

# Aerospace Engineering Welcomes Three New Faculty

Three new faculty members joined the Aerospace Engineering Department this year—Cedric Langbort, Timothy Bretl, and Daniel Bodony. Together, they bring with them expertise in aerospace information technology and computational fluid dynamics and aeroacoustics.

**Cedric Langbort** works in the field of aerospace information technology. In particular, he tries to understand the dynamics and control of large-scale distributed systems such as multi-vehicle missions, air traffic management systems, and smart materials. He is especially interested in 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. Langbort 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.

Before he joined the department in March, he was a postdoctoral scholar in the Center for the Mathematics of Information at the California Institute of Technology. He received his doctorate in theoretical and applied mechanics from Cornell University in January 2005. He earned a master's degree from the Institut Non-Linéaire de Nice, France, in 2000. In 1999, he received both a bachelor's and master's degrees in aerospace engineering from the Ecole Nationale Supérieure de l'Aéronautique et de l'Espace-Supaero in Toulouse, France.

*In his own words:* "I am currently teaching the *Introduction to*

*Aerospace* class, which has been very exciting so far, as I get to interact with motivated freshmen. Next semester, I will teach AE 302, which is our second course in Flight/Orbital Mechanics. I would love to be able to teach a course on my research interest (distributed control) in the near future.

"Research-wise, since arriving here, I have submitted a National Science Foundation grant and am trying to get connections with other agencies. I have started working on some papers on what I think is a new class of questions within distributed control/decision, and have had the opportunity to present some preliminary results at the American Control Conference this past summer.

"In the longer term, I would like to try to develop some ties between the department and my alma mater (Supaero in France, often considered one of the leading aerospace schools in Europe)."

**Timothy Bretl** arrived at the department in August 2006 from his position as a postdoctoral research affiliate in computer science at Stanford University. He also performs research in the field of aerospace information technology and systems and control, focusing on robotics and autonomous vehicles.

He earned his master's degree and doctorate in aeronautics and astronautics from Stanford, in 2000 and 2005, respectively. In 1999, he received a BA in mathematics and a BS in engineering from Swarthmore College.

Bretl's doctoral dissertation focused on motion planning for large, free-climbing robots, which (like human free-climbers) rely only on frictional contact with rock features, not tools like pitons.



*Cedric Langbort*

This research led to a working implementation on a real robot, in cooperation with NASA-JPL. As a postdoctoral fellow at Stanford, he extended this work to a variety of other legged robots, including a humanoid and a hexapod for lunar exploration.

Bretl said he chose the University of Illinois to be part of the new and growing area of aerospace information technology. Broadly, he develops tools for motion analysis, planning, and control. These tools include geometric search algorithms, methods of model reduction, and convex optimization routines that take advantage of problem structure. He is applying these tools to a diverse set of mechanical and biological systems: autonomous sail-planes for atmospheric and environmental science, neuroprosthetic devices with a control interface designed using biological principles, and robotic manipulators for intelligent machining of deformable objects. All of these applications are safety-critical, so there is a strong emphasis on trust: tools must be practical, easy



*Timothy Bretl*

to implement, and have verifiable performance guarantees.

*In his own words:* "I am teaching a new seminar course this semester, AE498MPA (Motion Planning for Aerospace Vehicles), that only has three students but is a lot of fun. I would like to continue teaching a course like this in future years, but I expect the content to change quite a bit over time.

"As far as collaborations...I have been having some fascinating conversations with another new faculty member in the Department of Electrical and Computer Engineering about neuroprosthetics. I expect that to result in at least one joint proposal.

"Moving to one of the flattest places in the country does present a personal challenge, since I enjoy bouldering, rock climbing, and mountaineering. So in my spare time, I'm building a climbing gym in the garage. Once the liability issues are worked out, feel free to join me for some good training sessions."



*Daniel Bodony*

**Daniel Bodony** spent two years researching at the Center for Turbulence Research at Stanford University before coming to the Department of Aerospace Engineering. His field of research interest is aeroacoustics, computational fluid dynamics, and combustion. He is interested in unsteady flow phenomena, particularly on flows that generate sound, using large-scale simulations and analytical methods. His research includes high-speed flows such as noise produced by modern turbofan engines, and low-speed flows such as the sound produced during turbulent combustion and by the human voice.

Bodony 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.

*In his own words:* "Since my first day on the job was October 1, 2006, I am not teaching in the fall 2006 semester. I will, however, teach AE514 (Boundary Layer Theory) in spring 2007. I'm excited

about teaching it because the curriculum involves a substantial amount of intuition, analysis, and application of fundamental physical principles.

"On the research side, I am currently involved in projects relating, in some form, to predicting the generation of sound (that is, noise) by engineering systems. For example, through a NASA-funded grant I am investigating the noise produced by turbulent flames, such as found in gas turbine engines. On the more human side, I am working with researchers at George Washington University on developing the computational tools necessary to predict the human voice.

"I am involved in research in computational algorithms and fluid mechanics in support of the Center for Simulation of Advanced Rockets, the Department of Energy's advanced simulation and computing program center at the University. I am also starting a new project on the design of acoustic liners, used to reduce noise emission by jet engines, in collaboration with UCLA. I am also involved in Computational Science and Engineering and am an affiliate professor in Mechanical Science and Engineering (MechSE).

"On the personal side, I have been involved in aviation since before high school, including working at a small airport with a grass runway and being an instructor for teaching others how to fly radio-controlled model aircraft. I have worked for a NASA Langley SBIR (Small Business Innovation Research) company designing low-drag aircraft and for the U.S. Air Force at Wright-Patterson AFB in Dayton, Ohio."

## Illinois Students Host National Space Conference

The Illinois Space Society, the University of Illinois chapter of Students for the Exploration and Development of Space (SEDS), hosted a four-day national conference on campus in November 2005. Guest speakers to SpaceVision 2005 included Peter Diamandis (X-PRIZE founder and chairman of its foundation), Jim Garvin (NASA chief scientist), George Whitesides (National Space Society executive director), and Elon Musk (SpaceX chairman and CEO), as well as Robert Farquhar (mission manager for MESSENGER), who talked to participants about career opportunities. Companies such as Lockheed Martin, AGI, and Northrop Grumman set up booths at the Space Fair.



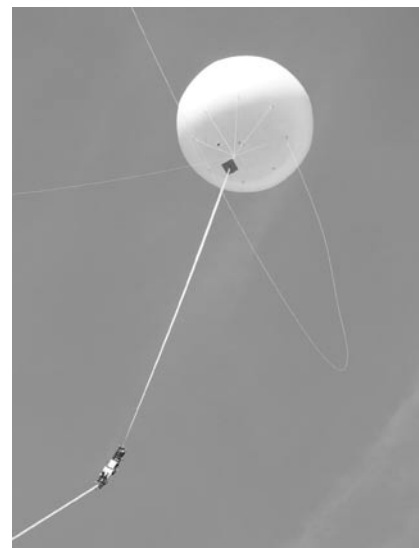
*Robert Farquhar ('59) manages the MESSENGER mission, a NASA Discovery mission of Mercury.*



*Kirk Kittell ('03, MS '06) was the main organizer for SpaceVision 2005. Kittell co-founded the Illinois Space Society in 2003.*



*Michael Lembeck ('80, MS '81, PhD '91) was a participant.*



*A wirelessly controlled space elevator climbs up a fiberglass ribbon tethered to a weather balloon, at a demonstration on the Bardeen Engineering Quad.*

## New Lab Is Home to Students on Engineering Team Projects

The Engineering Student Projects Laboratory is the new home for the Interdisciplinary Design Program, managed by the Engineering Design Council. The 7,000-square foot facility was formally dedicated in March 2006 as part of the 86th Engineering Open House. Jiang (John) J. Wu, a junior in aerospace engineering, was recognized for helping name the building as part of a student contest.

The facility includes a showroom, space for team meetings, computer workstations, and clean and dirty workspaces. The Engineering Design Council, a group of representatives from each of the departments within the college, provided input on the floor plan of the building. The new structure is located on the engineering campus and is an addition to AE's Aerodynamics Laboratory facility already on the site.

## Aviation Week Award, *continued from page 1*

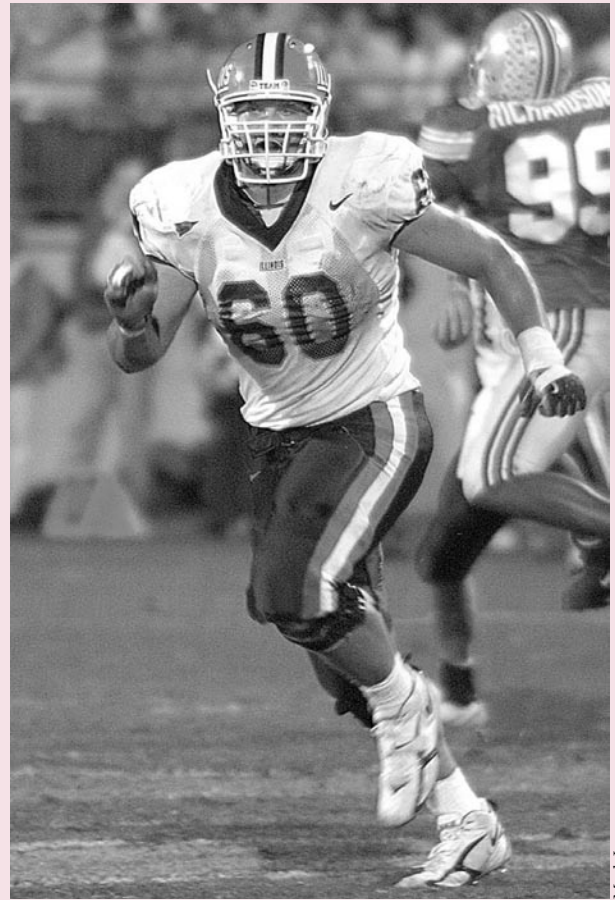
launch vehicle. The magazine reviewed over 300 federal programs before settling on the two finalists for the award.

Aerospace Engineering alumnus and former *Stardust* project manager **Kenneth Atkins** (PhD '74) was present to receive the award, together with NASA-JPL's current project manager, Tom Duxbury, and Joe Vellinga, *Stardust*'s program manager from Lockheed Martin Space Systems.

The award was presented on November 14 at a one-day workshop in Scottsdale, Arizona. The magazine had invited industry partners to participate in the workshop, "which focused on specific best practices from program leaders in managing technological complexity, managing and mitigating risk, and developing organizational capability controls," according to a NASA news release.



*From left to right: Ken Atkins, Tom Duxbury, and Joe Vellinga accepting the Aviation Week & Space Technology award.*



Mark Jones

**AE student combines science and football...** Aerospace Engineering isn't home only to future rocket and space scientists, it's also home to a player on Illinois' football team. Look out for Ryan McDonald, with jersey #60. McDonald is a sophomore, with three years of eligibility left. He is the starting center in 2006, following in the footsteps of his father, who played football from 1974 to 1976 when he attended Illinois. In 2005, the sophomore was the starting offensive right tackle.

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## Scott White, *continued from page 1*

gift for research in her will. Mrs. Willett died in 1993. In 1994 the College of Engineering established the Willett Research Initiatives Fund, the income from which has been used to support scholarships, fellowships, research awards, and other activities. In December 1998, three Willett Professorships were established under the auspices of the Willett Fund.

What brought Scott White to this point began several years ago. In 2001, his research on self-healing polymers grabbed the world's attention. White came up with the idea of autonomous materials, which can "heal" themselves when a crack or fault occurs within its structure. When damage occurs, microcapsules embedded in the material around the site rupture, releasing a healing agent and catalyst to reseal the defect. Groundbreaking as the research was, White soon realized that the supply of microcapsules in a material is limited. After they've been used up, what then? He next came up with the idea of a delivery system.

In a bookstore, he had discovered the writings of Adrian Bejan,



*Colleagues at the investiture included (L to R) Jeff Moore of Chemistry, Dean of the College of Engineering Ilesanmi Adesida, former White graduate student Daniel Therriault, White, AE Department Head Mike Bragg, and Nancy Sottos of Materials Science and Engineering.*

a professor of mechanical engineering at Duke University, who uses constructal theory to examine the natural world. "Adrian pays attention to the way nature fits things together and how natural networks grow. Following constructal theory, you end up with something very similar to natural

models. Just as the human body uses the circulatory system to deliver blood to all parts of the body, we can do the same for materials by designing microvascular networks." The Air Force Office of Scientific Research was so interested in White's ideas that it provided his team \$5 million for a 5-year MURI (multidisciplinary university research initiative) to further this research idea.

Eventually, it is hoped that these microvascular architectures would add other functionalities to materials: they will be able to heat or cool on demand, or self-diagnose and self-assess their state, for example. "Structural polymer-based materials are a very pervasive technology. In aerospace, the applications are relevant to structural composites, microelectronics, avionics, and other material systems.

"We're also developing self-healing elastomers for seals and potentially for tires (so they won't blow out). Circuit boards, cell phones, and pagers fail because



*Members of White's family who were present at the investiture included (L to R) daughter Audrey, son Evan, grandfather Charles Givens, grandmother Barbara Givens, and daughter Amy.*