Education Innovation

Interactive Learning via Mission Planning

PURDUE **AERONAUTICS & ASTRONAUTICS**

ENGINEERING**IMPACT**

WINTER 2007-08

Think Like a Rocket Scientist!
Professor Jim Longuski Tells How

Channeling Amelia Earhart
Our Design, Build, and Fly Team

John Underwood

On My Mind

As the School of Aeronautics and Astronautics settles into its new campus home—the recently dedicated Neil Armstrong Hall of Engineering (see page 2)—educating tomorrow's engineers remains the heart and soul of our daily pursuits. As always, our faculty members share a common commitment to prepare students to be innovators and leaders in their future careers. One such professor, Kathleen Howell, makes learning a hands-on, experiential process.

Beginning on page 4, you'll read about Professor Howell's concerted efforts to involve students in the various facets of spacecraft mission planning, plus the resulting impact these activities have on some top AAE scholars. We also spotlight the talented student team that participated in the recent AIAA Design, Build, and Fly competition, another initiative that makes education a practical experience by taking it beyond the classroom. And proving that learning can be a lifelong process, our own Jim Longuski shares his unique insights on how anyone can think like a rocket scientist.

It's an exciting time to be a part of Purdue AAE. We thank you for partnering with us and encourage you to stop by Armstrong Hall the next time you're on campus.

Thomas N. Farris

Thomas N. Farris
Professor and Head
School of Aeronautics and Astronautics

Don't be a stranger. We want to hear from you!

Tell us what you think by sharing your Purdue memories or reacting to a story in this issue. We invite you to write to us via the contact information at right. In doing so, you grant us permission to publish your letter in part or in whole in an upcoming issue. We also reserve the right to edit letters for length and/or clarity.

Vincent Walter

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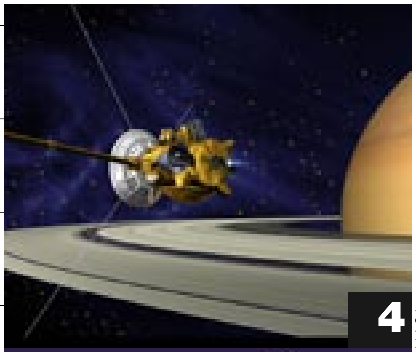


NASA

around aae

Seven Receive OAE Honors

The School of Aeronautics and Astronautics honored seven more alumni with the Outstanding Aerospace Engineer (OAE) award in October. Those selected have demonstrated career excellence in industry, academia, governmental service, or other endeavors reflecting the value of an aerospace engineering degree. This year's recipients included the following:

- **Nancy L.B. Anderson** (BSESc '61, MS '62), director of technical operations (retired), Hughes Space & Communications (now Boeing)
- **Thomas J. Beutner** (BSAAE '87), program manager, DARPA
- **Steven C. Drury** (MSAAE '89), director general of airlift and training systems, Defence Materiel Organisation (Australia)
- **Rune C. Eliasen** (BSAAE '77), vice president, product planning (retired), Ariba Inc.
- **Michael W. Hyer** (MSESc '66), N. Waldo Harrison Professor of Engineering Science and Mechanics, Virginia Tech
- **Andrew H. Kasowski** (BSAAE '72), vice president, product development, Cessna Aircraft Company
- **Miroslav A. Simo** (BSAE '61), president/founder, New Archery Products

continued on next page

John Underwood

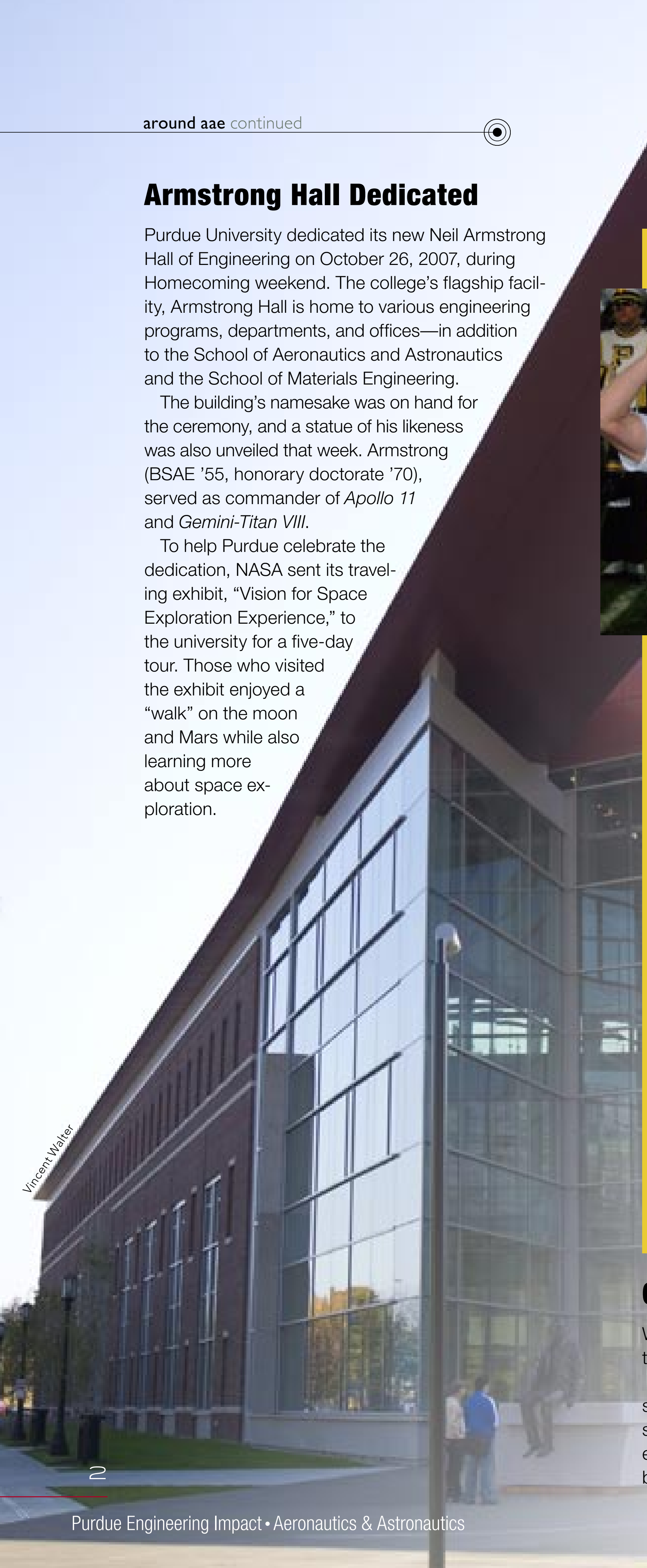
2007 OAE recipients (right to left): Michael Hyer, Miroslav Simo, Steven Drury, Andrew Kasowski, Nancy Anderson, Thomas Beutner, and Rune Eliasen.

Armstrong Hall Dedicated

Purdue University dedicated its new Neil Armstrong Hall of Engineering on October 26, 2007, during Homecoming weekend. The college's flagship facility, Armstrong Hall is home to various engineering programs, departments, and offices—in addition to the School of Aeronautics and Astronautics and the School of Materials Engineering.

The building's namesake was on hand for the ceremony, and a statue of his likeness was also unveiled that week. Armstrong (BSAE '55, honorary doctorate '70), served as commander of *Apollo 11* and *Gemini-Titan VIII*.

To help Purdue celebrate the dedication, NASA sent its traveling exhibit, "Vision for Space Exploration Experience," to the university for a five-day tour. Those who visited the exhibit enjoyed a "walk" on the moon and Mars while also learning more about space exploration.



Vincent Walter

Lunar Sample Lands at Purdue

David Umberger

Martha Chaffee (left) and President France Córdova during the presentation of the moon rock particle.

A piece of the moon has found a home at Purdue University, thanks to the widow of astronaut Roger Chaffee (BSAE '57). The sample will be on public display in Neil Armstrong Hall of Engineering.

Roger Chaffee was killed in a 1967 fire during training for NASA's first Apollo mission. Martha Chaffee, who was a student in Purdue's radio and television program in the 1950s, acquired the rock through NASA's Ambassadors of Exploration program. The program allows each astronaut or his or her survivor—from the Gemini, Apollo, and Mercury programs—the right to donate to the educational institution of his or her choice a piece of the 842 pounds of moon rocks and soil collected during six lunar missions. The sample housed at Purdue was collected during the 1972 *Apollo 17* mission commanded by Eugene Cernan (BSEE '56), the last astronaut to walk on the moon.

"I want to extend my gratitude to Martha Chaffee for her gracious and thoughtful gift and for choosing Purdue to display this piece of the moon," Purdue's president, France Córdova, says. "It will inspire our students and is a tribute to those who paved the way for us."

Qiao Joins AAE Faculty

We are pleased to welcome Li Qiao, the newest member of the Aeronautics and Astronautics faculty.

Qiao's research interests include combustion and propulsion (low and high speed), experimental flow dynamics, microscale power generation, alternative fuels, fire research, and environmental impact of combustion. She is a graduate of both Tsinghua University and the University of Michigan.

Think Like a Rocket Scientist!

Professor highlights key methods one can apply to any project at hand.

Jim Longuski, professor of aeronautics and astronautics, has written more than 180 conference and journal articles in the general area of astrodynamics, including such topics as spacecraft dynamics, mission design, space trajectory optimization, and a new test of Einstein's theory of general relativity. He has also worked with Buzz Aldrin on a human transportation system to Mars. Longuski's first book, *Advice to Rocket Scientists*, is subtitled, "A Career Survival Guide for Scientists and Engineers."

Let me tell you the first thing about rocket scientists: They are not in it for the money. They are in it for the fun. They are the biggest dreamers on Earth because they dream on a cosmic scale, and they love sci-fi movies and books. Sometimes, the dopier the movie, the more they like it.

That's why I start my book *The Seven Secrets of How to Think Like a Rocket Scientist* with Part I, "Dream." Dreaming about space travel is what makes rocket scientists tick. I end the book with Part VII, "Do," because the best part about rocket science is when those dreams come true. I think that the same is true for our graduates when they begin their careers. I give seven secrets of how to think like a rocket scientist, each an active verb: "Dream," "Judge," "Ask," "Check," "Simplify," "Optimize," and "Do."

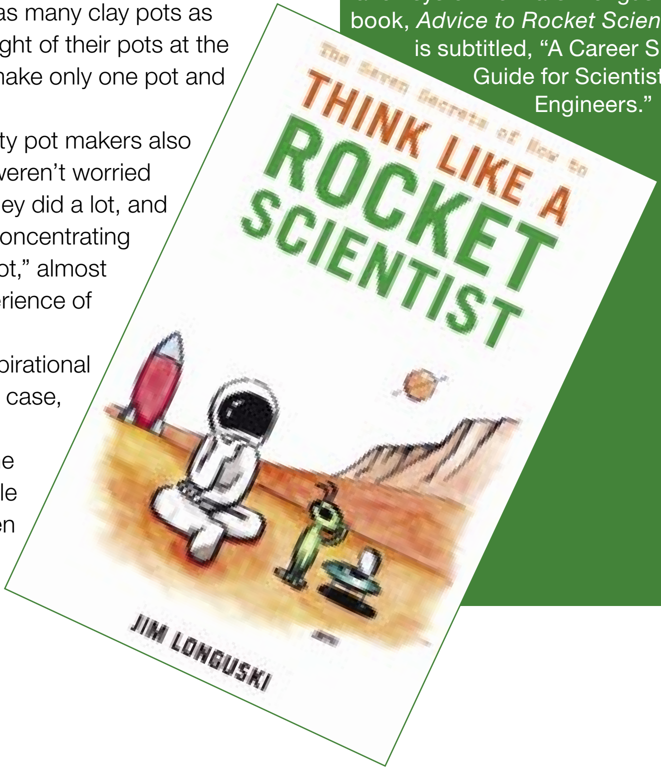
In my "Ask" section I urge the reader to "ask dumb questions." The only dumb question is the one that doesn't get asked. Consider the example of NASA's Mars Climate Orbiter, which disintegrated while entering the Martian atmosphere in 1999. During the planning of this mission, the dumb question that wasn't asked was, "Are these calculations in metric or the English system?" Later it was learned that some of the engineers used the metric system and others used the English system, and they interpreted the metric numbers as being English numbers, which ultimately doomed the spacecraft.

In the "Do" section I observe that no degree of planning can replace the value of experience. I demonstrate this point with a lesson I call "the parable of the pots," in which an art teacher divides a class into two halves. The students on one side of the class are told that they should make as many clay pots as possible and that they will be graded on the total weight of their pots at the end of the semester. The other students are told to make only one pot and that they will be graded on its quality.

At the end of the course it turns out that the quantity pot makers also made the highest-quality pots. Why? Because they weren't worried about perfection. They were worried about doing. They did a lot, and learned a lot. Meanwhile, those students who were concentrating on quality sat around theorizing about "the perfect pot," almost afraid to do anything, and so they didn't get the experience of doing.

In each section I try to capture the idea with an inspirational quote such as "Do. Or do not. There is no try." In this case, from Jedi Master Yoda, of *Star Wars* fame.

So now when I teach my classes I often write on the board, "NO DUMB QUESTIONS!" There's a noticeable hush from the students, but I usually get a laugh when I explain that, in my view, there's no such thing as a dumb question. ■ **Jim Longuski**

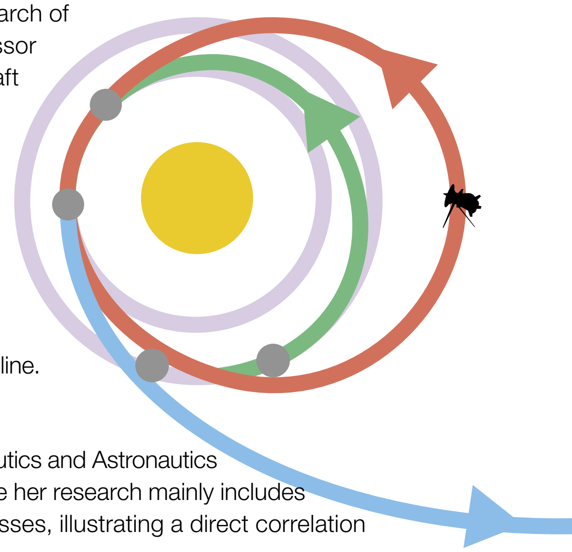


Todd Brown (foreground) and Chris Patterson reap the educational rewards that mission planning provides, working closely with Professor Kathleen Howell (right).

Photo by Vincent Walter

Mission: Education

Students reap the benefits of experiential learning, thanks to Kathleen Howell's passion for spacecraft mission planning.



What can we do that couldn't be done before? That underlying question drives the research of Kathleen Howell as she seeks capabilities that didn't previously exist. The Hsu Lo Professor of Aeronautical and Astronautical Engineering has amassed vast experience in spacecraft mission planning—a lifelong passion she shares with students via incomparable, hands-on learning opportunities.

In its broadest sense, mission planning includes everything one must accomplish in order to launch a spacecraft and complete the mission objectives established by the science community, NASA, or another entity. After initial goals are identified, one conducts initial feasibility analyses to determine if the mission is possible. This entails examining the trajectory (or path) the vehicle will follow, while also assessing—for example—the vehicle's launch capabilities, hardware, and control system. Over the course of the mission, further feasibility studies will likely prove necessary as additional systems come online.

Learning Beyond the Classroom

The detailed work that mission planning requires prepares students in the School of Aeronautics and Astronautics for cutting-edge careers. Howell is primarily involved with the robotic space program. While her research mainly includes graduate students, she does channel real-world experiences into her undergraduate classes, illustrating a direct correlation between material taught and research conducted.

"In my orbit mechanics class, to teach the fundamentals of the subject, we use the operational software that NASA uses for its missions," she notes. Through the software's applications, students can visualize how those fundamentals apply directly to spacecraft missions, that they're more than just "numbers on a page."

Graduate students study various types of research problems based on their interests, bringing an array of talents to the table. "Students come with different skills, goals, and views of the future," says Howell, who chairs the school's graduate study area in astrodynamics and space applications. "Some of them really like pondering what things might be possible in the future." By conducting fundamental research, for example, scholars involved in this first type of research may seek a greater understanding of the solar system and how a spacecraft might navigate through it. Or they may investigate the requirements for an infrastructure in the vicinity of the moon should humans one day live there.

At the opposite end of the spectrum, we find students aspiring to participate fully on a current mission team, a goal some graduates attain directly out of Purdue. This may require solving problems associated with an ongoing mission or spacecraft currently in flight or in preparation for launch. Such activity is usually fast-paced with a high demand for accuracy.

CONTINUED ON NEXT PAGE

Scholars in the middle sphere prefer working on proposals, seizing the opportunity to tackle something with a reasonable chance of success, even if they never participate on a funded mission. In reality, many proposals don't receive awards; yet the work involved generates a large number of new ideas, connecting students with NASA and industry to evaluate the viability of scientific suggestions. In fact, many current successes were seeded via studies for proposals that weren't selected.

For Chris Patterson, a PhD student working closely with Howell, AAE has provided a practical, experiential education. Hailing from Canada, Patterson studied space science as an undergraduate and has worked on various types of proposals and missions. When he became aware of space-related programs at U.S. schools, he was struck by the prospects and recalls thinking, *That looks awesome. I didn't think that was possible, so I definitely want to do that.*

At Purdue, Patterson sets his professional dreams in motion. "It's as close to actually working in industry as I think I could've gotten," he says. He recently applied his expertise by participating in a study supporting the *Cassini* mission (i.e., a spacecraft launched to Saturn in 1997). For this initiative, Purdue was tasked with determining options for the vehicle scenarios toward the mission's end.

Todd Brown, a master's student from Colorado who also works with Howell, has been examining resonant orbits in the Saturn system that could potentially be used for mission design or applications in orbital mechanics. An orbital resonance occurs when two orbit bodies (such as two moons of Saturn) possess orbital periods related by a ratio of integers. A resonance can also be created between a moon and a spacecraft.

"I first realized I was interested in orbital mechanics in a math class I took at my undergraduate school," Brown recalls. A calculus book he had read included a diagram of the Genesis trajectory, a path that intrigued Brown because it defied logic. He didn't know it at the time, but that particular trajectory fueling his imagination originated at Purdue.

"Being involved in these projects changes your perspective where suddenly it seems attainable and makes so much more sense," Brown says. While NASA's work may appear high-tech and remote to an outsider, contributing to mission initiatives gives Brown a rich understanding of how NASA approaches and accomplishes large-scale tasks.

Project Challenges and Complexities

Mission planning can pose many challenges, rendering problem-solving skills essential. Through their research, students learn that trajectories, with their broad influence, have become increasingly complex with detailed routes. "Now you don't just simply design a trajectory to go from here to there," Howell explains. In reality, the trajectory may appear "jagged" to incorporate the mission's multiple destinations and objectives. In interplanetary flight, it's almost always designed to use gravity assists as well, exploiting the gravity of another planet or moon to alter the trajectory without using fuel.

In time, the design teams face more complexities as additional systems come online during mission planning. A communications system, for example, will require a link back to Earth. Within the next few decades, missions will demand spacecraft trajectory concepts and efficient design tools for analysis and implementation. In preparation, current research focuses on spacecraft navigation and maneuver requirements in the neighborhood of Earth and in interplanetary space.

As AAE students immerse themselves in mission pursuits, they also learn to expect unforeseen circumstances to arise. “You always plan for the unexpected,” Howell says, noting a recent mission that suffered an onboard failure. In that situation, the NASA/industry team had to address hardware concerns, fuel limitations, and time constraints while ensuring the spacecraft could still reach its destination.

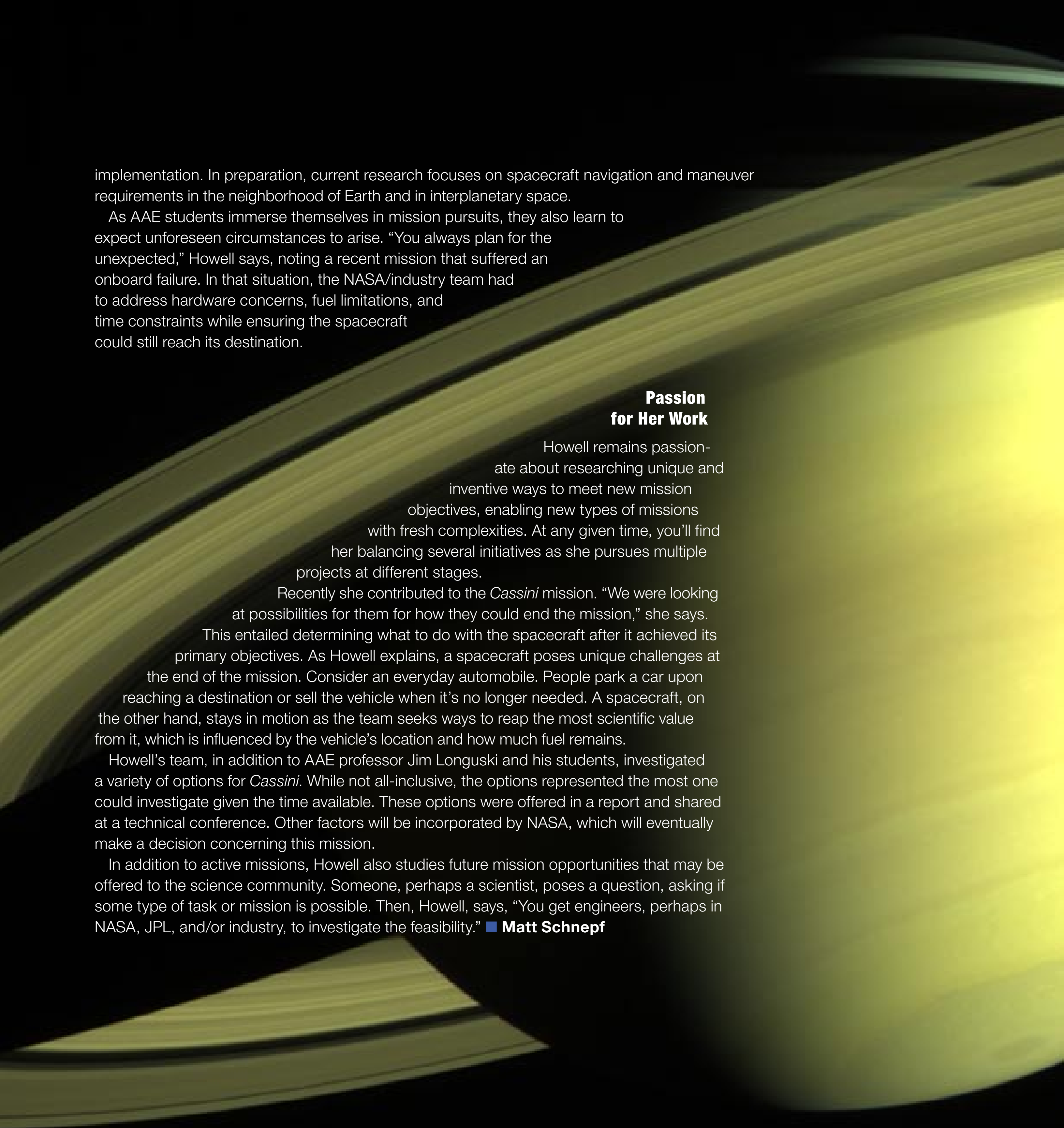
Passion for Her Work

Howell remains passionate about researching unique and inventive ways to meet new mission objectives, enabling new types of missions with fresh complexities. At any given time, you’ll find her balancing several initiatives as she pursues multiple projects at different stages.

Recently she contributed to the *Cassini* mission. “We were looking at possibilities for them for how they could end the mission,” she says. This entailed determining what to do with the spacecraft after it achieved its primary objectives. As Howell explains, a spacecraft poses unique challenges at the end of the mission. Consider an everyday automobile. People park a car upon reaching a destination or sell the vehicle when it’s no longer needed. A spacecraft, on the other hand, stays in motion as the team seeks ways to reap the most scientific value from it, which is influenced by the vehicle’s location and how much fuel remains.

Howell’s team, in addition to AAE professor Jim Longuski and his students, investigated a variety of options for *Cassini*. While not all-inclusive, the options represented the most one could investigate given the time available. These options were offered in a report and shared at a technical conference. Other factors will be incorporated by NASA, which will eventually make a decision concerning this mission.

In addition to active missions, Howell also studies future mission opportunities that may be offered to the science community. Someone, perhaps a scientist, poses a question, asking if some type of task or mission is possible. Then, Howell, says, “You get engineers, perhaps in NASA, JPL, and/or industry, to investigate the feasibility.” ■ **Matt Schnepf**



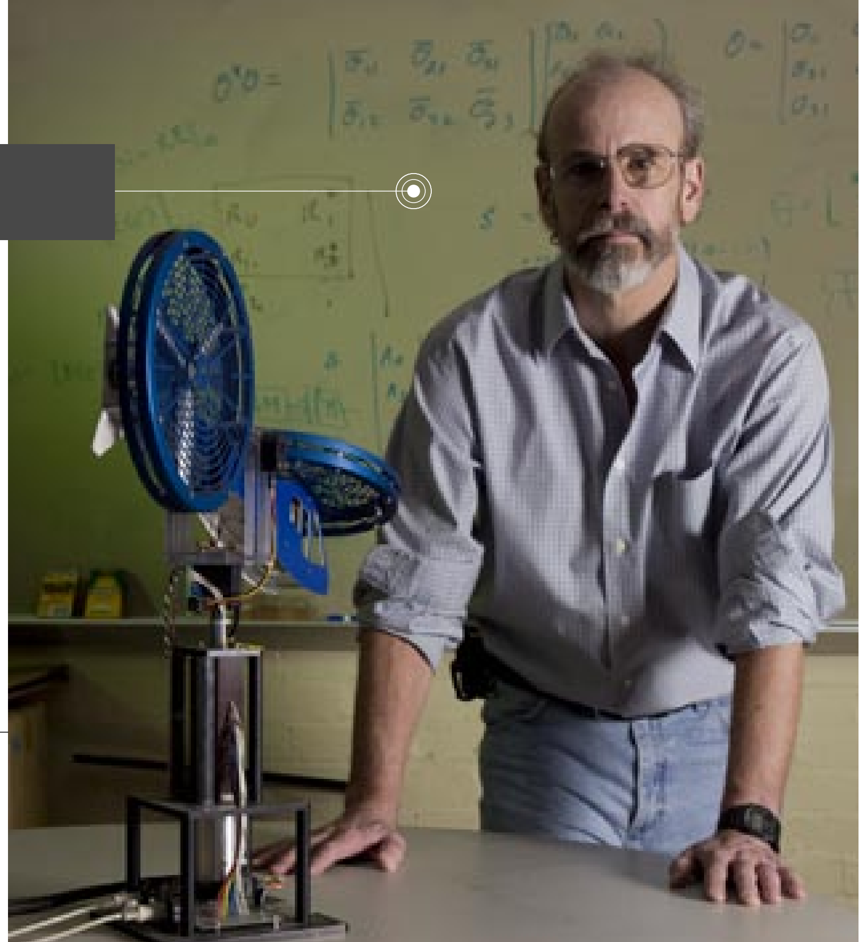
While on final approach for a close encounter with Saturn’s moon *Iapetus*, the *Cassini* spacecraft took in a sweeping view of the Saturn system. *Iapetus* is Saturn’s sole major moon with a significant inclination to its orbit. From this moon, Saturn’s rings usually appear at a tilt, shown here.

Photo courtesy of NASA

up close: faculty

Back to Basics

Arthur Frazho presents engineering fundamentals in a logical manner, gaining student interest and admiration along the way.



Vincent Walter

Arthur Frazho, professor of aeronautics and astronautics.

With students describing him as passionate, well-prepared, and talkative, a chalkboard his tool for slowing down his teaching, and daily bicycling or swimming his pastime, Arthur Frazho redefines on-the-go.

The professor of aeronautics and astronautics whirled onto Purdue University's campus in 1980, bringing three years' teaching experience at the University of Rochester and degrees from the University of Michigan in computer engineering, computer information, and control engineering.

His research focuses on control systems, signal processing, and operator theory. His books include *Linear Systems and Control: an Operator Perspective*, co-authored with Martin Corless. And he teaches signals and systems, modern control systems, and random processes and Kalman filtering.

"I like things that tend to be mathematical," he says. "You can always give the line that I became fascinated with aerospace due to the space program. There's some truth to it." But the real story is that his doctoral advisor and committee were in aerospace, so there was a bent toward that. "I am interested in aerospace and flight, but I'm more into controls," he says.

Frazho grew up in the Detroit suburbs, his father an engineer, his mother a homemaker. "They wanted me to get a serious engineering, science, or medicine education," he recalls. "My brain likes figuring things out, so I'm attracted to the hard sciences. I like to spend time looking for fundamental ideas."

He's also drawn to teaching. "I really like the kids. They're fantastic. I like sitting around with them, talking to them, teaching them. I like putting the material together in a logical way so the students can understand it."

That's appreciated, says graduate student Jimmy Bhosri. "He spends a lot of effort and time preparing his class materials. His notes are well-written."

Frazho describes his classroom style as being outside the norm. "I use the chalkboard, and I do examples in MATLAB, a numerical analysis program," he says. "I'm old-fashioned. I use the chalkboard because I don't like flapping notes in front of the students at a high rate of operation, and the chalkboard slows me down and allows me to do examples."

"No matter how much you love equations, paying attention in a math class uninterruptedly is not an easy task," says graduate student Carlos Lana. "Professor Frazho has a unique teaching style, which helps retain the student's interest and attention. If I had to choose three words to describe his style, they would be passion, dynamics, and participation."

"He cares a lot about what I learn," Bhosri says. "He teaches the fundamentals and how they are connected to other things, to give you a bigger perspective. He's a real master. Academically, he's superb."

For about the last 13 or 14 years, Frazho has spent summers in Amsterdam, working with the same colleagues at Vrije Universiteit. "I'm less of a workaholic as I get older," he suggests. He also enjoys reading some history and material about markets and economics. ■ **Kathy Mayer**

Education in Flight

Students put their skills to the test through the AIAA Design, Build, and Fly competition.

What do you get when you put 10 Aeronautics and Astronautics students in an airplane hangar late at night? The ghost of Amelia Earhart and a winning aircraft design.

Earhart was encountered by the students who comprised Purdue's team at the 2007 AIAA Design, Build, and Fly competition. Maybe it was the haze borne of late-night hours that became the norm as the project deadline neared. Or maybe the unexplained radio frequencies and footsteps on the catwalks actually were the ghost of Earhart, whose plane was kept in a nearby hangar during her days as a Purdue instructor.

All joking aside, the students' yearlong effort for the competition, sponsored by the American Institute of Aeronautics and Astronautics (AIAA), is serious business. The project, which can be taken as credit through AAE 490, is a competition in which undergraduate and graduate students from universities around the world design, build, and fly an unmanned, electric-powered, radio-controlled aircraft that meets a required mission. This year's assignment was to create an airplane that would fit in a 2 x 4 x 1.5-foot shipping container, be quickly deployable, and fly a simulated Air Sampler System task and a simulated Surveillance System task.

The long road to getting the aircraft into flight begins in fall, when team members—under the direction of AAE professor John Sullivan—begin to develop initial aircraft. Models then endure wind tunnel and flight tests, followed by advanced design methods such as computational flow dynamics and finite element analyses. The process can take up to 80 hours of work a week, teaches teamwork and problem solving, and introduces real-life situations and areas—like computational fluid dynamics—not always found at the undergraduate level.

The competition's rigors don't scare Aaron Wypyszynski, who hopes to own an aviation design company and has been involved with the team since it started at Purdue in 2004. Wypyszynski, who this fall began graduate studies in AAE, calls the experience the highlight of his college career.

"It took all those lessons from class and applied them to an actual problem. It taught true teamwork and created a network of friends working in aerospace that stretches from coast to coast. Most of all, it has shown me what it takes to be successful at designing an airplane and all the challenges that are faced along the way," says Wypyszynski, who has been team leader and pilot the last two years.

For Kyle Noth, who worked on the project's performance analysis and aerodynamic design portion, the experience helped define his career goals. "Before the project, I was not sure what exactly I wanted to do career wise. After the project, I have become set on pursuing a career in theoretical and experimental aerodynamics," Noth says. "The project introduced me to computational fluid dynamics and wind tunnel testing—both of which, I have found, fascinate me."

The team's aircraft, a lifting body design with a wingspan of 22.75 inches, ultimately placed third out of 49 universities worldwide. Not bad for the craft lovingly named *The Spirit of Amelia*.

Linda Thomas Terhune

Students who participated in the AIAA competition spent a year preparing for the event.

Learning Beyond Observation

This engineering professor makes learning an active, hands-on process—not a mere passive exchange.

Panagiotis Tsiotras (MS, Mathematics ’92; PhD ’93) stresses to his students that engineering is not a spectator sport. “One cannot become a good engineer, let alone an aerospace engineer—a ‘rocket scientist’—if he or she is not willing to study hard and solve many, many problems,” he says. “It is not enough to observe the professor in the class solving problems—the same way it is not possible to become a piano player by watching a symphony, or to become a top-notch basketball player by endlessly watching games on ESPN.”

The Georgia Tech professor of aerospace engineering advocates problem solving and teaching by example, which requires guiding students to the answers instead of providing the answers outright. “This is the well-known Socratic method of teaching, which I am a firm believer in,” Tsiotras states.

While a student himself in Purdue’s School of Aeronautics and Astronautics he appreciated the theoretical bent of the faculty and the support of his PhD academic advisor, Jim Longuski. He notes Longuski’s relaxed attitude, his guidance in navigating the post-graduation job market, and the freedom provided to explore one’s areas of interest.

Besides teaching future engineers, Tsiotras also directs Georgia Tech’s Dynamics and Control Systems Laboratory (DCSL), which was established using financial support he received from his National Science Foundation CAREER award. DCSL provides an intellectual “hub” for students interested in the dynamics and control of aerospace and mechanical systems. In addition to grad students, undergrads also contribute to the lab’s activities, earning academic credit (and often receiving compensation) for their efforts.

“This is part of an institute-wide initiative to have more undergrad students involved with research early on,” Tsiotras says—a prime example of how he actively involves students in the education process, preparing them for long-term success.

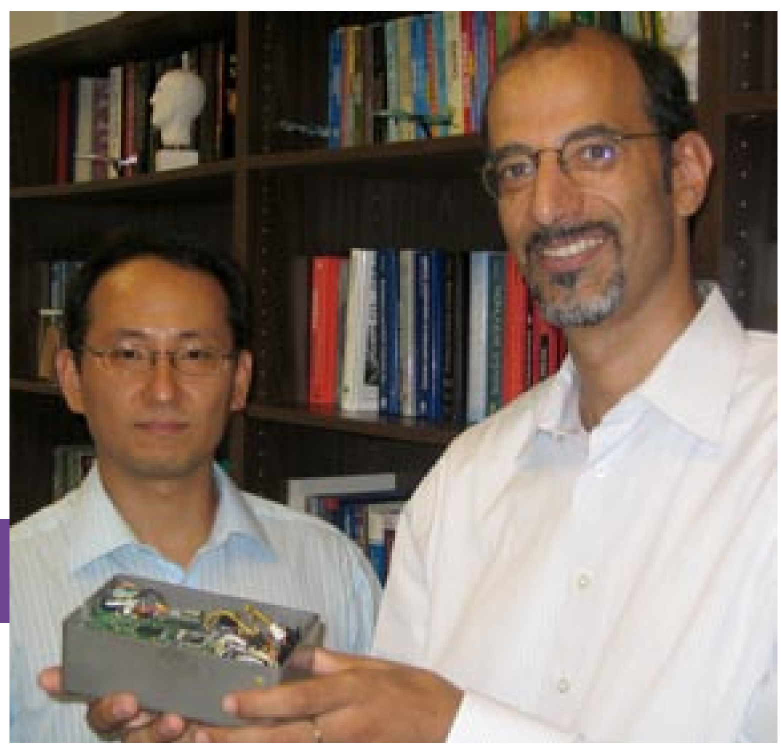
Looking to his field’s future, Tsiotras believes the United States will face increasing challenges when it comes to attracting and retaining graduate students. “The U.S. model of higher education has been very successful and is being copied around the world,” he notes, adding that a large number of engineering grad students come from nations abroad, like India and China.

“Both of these countries are revamping their graduate programs and have declared the establishment of research-oriented institutions with large graduate programs. The Europeans have recently declared similar courses of action,” he states, explaining how such trends could entice students to study engineering closer to home.

Thanks to engineering’s heightened globalization, students must also prepare to compete and collaborate with engineers worldwide. “The growth of the Internet has made it very easy for engineers to collaborate across the globe,” he says. “Companies are more likely to outsource or subcontract large parts of the engineering design and manufacturing to other companies these days.”

Thus, Tsiotras stresses, engineers must become comfortable working in multidisciplinary, multinational teams while remaining sensitive to intercultural practices and ethics. And amid such changes, hands-on problem solving will remain paramount to their success.

■ **Matt Schnepf**



Panagiotis Tsiotras (right) and one of his students, pictured with an autopilot they developed in their lab.

Photo courtesy of Panagiotis Tsiotras

Vincent Walter

Christine Troy (left) and Brittany Waletzko.

Sweet Reward

Financial assistance helps AAE students at all stages of the academic game.

For some students, financial awards—scholarships, assistantships, or fellowships—prove instrumental toward influencing their college choice. For senior Christine Troy and junior Brittany Waletzko, however, their decision to attend Purdue was solidified before they received financial assistance. Their scholarships, which were not awarded until their later years here, served as icing on the cake.

"I didn't receive my scholarship until my junior year so it did not influence my decision to attend Purdue," explains Troy. "I had just always wanted to go to Purdue, since both my parents are alumni. I can remember as a young girl being particularly interested in space. My father had a small telescope, and we would use it to look at the moon and see Saturn's rings. Astronautical engineering was a perfect fit, and Purdue's program is the best."

Upon arriving at Purdue, Troy joined the Cooperative Education Program (Co-Op), a five-year professional development experience where students alternate sessions of fulltime work with sessions of fulltime study. Through this program Troy received the Mark Weaver Memorial Scholarship presented to an AAE co-op student with outstanding academic achievement. The scholarship was established in 2003 to honor Weaver (BSAAE '94, MS '95), who also participated in the program during his time at Purdue.

According to Troy, "One of the best parts of the scholarship was the opportunity to meet his parents, Rick and Rita Weaver. They are both kind and encouraging, and we have kept in touch as I go back and forth between co-oping and school. It was really an honor to be chosen as the recipient."

Becoming an astronaut was a longtime goal for Waletzko. "But as I grew up, I became more dedicated to designing equipment that could help people explore our universe. My parents have always been really supportive of me and used to let me experiment with and build new things. Ever since then I knew I wanted to be an astronautical engineer," she says.

Waletzko came to Purdue to pursue her dreams of becoming an engineer although it wasn't until halfway through her college tenure that she received the Swain Schimmel Scholarship. Funded by David O. Swain (BSAE '64, honorary doctorate '01) and his wife, Linda Schimmel Swain, the scholarship awards full tuition and fees to four Indiana residents studying in the School of Aeronautics and Astronautics.

"My parents are both really proud of me and think it's absolutely wonderful," she says. "The fact that I'm getting a college education without having to start my professional career with a large amount of debt makes us all extremely grateful."

Waletzko is seeing immediate benefits as well. "It really makes studying easier. Instead of worrying about working more hours to pay for [my education], I can really focus on my schoolwork. It motivates you to do even better, and it makes you a more responsible student." ■ **Kristen Senior**

Financial awards aid students on the road to an engineering degree. To learn how you can support scholars in the School of Aeronautics and Astronautics, please contact Nathan Wight, director of development, at (765) 494-9124 or nwight@purdue.edu.

aperture

This is an image of a quantum dot produced by a simulation using the nanoHUB, a Web site created by the Purdue-based Network for Computational Nanotechnology. NanoHUB is used by more than 3,000 national and international researchers and educators each month. This image shows the computed second excited electron state of a quantum dot nanodevice in which electrons resonate and emit pure bright light. Quantum dots are the basis of the new, energy-efficient, long-lasting, ultrabright light-emitting diodes (LEDs) that are becoming widely used in highway traffic signals.