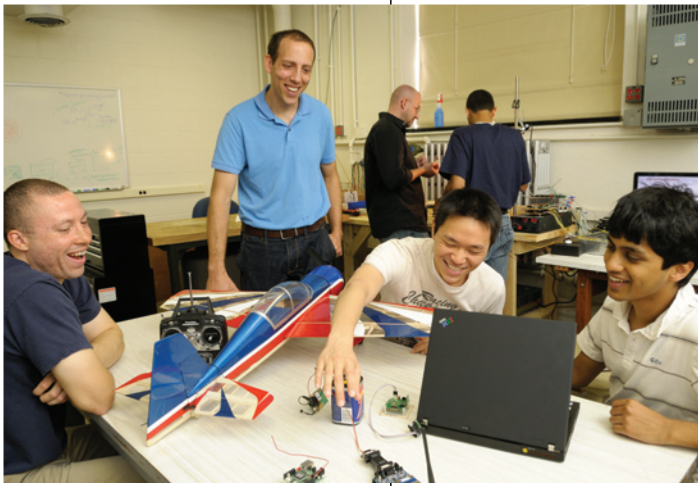
BRETL

Robotics and Autonomous Systems

A member of the AE faculty since August 2006, Assistant Prof. Timothy W. Bretl concentrates his research in the area of robotics and autonomous systems.

His students are working on two main projects:

1. brain-machine interfaces, where they are developing algorithms that allow people to steer wheelchairs, drive cars, or fly airplanes just by thinking; and
2. "crowd control" at multiple scales, where they are developing algorithms that enable new methods of microfabrication using electromagnets and of non-contact industrial manipulation using vectored air jets.



Timothy W. Bretl and students

These projects are supported by the Pilot Grant Program of the Center for Healthy Minds and the Campus Research Board, both through the University of Illinois, and an Illinois Space Grant Consortium Research Seed Grant.

Before coming to Illinois Bretl held a year-long postdoctoral research affiliate position in Computer Science at Stanford University. He had earned bachelor's degrees in mathematics and engineering from Swarthmore College in 1999, and a master's degree and PhD in aeronautics and astronautics from Stanford in 2000 and 2005, respectively.

Bretl's honors and awards include:

- Herbert Kunzel Stanford Graduate Fellowship, 2002-2004
- National Defense Science and Engineering Graduate Fellowship, 1999-2002
- National Science Foundation Graduate Research Fellowship (honorary), 1999-2002
- McCabe Engineering Award, 1999
- Heinrich W. Brinkmann Mathematics Prize, 1999

LANGBORT

Aerospace Information Technology

In his study of Aerospace Information Technology, Assistant Prof. Cedric Langbort tries to understand the dynamics and control of large-scale distributed systems such as multi-vehicle missions, air traffic management systems, and smart materials.

Of particular interest are fundamental questions regarding the role of communication constraints between subsystems, system architecture, tolerance to individual failure, and intrinsic limitations of distributed control algorithms due to segmentation of information. He uses tools from dynamical systems theory, control theory, and convex optimization coupled with concepts from economics and computer science such as organization efficiency and online algorithms.

A recent project, funded by the National Science Foundation, is the distributed control of constrained compartmental systems, with applications to large-scale infrastructures. In this project, Langbort collaborates with researchers from the National Aeronautics and Space Administration Ames Research Center to investigate the use of distributed control design tools for the regulation of air-traffic flows and irrigation networks.

Langbort is also interested in communication, incentives, and privacy in the control of multi-party dynamical systems that aim to construct new mechanisms for designing controllers. In these situations, varying agents have access to different parts of a system's model, and are possibly self-interested in the choice of the regulation scheme. Such situations occur frequently in power market and multi-player online computer games.

Langbort came to AE in 2006, after working two years as a postdoctoral scholar at California Institute of Technology's Center for the Mathematics of Information. Prior to that, he had been a research assistant in Cornell University's Department of Theoretical & Applied Mechanics.

Langbort earned a PhD in that department at Cornell in January 2006. He had earned a master's degree in turbulence & dynamical systems from the Institut Non-Linéaire de Nice, Nice, France in 2000. He had earned both a bachelor's degree in aerospace engineering and a master's degree in control theory from the Ecole Nationale Supérieure de l'Aéronautique et de l'Espace-Supaero, Toulouse, France, in 1999.

Cedric Langbort

Bodony, *continued*

In addition to his research efforts, Bodony has quickly developed an excellent rapport with students. He has been named to the List of Teachers Ranked as Excellent every semester since joining the department. The local American Institute of Aeronautics and Astronautics (AIAA) student chapter selected him as AE's 2008 Teacher of the Year.

Bodony came to the University of Illinois in October 2006, after spending two years working at the Center for Turbulence Research at Stanford University. He received his bachelor's and master's degrees in aeronautics and astronautics from Purdue University in 1997 and 1999, respectively. He earned a PhD in aeronautics and astronautics from Stanford in 2004. His awards include Boeing Company Scholar (1996), Department of Defense Science and Engineering Graduate Fellowship (1998-2001), AFRL Graduate Research Fellow (1998), and ARCS Scholar (2003-2004).

Chasiotis' Work in MEMS and Nanostructured Materials Recognized

The work of AE Associate Prof. Ioannis Chasiotis and his graduate students in MicroElectroMechanical Systems (MEMS), thin films and other materials has been well-received and recognized over the past year.

Chasiotis received a 2007 Office of Naval Research Young Investigator Program Award for his proposal on Polymer Nanocomposites, a work that aims at brining nanotechnology to the service of the U.S. Navy. In 2008 he was also selected for an NSF-CAREER award from the Materials Design and Surface Engineering Program at the National Science Foundation. This five-year award will support his group to develop a research program on soft/hard interfaces in polymeric materials with applications to Aerospace Engineering.

In addition, an article he co-authored with his graduate students on "Mode I and mixed mode fracture of polysilicon for MEMS," published by the *Fatigue and Fracture of Engineering Materials and Structures* in January 2007, received the journal's 2007 Best Paper Award. According to the award, "This paper addressed for the first time experimentally the problem of mixed mode fracture in brittle materials for Microelectromechanical Systems (MEMS) by novel experiments coupled with a detailed numerical analysis. A key finding of this paper is that fracture of brittle thin polycrystalline silicon films that are routinely used in MEMS is stochastic in nature, because it is strongly controlled by the random orientation of individual nanoscale grains comprising the material. As a consequence, one cannot talk about a unique value of

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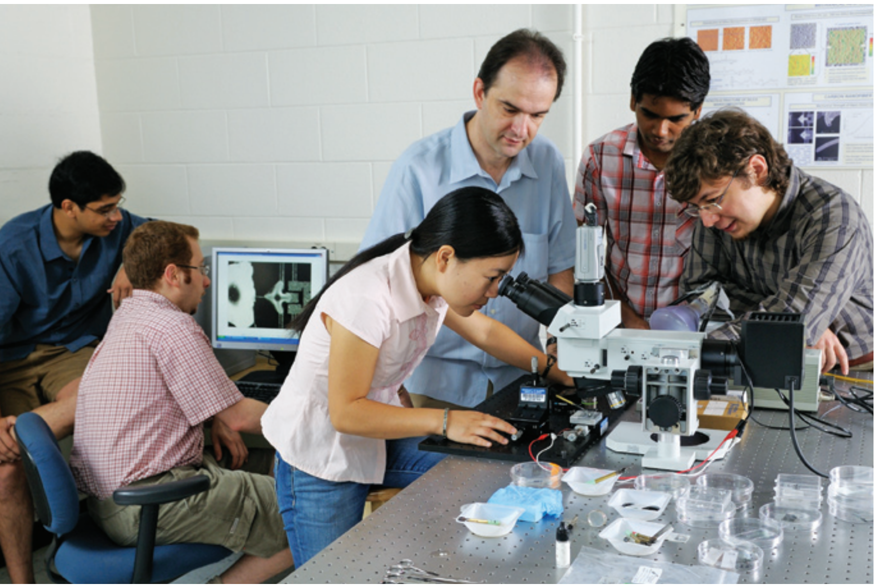
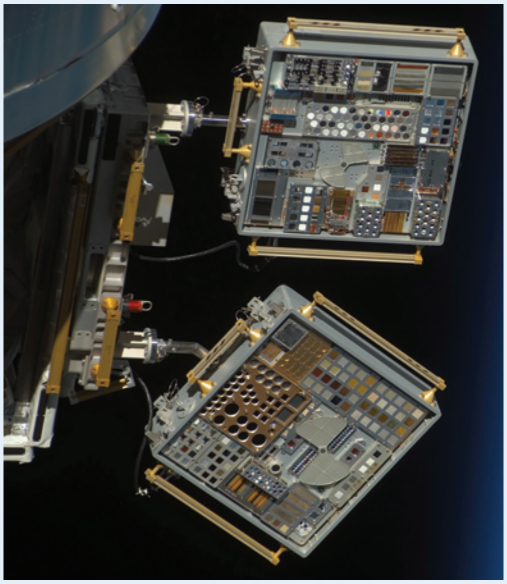


Ioannis Chasiotis and students

Space Station carries AE experiment

An experiment of AE Associate Prof. Ioannis Chasiotis and his graduate student Ms. Qi Chen is underway in a set of "briefcases" attached since the spring of 2008 to the International Space Station.



The polymer nanocomposite samples with various compositions and sizes of silica nanoparticles were divided into two identical groups and were mounted on two briefcases together with samples from other research laboratories. The two briefcases, transported aboard the space shuttle Endeavour and mounted in mid-March at the exterior of the International Space Station, will be in place for the next six months. They will be returned to NASA labs and then to Chasiotis' laboratory at UIUC by another space shuttle mission. Both sets of samples will be exposed to UV radiation, and one set will be in contact with atomic oxygen. This project aims at investigating the shielding effect of nanocomposites, the degree of deterioration of their properties in space, and of course their qualification for space materials.

This work was made possible by AFOSR grant #FA9550-06-1-0140 and a collaboration with Wright-Patterson Air Force Base.

fracture toughness for such thin films, but rather a broad envelope of fracture toughness values with the grain boundaries providing a toughening effect."

The research interests of Chasiotis' group are experimental mechanics at the nanoscale with emphasis in mechanical reliability, fracture, and fatigue of MEMS, NanoElectroMechanical Systems (NEMS), and thin film electronic materials. These materials are employed to fabricate microscale sensors for common engineering systems including aircraft and satellites. In addition, his group is working on the experimental failure mechanics of inhomogeneous and anisotropic materials for lightweight applications with emphasis in the nanoscale deformation and damage mechanics of polymer nanocomposites.

Chasiotis has been a member of AE's faculty since 2005. He also is a part-time faculty member of the Beckman Institute for Advanced Science and Technology, and the Micro and Nanotechnology Laboratory. Previously, he was a member of the Mechanical and Aerospace Engineering faculty at the University of Virginia. In August of 2008 he was officially promoted to the rank of Associate Professor.

Chasiotis earned a five-year Diploma in Chemical Engineering in 1996 from the Aristotle University of Thessaloniki in Greece, and his Master's and Ph.D. degrees in Aeronautics from the California Institute of Technology in 1998 and 2002, respectively.

Joanna M. Austin and students

Austin wins Young Investigator Award

AE Assistant Prof. Joanna M. Austin has received a Young Investigator Award from the U.S. Air Force Office of Scientific Research. Austin's proposal was one of 29 chosen from among 215 submitted.

Austin's work for the award studies hypervelocity boundary layers for axisymmetric engine flowpaths. Her research interests focus on reacting, compressible flows. Other current research projects include the study of thermochemical nonequilibrium effects on transition and turbulence in hypervelocity flow; hotspot formation and detonation initiation in heterogeneous energetic materials; the study of compressible flows in geological applications, such as volcanic blasts and impact craters; compressible flows at small scale; and engine exhaust studies for the supersonic business jet.

Austin has been on the AE faculty since 2003. She earned BE (Mechanical and Space Engineering), and BSc (Mathematics) degrees in 1996 from the University of Queensland. She earned a master's and PhD in aeronautical engineering from the California Institute of Technology in 1997 and 2003, respectively. Her doctoral research was awarded the Richard Bruce Chapman Award for distinguished research in hydrodynamics in the Engineering and Applied Science Division, Caltech.

Bragg is new AIAA vice president; Muellner assumes organization's presidency

Michael B. Bragg

AE Prof. Michael B. Bragg is the new Vice President, Publications, of the American Institute of Aeronautics and Astronautics.

Bragg was selected during the 2008 AIAA Board of Directors election in April, and assumed office in May. Also at that time, AE alumnus and Alumni Board member George K. Muellner, BS 1967, assumed office as AIAA President.

In addition to serving on the AE faculty, Bragg also is Executive Associate Dean in the College of Engineering. Bragg served as AE Department Head from 1999 until 2006, having joined AE in 1990.

Bragg's two primary areas of research are aircraft icing and unsteady aerodynamics. He received the 2007 AIAA Aerodynamics Award for "for pioneering research on the aerodynamic effects of ice accretion on aircraft and the aerodynamic phenomena responsible."

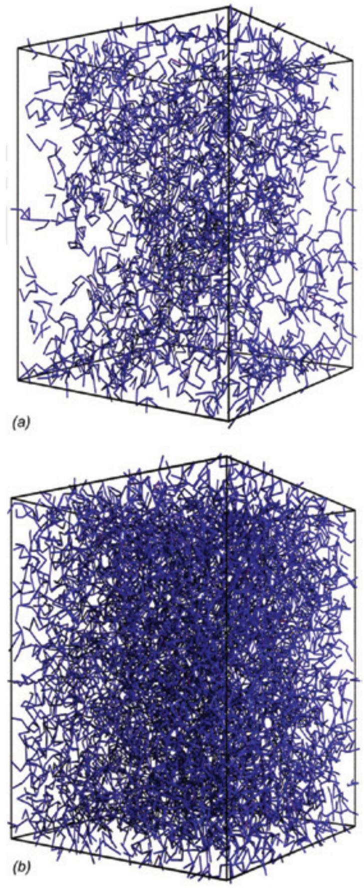
Muellner is the recently retired president of Advanced Systems for the Integrated Defense Systems business unit of the Boeing Company, responsible for developing advanced cross-cutting concepts and technologies, and executing new programs prior to their reaching the System Design and Development phase. Since starting with Boeing in 1998, Muellner has held a variety of positions, including vice president-general manager of Air Force Systems and president of Phantom Works, the advanced research and development unit.

Geubelle Earns Best Paper Award

Philippe H. Geubelle

Prof. Philippe H. Geubelle and his colleagues have been recognized by the Materials Division of the American Society of Mechanical Engineers (ASME) as the authors of the Best Fatigue and Fracture paper published in the *Journal of Engineering Materials and Technology* between July 2006 and June 2007.

The paper, "Continuum and Molecular-Level Modeling of Fatigue Crack Retardation in Self-Healing Polymers," was co-written by Spandan Maiti, Chandrashekar Shankar and John Kieffer. The paper, which appeared in the journal's October 2006 issue, describes a multi-scale model of the fatigue response of the self-healing polymers developed at the University of Illinois by a group led by Prof. Scott White.



(a)

(b)

Geubelle's research interests are theoretical and computational solid mechanics, (dynamic) fracture mechanics, multiscale modeling of complex materials, computational aeroelasticity, massively parallel computing, solid mechanics issues in manufacturing, and computational design of novel autonomic materials.

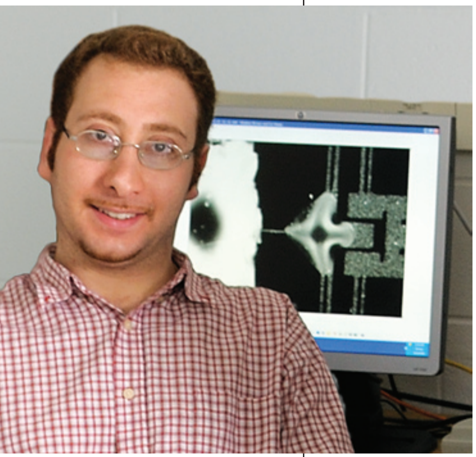
Geubelle is the AE Associate Head for Graduate Programs and directs the Illinois Space Grant Consortium.

He has been an AE faculty member since 1995. He also is a faculty member of the Computational Science and Engineering program, and has joint appointments in Mechanical Science and Engineering, Civil and Environmental Engineering and the Beckman Institute for Advanced Science and Technology. He was a NATO postdoctoral research associate at Harvard University prior to coming to Illinois.

Geubelle earned a bachelor's degree in mechanical engineering from Catholic University of Louvain, Louvain-la-Neuve in Belgium in 1988. He earned a master's and PhD in aeronautics from the California Institute of Technology in 1989 and 1993, respectively.

AE PhD Takes First for Second Year in Sandia Lab Contest

Doctoral student Mohammad Naraghi has taken first place for two consecutive years at Sandia National Laboratory's University Alliance competition.



Mohammad Naraghi

Most recently, Naraghi took first at Sandia's fourth annual competition for student microelectromechanical systems designs. His design fit the category calling for a micro design to reliably inspect nanoscale phenomena. The Illinois device featured a mechanical testing platform specifically designed to perform creep/stress relaxation tests on soft polymeric and biological nanostructures. The device incorporated a piezoresistive loadcell with a novel on-chip actuator capable of generating large deformations on the sample. AE Assistant Prof. Ioannis Chasiotis advises Naraghi.

The University Alliance competition gives universities around the country an opportunity to test their skills in developing all the intricate details of design, analysis, and fabrication of complex MEMS devices, says Mark Platzbecker, technical team lead in Sandia's MEMS Core Technologies Department.

Naraghi's work was supported in part by the National Science Foundation (NSF) under NSF-NIRT grant DMI-0532320.

AE Grad Student Wins NASA Scholarship to Improve Air Transportation

AE PhD student Heather Arneson has received a highly competitive NASA Aeronautics Scholarship, awarded to only five graduate students nationwide each year.

Working with AE Prof. Cedric Langbort, Arneson will use the scholarship to study management of the U.S. air transportation system, in which the current 50,000 flights a day are expected to increase up to three times that many by 2025.

The NASA scholarship will fund two years of research and a third year, if needed. It will provide Arneson with two summer internships at top NASA research centers.

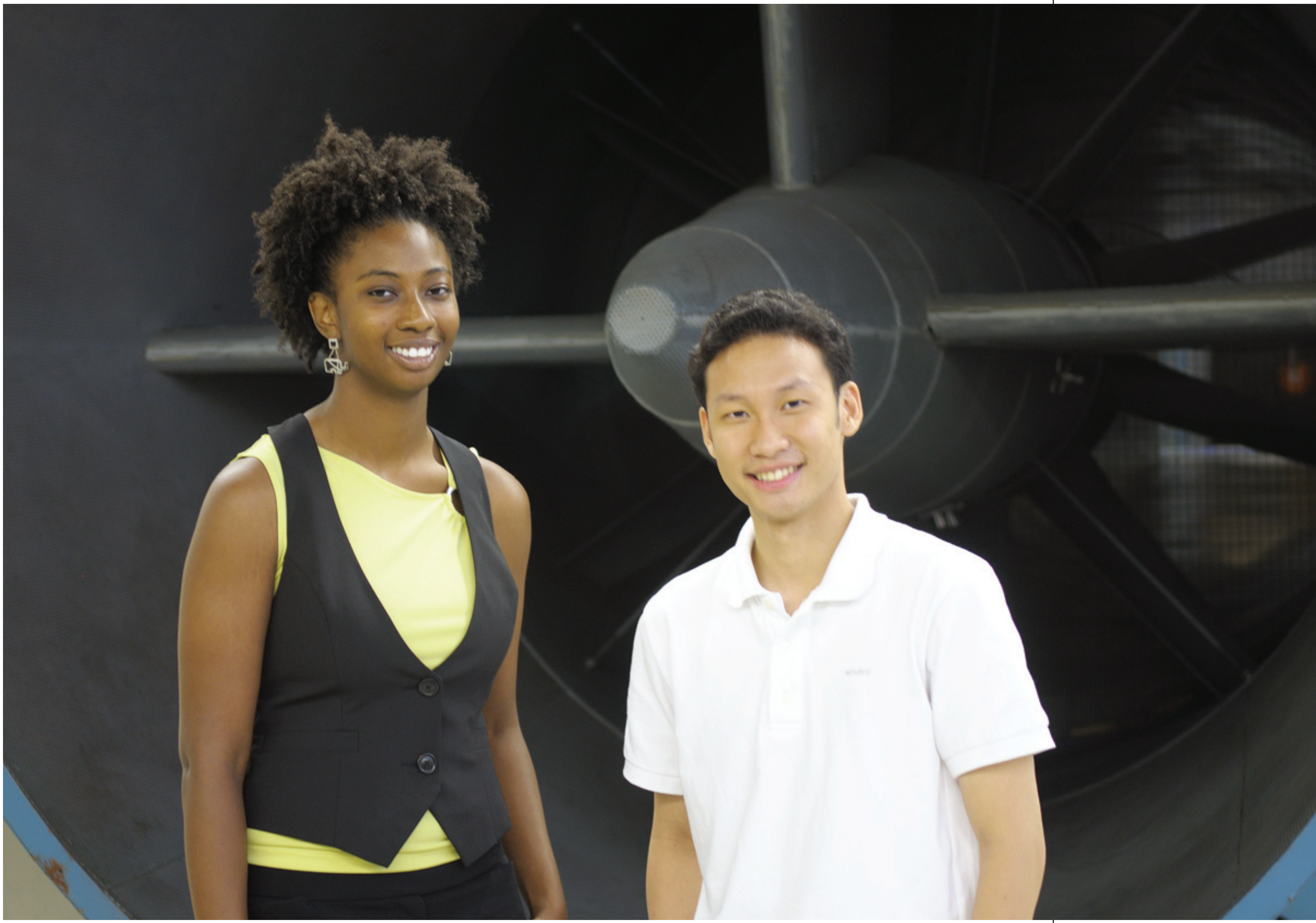
Heather Arneson

Arneson is working at the flow control level of the new air transportation system. She is interested in management of the flow of large groups of airplanes through specific air spaces. In particular, she is looking at ways to more efficiently reroute airplane traffic around regions when they become congested due to factors such as weather.

Arneson came to AE in 2005 after working on NASA's Mars Exploration Rover Mission for three years.

As part of her master's work at Illinois, she developed two algorithms that could be applied to an existing Eulerian flow model for air traffic management. Her focus was on air traffic between just a single take-off airport and single landing airport.

Arneson's PhD research will build on her master's work, dealing with increasingly more complex network scenarios. She and Langbort will concentrate on distributed control algorithms to solve problems with air traffic delays, primarily those caused by weather.



Graduate students Ingrid Chiles and Yong-Han Yeong work with fellow undergraduate student Joe Bottalla and AE Profs. Mike Bragg, Eric Loth and Greg Elliott on research to reduce the sonic boom for a potential supersonic business jet. Chiles and Yeong are doing computational and experimental studies to evaluate the bypass flow and investigate improved bypass flow designs.

Contact Information

Department of Aerospace Engineering
University of Illinois at Urbana-Champaign
306 Talbot Laboratory, MC-236
104 South Wright Street
Urbana, Illinois 61801

Phone: +1-217-333-2651
Fax: +1-217-244-0720

Website: www.ae.uiuc.edu
Email: aerospace@illinois.edu

ILLINOIS

Department of Aerospace Engineering
University of Illinois at Urbana-Champaign
306 Talbot Laboratory, MC-236
104 South Wright Street
Urbana, Illinois 61801