University of Illinois
at Urbana-Champaign

Department of Aerospace Engineering
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Way to the Future

Stillwell Seminar Is Revived to Celebrate AE's 60th Anniversary

More than 100 years have passed since the Wright Brothers ushered in the era of heavier-than-air flight with their Flyer from the sand dunes at Kitty Hawk. Since then, dramatic changes have taken place in the field of aerospace engineering. These changes will require "nothing less" than a redefinition of the profession, according to Sheila Widnall, the former Secretary of the U.S. Air Force. This redefinition will have major implications for university curricula.

Widnall, currently an institute professor at the Massachusetts Institute of Technology, articulated this challenge to participants attending the Department of Aerospace Engineering's 60th anniversary celebration. She was delivering the Stillwell Memorial Seminar, which was revived to celebrate Aerospace Engineering's sixty years in teaching and research.

In aerospace education, what is needed is to organize a curriculum that will address these changes while capturing and shaping students' passion for aerospace. In her keynote speech, Widnall said that "our society desperately needs talented engineers who can invent, design, realize, explain, and remake the use of technology in our world." The

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Sheila Widnall.

Stardust Return Signals Success for Alumnus Project Manager

When *Stardust* landed on the salt flats of the Utah Test and Training Range on Sunday, January 15, 2006, Aerospace Engineering alumnus **Kenneth Atkins** (PhD '74) was a very happy man. "I've been involved for all of the flight phase as I have a major stake in the outcome. I would certainly have inherited any failure as the manager who did the development, launch, and first year of flight. Of course, now with the landing, the tough work is done!"

Atkins managed the project for this mission from June 1995 to June 2000. Today, he is a semi-retired member of the team at the Jet Propulsion Lab in California, working out of NASA's Project

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NASA/JPL–Caltech

A comet particle pierces the aluminum frame that holds the aerogel tiles. The debris from the impact shot into the adjacent aerogel tile, producing the explosion pattern of ejecta fragments captured in the material.

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From the Department Head

I am proud to be able to introduce a new faculty member, Ioannis Chasiotis, to you in this edition. We are very pleased that Ioannis has joined us, and he brings a robust research program in the exciting new area of nano materials. Ioannis adds a new dimension to an already world-class group in the department in the area of structures and materials.

Last spring, we celebrated the department's 60th anniversary with a one-and-a half day program on campus, with over 100 alumni, faculty, students, and friends in attendance. For those of you who were not able to join us then, I hope you will enjoy the article on the 60th. We all had a great time learning some of the history of the Engineering campus, looking forward to a bright future, and catching up with old friends as well as making new ones.

While writing this letter, I spoke to Ken Atkins (PhD '74 and Alumni Board member), who was a key part of the JPL management team of the NASA *Stardust* mission. What an amazing success! Surely this mission rivals any in complexity and potential impact on the scientific community and the broader public. Ken wanted me to thank his professors at Illinois for their part in his success and told me he made it a point to tell the interviewer when he was on the *Today Show* that he was an engineer with a degree from Illinois. Our congratulations to Ken, the *Stardust* team, and all those at NASA for a great mission. One of the best parts of being head is to get to know AE's successful alumni and feel at least partially responsible for their accomplishments. Read about Ken and *Stardust* in this edition. Also in this edition, enjoy reading about Preston Henne ('69), a senior vice president at Gulfstream Aerospace Corporation. Preston recently won the College's most prestigious award for alumni. Other recent alumni and student award winners are featured too.

This year has been an exciting one on campus, with the search for a new Engineering dean and the appointments of a new Chancellor and a new President. In the department, we continue to attract new faculty to add to our strength. I look forward to updating you in a future edition and as always, please drop us a note or e-mail to keep us informed of your activities and accomplishments. I am sure there are many more Illini successes to share and celebrate.

Best regards,

Mike Bragg

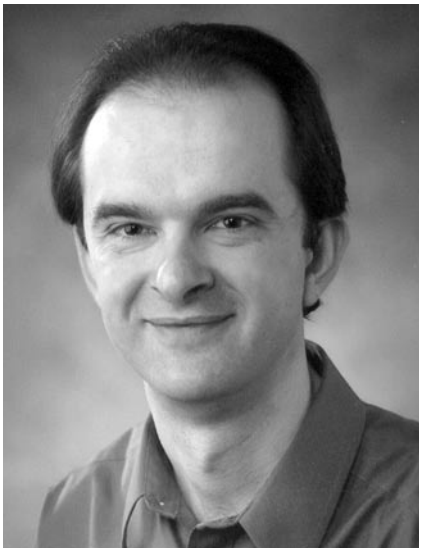
Visit us at our Web site: www.ae.uiuc.edu

Introducing Ioannis Chasiotis...

Ioannis "Yannis" Chasiotis spends his days studying the behavior of objects that aren't there. At least, they aren't "really there" for the naked eye to see. Use a high-magnification optical microscope, however, and one is introduced to perfectly machined and quite complex silicon micromachines that are 100 times finer than a strand of human hair. "These microstructures have been around for 15 to 20 years. Although they're extremely small, they're made in large numbers and with high precision," Chasiotis said. "They can be very good inertia and chemical detection sensors, as well as radio frequency devices. Their small size is advantageous for aerospace applications because they are lightweight and can be integrated with high redundancy." To be useful for unmanned aerial vehicles and pico-satellites, however, these micromachines must be reliable and durable.

Chasiotis is investigating the mechanical behavior of micro- and nanoelectromechanical systems (MEMS and NEMS for short). These are micromachines that are integrated with electronics and can be substitutes for many large and relatively heavy components such as accelerometers, gyroscopes, chemical sensors, and ultra-fast communication routers. "I'm investigating the way these nanostructures fail, their fatigue and fracture characteristics over long periods of operation, and how they can be made more durable. Because MEMS are so tiny, they usually accumulate millions of cycles of operation in a matter of hours, much faster than the macroscopic structures we are familiar with," he said.

The majority of his research work is experimental, performed in his labs both at Aerospace



Engineering and at the Beckman Institute for Advanced Science and Technology. Chasiotis joined the department in January 2005. He previously taught mechanical and aerospace engineering at the University of Virginia. "I am extremely pleased that we were able to attract someone of his talents and potential to the department," said AE Department Head Mike Bragg. "Prof. Chasiotis is a key addition to our departmental thrust in aerospace materials and to the larger college and campus efforts in nanotechnology."

Chasiotis said his research group studies "how individual 'building blocks' of large-scale, hierarchical structures behave mechanically and how they interact with the surrounding materials. For example, some of the structural elements in the nanocomposite materials we study in our lab are silica nanospheres that are only 15 to 100 nanometers in diameter. Including 1 to 2 percent of these nanospheres in a polymer epoxy improves its properties by as much as 10 percent. Similarly, in our lab we test individual nanofibers that are 500 to 1,000 times finer than a human hair. We use MEMS micromachines to mechanically test each of those nanofibers." The group also studies carbon nanofibers, which have been introduced to lightweight, multifunctional materials to improve their electrical and thermal conductivity, key qualities in air and space applications. "Carbon nanofibers added to an epoxy matrix allow conventional carbon fiber composites to be electrically conductive: more than 50 percent of Boeing's new 787 will be made with such composites. However, the minuscule size of nanofibers makes the study of their mechanical and bonding properties very challenging. It is too late to say anything about their individual properties once they have been integrated in a large-scale composite panel following many processing steps." At the nano scale, Chasiotis said, mechanics and chemistry become inseparable. Investigating the challenges arising from this convergence matches well with his academic background, which includes a degree in chemical engineering and a minor in materials science.

Investigating the failure and fatigue and other mechanical problems posed at the scale of microns provides Chasiotis with one major direction of his research. Determining what instrumentation and measurement methods to use is his second major research objective. "The big challenge is how to apply methods and techniques to study these micro- and nanostructures when they are barely visible even by an optical microscope. We are developing new experimental methods to detect failure in microscale structures while they are in operation," he said. "Traditional tools in mechanics (for example, optical microscopes) used to measure deformation and failure don't work. Instead, we use atomic force

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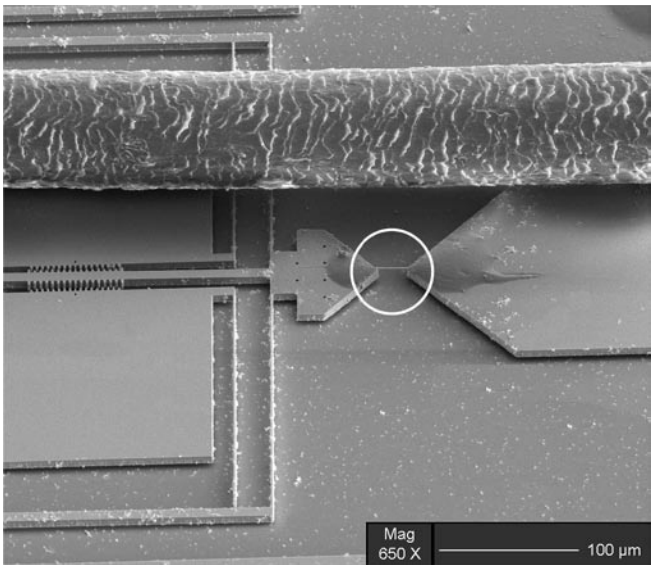
Chasiotis, *continued from page 3*

microscopes (AFM) with a thousand times better resolution than an optical microscope. Atomic force microscopes haven't been used before in mechanics." Chasiotis says that he is "probably one of only a handful of people in this country who perform this research."

Chasiotis has already begun collaborations with colleagues at Aerospace Engineering and in other departments. At Aerospace Engineering, he and John Lambros are investigating the durability and reliability of MEMS military and space sensors under high G or shock loads. "The reliability and durability of MEMS when shock loads occur is completely unexplored, and we know very little about how to design them to mitigate failure." At Beckman, Chasiotis is affiliated with the Advanced Chemical Systems research group of the Molecular and Electronic Nanostructures research initiative. Scott White and Philippe Geubelle, two other professors from Aerospace Engineering, are also in the same research group.

Chasiotis received his PhD and MS degrees in aeronautics, with a minor in materials science, from the California Institute of Technology (Caltech) in 2001 and 1998, respectively, and his Diploma (equivalent to a master's degree) in chemical engineering from the Aristotle University of Thessaloniki in Greece in 1996. In 2005, he and one of his students received a best research paper award at the 6th International Symposium on MEMS and Nanotechnology of the Society for Experimental Mechanics. In 2000, he received the Founder's Prize from the American Academy of Mechanics, and in 1999, the Charles D. Babcock Memorial Award from Caltech.



In Ioannis Chasiotis' lab, micromachines are used to mechanically test individual nanofibers. To provide a perspective on size, the larger fiber in the figure is a strand of hair; a nanofiber is shown in the circle.

To find out more about Chasiotis' research, go to ***www.ae.uiuc.edu/NMRL***

—Alison Fong Weingartner

AE Team Places Third in Space Design Competition

The Archimedes Project team won third place in the 2004-2005 undergraduate space design competition sponsored by the American Institute of Aeronautics and Astronautics Foundation. Teams were asked to design a space system that can rendezvous with an asteroid that is on a collision path with Earth. The objective was to remove the hazard by changing the asteroid's orbit or destroying it. The Archimedes team proposed four missions, each using nuclear standoff detonations to impulse the asteroid, thus removing the threat from Earth. Students on the team were Dawn Cole, Tyler Field, Gina Miller, Richard Page, Lyle Shipton, and Scott Tagge.

The project logo.

Team members on the Archimedes Project *(from L to R): Tyler Field (since graduated), Gina Miller (first-year graduate student in AE), Dawn Cole (working for Cessna), Scott Tagge (working for Schlumberger), Richard Page (first-year graduate student in AE), and Lyle Shipton (first-year graduate student in AE).*

Collegial Atmosphere Marks Annual Awards Ceremony in Aerospace Engineering's 60th Year

Astronaut **Steven Nagel** ('69) welcomed alumni, students and their families, and faculty to the Aerospace Engineering annual awards party, held this year at the Holiday Inn in Urbana. "Steve did a great job as emcee, despite his modesty ahead of time," said Department Head Mike Bragg. The awards ceremony was the culmination of a day-and-a-half celebration of the department's 60th birthday. Bragg remarked on how people knew very little of the engineering campus' early history. "Very few people knew that today's engineering campus was originally the university's arboretum. The engineering dean used to run O&M (Operations and Maintenance), and all the students helped out. Most of us didn't know that, even the long-timers." He said the department reconnected with many older alumni: "That was part of the intent of this celebration. A faculty member from another institution was very impressed by how collegial the atmosphere was." What follows are précis of the achievements of award recipients:

Advisory Board member Steve Nagel acted as the emcee during the awards ceremony.

Photos by Harry Zanotti and Thompson•McClellan

Distinguished Alumnus Award

P. Barry Butler ('79, MS '81) is Dean of the College of Engineering at The University of Iowa and Chairman of the Department of Mechanical and Industrial Engineering. He earned his doctorate in mechanical engineering from Illinois in 1984. His present research interests include ignition phenomena in energetic materials; real-gas thermochemical processes; reaction in supercritical water medium, and detonation of gas and condensed-phase media. He is an AIAA associate fellow and is associate editor for AIAA's *Journal of Propulsion and Power*.

P. Barry Butler shows his Distinguished Alumnus plaque, which Hilton presented to him.

Shirley Dyke ('91) holds the Edward C. Dicke Professorship in Civil Engineering at Washington University in St. Louis. She is also director of the University Consortium on Instructional Shake Tables (UCIST). In 1998, she received both the PECASE and CAREER awards from the National Science Foundation. Dyke is chair of the American Society of Civil Engineers' committee on structural control, an associate editor of the American Society of Mechanical Engineers' *Journal of Vibration and Acoustics*, and a director of the Automatic Controls Conference. She earned her PhD in civil engineering from the University of Notre Dame in 1996.

Larry Bergman presents the Distinguished Alumnus Award to Shirley Dyke, who is also an Advisory Board member.

Outstanding Recent Alumnus Award

Laura Bogusch ('95) is program manager for fuselage development for Boeing's 787 aircraft. Prof. Scott White, Bogusch's advisor for

Scott White recognizes Laura Bogusch with the Outstanding Recent Alumnus Award.