HAVE YOU SEEN ME LATELY?

CONCUSSION CONTROL
Collaborative breakthroughs

PURDUE’S NEW SPACEMAN
Astronaut Scott Tingle

OUR ALL-AMERICAN
Volleyball’s Ariel Turner
I ARRIVED AT PURDUE ON JANUARY 7, 1981. If you got here by quarter to eight in the morning, you could park right outside the Mechanical Engineering Building.

BACK THEN, THE FACULTY WAS MUCH MORE FOCUSED ON MECHANICAL ENGINEERING ALONE. There was very little collaboration across campus. Nowadays, the research is significantly interdisciplinary. Researchers are able to address bigger problems through collaboration across disciplines.

THE NATURE OF PROBLEMS HAS CHANGED. There was no micro- or nano-research in those early days. There was some biomedical engineering, but not much. Now, it’s all over campus.

WE’RE TRANSLATING THE DISCOVERIES IN THE LAB TO PRACTICAL PROJECTS MORE QUICKLY. It’s not just about research that gets into a publication, or graduating students that are ready to go out into the world.

THE INTERACTIONS ACROSS CAMPUS WITH DISCIPLINES SUCH AS BIOLOGY, PHYSICS AND PSYCHOLOGY HAVE GROWN SIGNIFICANTLY. That means researchers have to learn about those other areas so that they can speak intelligently about them.

STUDENTS ARE STILL OUR PRODUCTS, but things like intellectual property have become equally important. That has helped decrease the boundaries between engineering and science, as well as between industrial and university research.

THE NEW GATEWOOD WING has created space to further education and research. Faculty like Eric Nauman (see story on page 8), who works in biomechanics, have more room to do their work in suitably structured spaces.

THERE HAS BEEN A TREMENDOUS RECOGNITION OF THE IMPORTANCE OF A FLEXIBLE UNDERGRADUATE CURRICULUM. Students are being prepared for varied professional opportunities and career paths, life-long learning abilities, entrepreneurship and even undergraduate research.

THE SCHOOL’S DIVERSITY OF THE STUDENT BODY AND FACULTY HAS ALSO CHANGED significantly over the last 30 years. The number of educational options available has also undergone a sea change.

I CAN’T SAY WHERE THE WORLD IS GOING TO BE IN 2020, but we want to continue to recruit the best faculty and give them the freedom to do what they do best. Whatever they do, they should do it in a way that credits Purdue. If their reputation grows, so does that of our school and Purdue.

ALUMNI SEEM TO REMEMBER THEIR PROFESSORS MOST FROM THEIR COLLEGE DAYS. They always ask about two or three professors they had as students who took interest in them, who had impact on career choices and even on staying in engineering. The alumni I meet are very gracious and want to see Purdue do well. It’s a fun job.

FINALLY, we are reinitiating Mechanical Engineering Impact magazine. We hope that regularly produced issues will keep you informed about our campus activities. We welcome your feedback on the articles along with any questions you have about the school. Please keep in touch.

ANIL BAJAJ
William E. and Florence E. Perry Head and Alpha P. Jamison Professor of the School of Mechanical Engineering.
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Researchers have learned how to improve the performance of sensors that use tiny vibrating "microcantilevers," like the one pictured here, to detect chemical and biological agents for applications from national security to food processing. (Vijay Kumar, Birck Nanotechnology Center)

**INNOVATION PROMISES EXPANDED ROLES FOR MICROSENSORS**

Research by Jeffrey Rhoads, professor, and George Chiu, professor, has led to improvements in the performance of sensors that use tiny vibrating microcantilevers to detect chemical and biological agents for applications from national security to food processing.

The microcantilevers — slivers of silicon shaped like small diving boards — vibrate at their natural, or “resonant,” frequency. Analyzing the frequency change when a particle lands on the microcantilever reveals the particle’s presence and potentially its mass and composition.

The sensors are now used to research fundamental scientific questions. However, recent advances may allow for reliable sensing with portable devices, opening up a range of potential applications, says Rhoads.

Creating smaller sensors has been complicated by the fact that measuring the change in frequency does not work as well when the sensors are reduced in size. The researchers showed how to sidestep this obstacle by measuring amplitude, or how far the diving board moves, instead of frequency.

“When you try to shrink these systems, the old way of measuring does not work as well,” Rhoads says. “We’ve made the signal processing part easier, enabling small-scale, lower-power sensors, which are more reliable and have the potential for higher sensitivities.”

The work is based at the Dynamic Analysis of Micro- and Nanosystems Laboratory at Purdue’s Birck Nanotechnology Center.

- E. Dan Hirleman, John Sanderson, Gordon Chavers and Laura Edwards

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**IN MEMORY OF FLORENCE E. PERRY**

A longtime friend of the School of Mechanical Engineering, Florence E. Perry, passed away on December 10, 2011. Along with her husband, William E. Perry, she created a strong legacy within the school through philanthropy. After supporting several research initiatives, the Perry’s decided that lending their name and financial support to the William E. and Florence E. Perry endowment for the head of the school could have the most impact. That support allows our school’s head to respond quickly to changing times and the needs of the school. And the name Florence E. Perry continues to resonate as a legacy of support to our school.

- E. Dan Hirleman, John Sanderson, Gordon Chavers and Laura Edwards

- Emil Venere, Purdue News Service
ECO-FRIENDLY CARS HELP DRIVE MECHANICAL ENGINEERING INNOVATION

Two different car competitions are showcasing students’ responsiveness to the environment alongside their engineering knowhow. In April, the Purdue Solar Racing team won first place in the Solar Power Energy Urban Concept category at the Shell Eco-marathon America in Houston. The Celeritas, designed and built entirely by students, achieved an efficiency equivalent to 2,175 miles per gallon. They also took home a Communications Award.

About 50 undergraduate students (from a variety of disciplines) are involved in the project in teams focusing on the car’s carbon-fiber body; the propulsion, braking and suspension systems; as well as critical business, marketing and fundraising functions. Galen King, professor of mechanical engineering, and John Nyenhuis, professor of electrical and computer engineering, advise the team.

Also in the spring, a group of Purdue engineering and technology students began work on a 2013 Chevrolet Malibu as part of an international competition designed to reduce the environmental impact of passenger vehicles.

The effort is part of EcoCAR2, a program established by the U.S. Department of Energy and General Motors, which allows students to achieve the contest’s mission by designing and implementing hybrid-electric power train technology on a 2013 Chevrolet Malibu. Purdue is scheduled to receive its vehicle this summer, as participating schools in EcoCAR2 will receive the first 15 automobiles off the assembly line.

“Students get a perspective on what it takes to build a real-life car,” says Peter Meckl, professor of mechanical engineering who oversees work in power train controls and diagnostics. “Often times in academia we’re forced to the bare bones minimum. This has all of the complexities of real-life design. They’re going to be able to see their accomplishments.”

PATENT PENDING ON STUDENTS’ ‘WAH’ PEDAL DEVICE

Electric guitar players soon may be free to walk anywhere on stage during a performance or rehearsal and still activate “wah” pedal-type distortion effects by using technology created by eight mechanical engineering students. And because of their work with the Purdue Research Foundation and its Office of Technology and Commercialization, this rock and roll enabler could soon reach the marketplace.

For their senior project, students from the School of Mechanical Engineering developed the Ghost Pedal, a wireless device that uses sensors attached to the guitar player’s foot to create the distortion effect. The conventional wah pedal alters the tone of an electric guitar to create a distinctive effect that mimics the human voice.

The Ghost Pedal team consisted of Garrett Baker, Will Black, Matthew Boyle, Brett Hartnegal, Christine Labelle, Adam Pflugshaupt, Nick Sannella and Robbie Hoye. The students graduated from Purdue in 2011 with bachelor’s degrees.

Hoye says traditional wah pedals limit where guitarists can perform during a concert due to demands of the music.

“During a performance, the guitarist uses and changes audio distortions by stepping on pedals. While vocalists and other band members can move around the stage to interact with the audience and each other, the guitarist is often restricted to the space around the pedals,” he says. “Because Ghost Pedal is wireless and does not have a physical pedal, guitar players can activate and use their wah distortion effect anywhere on stage at any time. They also have the ability to deactivate the effect whenever they choose.”

MEMBERS OF PURDUE SOLAR RACING SHOW THEIR CREATIONS, CELERITAS, LEFT, AND PULSAR. (PHOTO BY ANDREW HANCOCK)
HAVE YOU SEEN ME LATELY?

Facility expansions propel undergraduate education, graduate research

WILLIAM MEINERS
As students and faculty moved into Gatewood in fall 2011, construction started on the first phase of the Ray W. Herrick Laboratories project to rebuild and expand the historic laboratories. The capabilities embedded in this new building will enable industry-transformative research and further strengthen the labs’ longtime relationships with industry.

There’s no downplaying the importance of developing fundamental engineering concepts for young students. From thermodynamics to mechanical designs, the education that takes place in mechanical engineering classrooms can forever influence the day-to-day practices of future careers. The ability to put concepts into practice, however, not only prepares students for the working world, but also better positions them for places within it.

The Gatewood Wing may be easing that transition from higher learning to the workplace. With the addition of a 120-seat classroom, teaching labs, instructional space, breakout spaces for the Product Engineering and Realization Lab (PEARL) and more, this new space better mimics an industrial setting. Conference rooms complete with state-of-the-art communication devices even replicate the boardroom.

Mechanical engineering students begin design classes in their sophomore year and pass through PEARL as seniors. And none of them will graduate without taking ME 463, the senior design class, which now accounts for about 280-300 students per year. Teams work on design projects, taking them from calculations through working prototypes in this capstone course.

John Starkey, associate professor of mechanical engineering, is charged with matching projects with student teams, typically made up of three to six seniors. Professors can suggest projects, and Starkey interfaces with companies that might have a research and development project they're willing to turn over to students. He also advises teams with their own ideas on scheduling and logistic concerns.

If you haven’t been to campus in the last dozen years, you may not recognize Purdue. Brick and mortar expansions have changed the academic landscape from Neil Armstrong Hall of Engineering on the north end to the various Discovery Park facilities on the south side. The School of Mechanical Engineering is in on it, too. And the renovations are overhauling undergraduate education and ramping up graduate research.

Last year, the $34.5 million Roger B. Gatewood Wing of the Mechanical Engineering Building added 41,000 square feet of flexible classroom space, student commons, computer labs, and student learning and research labs. Purdue’s first LEED (Leadership in Energy and Environmental Design)-certified building, the Gatewood Wing (gold certified) was built to be green. Designed to increase energy savings, improve water efficiency, reduce carbon dioxide emissions, improve indoor environmental quality and be ever mindful of its impact, the building itself stands for long-term sustainability.
ME 463 allows students to incorporate the concepts of their earlier courses. “They’ve had all these classes where they’ve learned fundamentals,” Starkey says. “Having learned machine design, for example, now what happens when you’re designing a power assist for a stroller?”

Companies have often sought out senior design teams at Purdue, not only for the research discovery potential, but also as an employee recruiting tool. A Wisconsin company that makes sand castings wanted a machine that could automatically transfer the molds into the pouring facility. Another sponsored project focused on waste heat recovery from a small two-stroke engine. And a South Bend company was looking for design concepts for a fast friction welding machine.

The real-world experience may test the comfort zones of undergraduates. “It happens while they have to work and get along with others,” says Starkey, who believes students typically gain more confidence in their ability to make the leap from concept to design throughout the semester.

The specialized space in Gatewood alone is helping to further education and research in the School of Mechanical Engineering. Two applied optics laboratories, a micro/nanoscale research laboratory, a flame diagnostics laboratory and a computational biomechanics laboratory offer students cutting-edge capabilities on the lower level. A rapid prototype lab, a prototyping and assembly lab and a collaboration room enable hands-on teamwork on the first floor. And the conceptual/design research center (see sidebar), two experimental research labs and a multiscale simulations lab keep things cooking on the third floor.

Though the undergrads coming along now may not know the challenges of past senior projects, they’re not likely to be taking engine parts back to apartments to work on, or finding work space on the loading docks behind the school. And if form has meshed well with function, the brand new digs of the Gatewood Wing could be a shining example of such efficiency.
still hanging around. They’re learning from graduate students and seeing what they can do to take their product (a prized secret now for propriety reasons) to the market. The graduate students serve as coaches to the younger students, and Ramani is just down the hall.

Engineering is analysis and design, Ramani says. “But design is the driver. It’s the core part of our philosophy.”

A philosophy that could pay dividends. “We cannot rely solely on manufacturing. The U.S. innovation economy need entrepreneurial thinking to create high-value jobs,” Ramani says. “Apple has shown that. It’s all about design thinking.”

Ultimately, design is engineering at its most creative. “It’s shaping something that hasn’t been there before,” Ramani says. “The problem is we don’t have too many of those dreamers. How do you teach someone to imagine and create the future?”

Maybe it starts with a notepad, a discussion on the couch and a couple of cups of coffee.

INNOVATION BY DESIGN

It’s a mid-winter Tuesday. On the third floor of the new Gatewood Wing, a group of graduate students is immersed in a lively debate inside the conceptual/design research center. Product sketches and geometric renderings are scrawled on the walls behind them. They’re talking potential design flaws alongside marketing concepts. And they just might be on to a new way of engineering thinking.

“How can we change how engineers design in the future?” poses Karthik Ramani, the Donald W. Feddersen Professor of Mechanical Engineering. “We want people to be able to externalize their ideas at the speed of thinking, especially in visual thinking.”

For Ramani, design is a social process. The environment of the lab reflects the philosophy. Couches up front allow for informal discussions and creative brainstorming. Laptops, big screens, the white boards for dashing out wall thoughts all contribute to a space designed to spark design.

Two young graduates, Matt Parker and You Wu, who won December’s Thomas J. & Sandra H. Malott Innovation Awards are still hanging around. They’re learning from graduate students and seeing what they can do to take their product (a prized secret now for propriety reasons) to the market. The graduate students serve as coaches to the younger students, and Ramani is just down the hall.

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Maybe it starts with a notepad, a discussion on the couch and a couple of cups of coffee.
A high school football player may take anywhere from 200 to 1,800 hits to the head during the course of a single season. Now Eric Nauman, Thomas Talavage and Larry Leverenz are leading a team of researchers who are asking whether these impacts might impair the brain, even if a player shows no clinical signs of a concussion. Findings could aid efforts to develop safety guidelines that stipulate the number of hits a high school player should receive and may help determine techniques that coaches and players might use to reduce the severity of blows to the head. The work has also led to the development of new shock-absorbing materials for football helmets.

“The most important implication of our findings is the suggestion that a concussion is not just the result of a single blow, but it’s really the totality of blows that took place over the season,” says Nauman, associate professor of mechanical engineering and an expert in central nervous system and musculoskeletal trauma. “The one hit that brought on the concussion is arguably the straw that broke the camel’s back.”

The researchers studied football players for two seasons at Jefferson High School in Lafayette, Ind., where 21 players completed the study the first season and 24 the second season, including 16 repeating players.

“Over the two seasons we had six concussed players, but 17 of the players showed brain changes even though they did not have concussions,” says Talavage, an expert in functional neuroimaging and co-director of the Purdue MRI Facility.

Learning more about the effects of head impacts might be especially important in young people, because the brain is still developing. Even though subtle damage doesn’t manifest as a concussion, it could affect the brain later in life.
The researchers have evaluated players using helmet sensors and a type of brain-scanning technology called functional magnetic resonance imaging, or fMRI, along with neurocognitive screening tests. The fMRI scans reveal which parts of the brain are most active during specific tasks that the players perform.

The scans are revealing changes in mental processes among many players who do not show clinical signs of concussion, Talavage says.

“The changes in brain activity we are observing suggest that a player is using a different strategy to perform a mental task, and that is likely because functional capacity is reduced,” he says. “Overall performance doesn’t change, but brain activity changes, showing that certain areas are no longer being recruited to perform a task.”

The findings represent a dilemma because they suggest athletes may suffer a form of injury that is difficult to diagnose.

“Clinicians would say that if you don’t have any concussion symptoms you have no problems. However, we are finding that there is actually a lot of change, even when you don’t have symptoms,” says Leverenz, director of Athletic Training Education, an expert in athletic training and clinical professor in the Department of Health and Kinesiology.

Expanding their work to West Lafayette High School, the researchers will follow the case studies of players who take the most hits to see if there is evidence of permanent changes in brain structure using MRI scans.

“We want to increase the number of football players in the study and also include soccer to study athletes who don’t wear head protection,” Nauman says. “We also want to include girls to see whether they are affected differently from boys.”

The research has paved the way for development of new shock-absorbing materials that might be used in helmets to better protect players from head impacts, work funded by Purdue’s Trask Fund and the Alfred E. Mann Institute for Biomedical Development.

Nauman, Talavage and Leverenz are part of the Purdue Neurotrauma Group, a collaborative research effort that combines expertise in clinical diagnosis and care, biomechanics and neuroimaging. More information about the research group can be found at http://spin.ecn.purdue.edu/png/.

TO BUILD A BETTER HELMET

The Purdue researchers are creating a better shock-absorbing material in efforts to improve football helmets.

“We defined what properties the ideal material should have and then we engineered it,” Nauman explains. “The new materials absorb at least twice as much energy as normal padding in helmets. We are pretty jazzed about it.”

Nauman and his students have studied the material using a specialized impact-testing laboratory operated by Weinong “Wayne” Chen, professor of aeronautics and astronautics and materials engineering. The material was dreamed up by Nauman, graduate student Anne Zakrjsek and doctoral student Evan Breddlove. Zakrjsek and Nauman performed experiments to optimize it.
Nicole Key always knew she wanted to be an engineer — just not at Purdue

Today, leading a team of graduate students as an assistant professor of mechanical engineering and running the High Speed Compressor Research facility at Purdue’s Maurice J. Zucrow Laboratories, Nicole Key is exactly where she’s supposed to be.

But as a top scholar-athlete coming out of high school in Yorktown, Ind., she initially aspired for faraway destinations. Even with a passion for aerodynamics forged by a childhood trip to Space Camp, staying in the Hoosier State and becoming a Boilermaker wasn’t part of the plan.

“Ultimately, it was the opportunity to play volleyball that brought me to Purdue,” says Key. “Once I began taking classes, I realized what a great university it is and how highly it’s regarded, not just in the state, but worldwide.”

After earning a BS in aeronautical engineering, Key planned to join GE Aviation, where she had interned in the compressor aerodynamics group.

“I really loved it there,” Key says. “I couldn’t wait to graduate and be a ‘real engineer.’ But I needed a master’s degree, and I could either get one through GE’s work-study program or get one on my own.”

This time, the choice was simple. Key had taken a course during her senior year with former Purdue professor Patrick Lawless, who at the time also ran Zucrow’s High Speed Compressor Lab along with Sanford Fleeter, the McAllister Distinguished Professor of Mechanical Engineering — who originally created the lab in the 1980s.

“I knew he was someone I could learn a lot from, so I decided to stay at Purdue, earn a master’s degree, and then be a ‘real engineer.’ But once I started grad school, I realized how much I love doing research and wanted to continue,” she says.

Before starting her PhD in mechanical engineering, however, Key spent a year studying turbomachinery at the von Karman Institute for Fluid Dynamics in Brussels, Belgium.

“It broadened my perspective,” she says. “All of our exams were oral, which is common in Europe. It’s a different way of thinking and learning and helped me become more rounded as a scholar.”

Another unexpected opportunity came in 2006 during Key’s final year in the PhD program, when Lawless left Purdue to work in the private sector.

“It’s rare to have a faculty opening at your home university in your exact field at the exact time you’re finishing your degree,” Key says. “When I started interviewing at other schools, they’d show me an empty lab and say, ‘this would be yours.’ But I’d have to build the experimental facilities from scratch. If I stayed at Purdue and picked up where Dr. Lawless had left off, I’d have a big head start in establishing my research program.”

Purdue also helped Key’s startup by reinvesting in the lab’s facilities, funding a major upgrade and renovation. “We now have 1,400 horsepower available to drive our compressors, which is more than double that of any other university in the U.S.,” she says. “It’s created a unique niche for us.”

Since taking over, Key and her team have been conducting research focused on the effects of blade row interactions on the performance, durability and energy efficiency of high-speed compressors used in modern jet engines — and those of the future. Currently, she has two projects with Rolls-Royce — a longtime sponsor of Purdue research and among the world’s largest jet engine manufacturers — as well as projects with Siemens and Honeywell.

“I want the industry to think of Purdue as the first and best choice for the study of compressor aerodynamics,” Key says. “Our students are one of the main products of our research. Being one of the people who helped them to learn how to do experimental research and have them use those skills to make a difference in their field and the world would be a great achievement.”
Nicole Key, assistant professor of mechanical engineering leads a team of student researchers at the High Speed Compressor Research facility at Purdue's Maurice J. Zucrow Laboratories. From left to right are Key, John Brossman (PhD, ME), Marissa Pinnola (MS, ME), Patrick Ball (MS, AAE), and Natalie Smith (PhD, AAE). (Photo by Mark Simons)
Selected in 2009 out of more than 3,500 applicants as one of 14 members of NASA’s 20th astronaut class, Scott Tingle (MSME ’88) became the latest Purdue graduate to join the elite group with his completion last year of Astronaut Candidate Training, including intensive instruction in International Space Station systems, extravehicular activity (EVA), robotics, physiological training, T-38 flight training and water and wilderness survival training.

Tingle, a commander in the U.S. Navy, earned a master’s degree in mechanical engineering from Purdue with a specialty in fluid mechanics and propulsion. He has accumulated more than 3,100 flight hours in 48 types of aircraft, 700 carrier arrests and 54 combat missions in Iraq and Afghanistan. His decorations include a Meritorious Service Medal, three Air Medals, six Navy Commendation Medals, four Navy Achievement Medals and various unit commendations.

Q. **YOU ONCE SAID THAT YOU’VE WANTED TO BE AN ASTRONAUT EVER SINCE NEIL ARMSTRONG STEPPED ON THE MOON ON JULY 21, 1969, JUST AFTER YOUR FOURTH BIRTHDAY. WHAT DO YOU REMEMBER ABOUT THAT DAY?**

A. I remember watching television and listening to my mom talk about what was happening. I don’t recall exactly what I was thinking, but I do remember being absolutely interested in the event. My mom has reminded me of it many times, and she tells me I was glued to the TV for a couple days as they played and replayed footage of the moon landing and moonwalk. I can’t wait to get back there … to the moon, I mean!
HOW DID YOUR GOAL OF BECOMING AN ASTRONAUT INFLUENCE YOUR DECISION TO ATTEND PURDUE FOR GRADUATE SCHOOL?

Purdue is a great school, and my decision to attend was largely based upon its excellent reputation and high rankings throughout industry as well as academia. When I approached a professor and one of my mentors during my undergraduate years to discuss going to graduate school at Purdue, he cut me off and just said, “Go!” As I was working through the application process, I noticed how many astronauts had been educated at Purdue, and then my desires were sealed. Even without being selected to the Astronaut Corps, I believe attending Purdue was one of the best decisions that I’ve made in my life.

HOW DID YOUR PURDUE ENGINEERING EDUCATION HELP PREPARE YOU FOR YOUR NAVY AND NASA CAREER?

One of the best aspects to Purdue for me was the ability to take highly theoretical science and engineering and apply it to everyday technical challenges. Though we were all very interested in cutting-edge science and technology from a research perspective, the professors at Purdue seemed to have a firm handle on real-life application. This provided a nicely rounded educational experience that has proven to have much value. There are technical challenges everywhere. Everything we do is usually the result of a system and/or process. Understanding the math and science behind the fundamentals of the system is a huge benefit in any community.

In the Navy, while deployed aboard USS Nimitz, I solved a performance problem that threatened the safety of our aircraft and aircrew when they were being catapulted off the front end of the carrier on their way into battle. High temperatures and high humidity combined with only a single temperature correction for the catapult settings caused a heavily loaded FA-18 aircraft to settle below the deck, coming dangerously close to the water as they catapulted off the ship. Understanding the technical aspects of this performance problem allowed to me investigate, assess and recommend a fix that ultimately resulted in new aircraft launch bulletins for all carriers operating in the Persian Gulf and Indian Ocean.

WHAT WAS MOST CHALLENGING ABOUT YOUR ASTRONAUT TRAINING?

There were many aspects to astronaut training that were challenging. Fundamentally, EVA training is extremely challenging from both a physical and mental perspective. The spacesuit can be very hard on your body, and you really have to reach deep to keep the energy up and your mind focused during six hours in the pool. EVA training is also extremely fun and rewarding. Upon resurfacing after being submerged in our neutral buoyancy lab, all tired and sweaty, you really feel like you earned your paycheck. The hours spent in training can be a burden on family life as well, but thanks to my lovely wife, Raynette, our three kids — Amy, Sean and Eric — are healthy, strong and smart.

HOW DID YOUR TRAINING DIFFER FROM PREVIOUS CLASSES AS A RESULT OF THE SPACE SHUTTLE PROGRAM COMING TO AN END?

The training that the 2009 class of astronaut candidates completed was a newly developed program designed to prepare us for long-duration space missions aboard the International Space Station (ISS). The program was approximately twice as long as previous training programs and lasted two years. Russian language became a required part of the new curriculum, and we also completed greater training in geology, ISS systems, robotics and EVA skills. Flying the T-38 and some other areas of training remained the same.

WHAT IS YOUR RELATIONSHIP WITH OTHER PURDUE ALUMNI WHO HAVE BEEN ASTRONAUTS OR WORK AT NASA?

Purdue has a strong following in every major metropolis I have visited. It is rare that I go anywhere, including overseas, and not meet at least one Purdue graduate — and they are all extremely proud to tell me that they are Boilermakers. Jerry Ross, Dave Wolf, Mark Polansky, the late Janice Voss and Drew Feustel all are Purdue alumni and accomplished astronauts. They sought me out after I was selected and were very interested in keeping the Purdue legacy at NASA strong. I’ve also met many NASA engineers who graduated from Purdue, and every one of them has been extremely competent and great to work with.

Jerry Ross recently retired from NASA, and I was honored when he asked me to give him his last flight in a T-38 before his official retirement ceremony. When I asked him what he wanted to do during the flight, he replied, “I just want to go fast!” So, two Boilermakers set out to enjoy a last flight fit for a legend, and fast we went. Mach 1.26 to be exact — very fitting!

■ ERIC NELSON
Killer Instinct

A nationally dominant volleyball player is a dual threat with engineering know-how.

There are connections between volleyball and mechanical engineering. If not in theory, then certainly in practice. Just ask Ariel Turner, a junior in mechanical engineering named first-team All-American and second-team Academic All-American in 2011. She was also the Big Ten Player of the Year.

Following a breakthrough 2010 season, when the Purdue volleyball squad made it to the Elite Eight of the NCAA Tournament, Turner led her teammates to victories over seven ranked opponents, including wins over Nebraska and Illinois, which lost the national championship match to UCLA. And though the team fell one win shorter in 2011, losing to Florida State in a NCAA Sweet Sixteen match, its 29-5 record was a Boilermaker best since 1985.

Head coach Dave Shondell says Turner is one of the most naturally talented players he has ever coached. And the upswing is that she's gotten better. “She really improved her power game this season,” Shondell says. “I told her she needed to hit the ball harder and she took it personally.”

One of the nation’s leaders for her work at the net (she averaged 4.84 kills per set), Turner also plays all over the court, rotating through the back row and serving. But can a mind for mechanical engineering really help a volleyball player in Big Ten competition? “She definitely understands angles,” Shondell says.

For Turner, the common denominator between engineering equations and volleyball spikes might be problem solving. “In both you have to see the situation and manipulate it so you either solve the problem or win the point,” she says. “I think mechanical engineering has helped me visualize problems better so I can see the motions of the other team on the court. I can see where they’re going and how they’re defending us.”

As she envisions her future, Turner hopes to play volleyball professionally in Europe. Volleyball has been so much of her life, she says, it’s hard to imagine not playing. In February, she was invited to her home state of Colorado to try out for a national team. She was one of three Boilermakers selected for the 48-member USA Volleyball Women’s National A2 Program teams, which will compete in exhibition matches this summer at the USA Volleyball Junior National Championships in Columbus, Ohio.

On the mechanical engineering front, she’s interested in getting into the aerospace industry after a possible stint in graduate school. No matter the career path, Turner likes the diversity of mechanical engineering. “The degree can be used for a variety of career options,” she says.

Still, a senior volleyball season in fall 2012 awaits Turner. She is hopeful the “do or die” year will elevate her game, along with that of her fellow seniors, bringing the team to collective new heights. A distinct home court advantage — complete with a rabid student section — could go a long way in this Purdue program on the rise. “We have what I think are the best fans in the country,” she says. “They support us for every game. The student section is fantastic.”

As for the All-American honors, Turner is quick to deflect her personal accomplishments, turning them into team victories. “It was great to be recognized for both on the court and the academic side of it,” she says. “I think that shows how far the whole team has come because I can’t play at a high level if the whole team isn’t playing at a high level.”

William Meiners
Ductless heat pump (DHP) systems have existed for more than 50 years and have been available in the U.S. market for more than 30 years. Most American consumers, however, are unaware of these products.

Three Purdue mechanical engineering graduate students want to change that. Through their research at the Ray W. Herrick Laboratories, Simbarashe Nyika, Howard Cheung and Seth Holloway are conducting independent and group research that will benefit consumers and the environment.

Nyika and Cheung work under the tutelage of James Braun, the Herrick Professor of Engineering, and Holloway works with W. Travis Horton, assistant professor of civil engineering.

Even though ductless systems make up only 3 percent to 4 percent of total HVAC sales in the U.S., in Japan it’s 90 percent and in Europe it’s 81 percent.

Cheung, a PhD student, grew up in homes using ductless systems in his native Hong Kong. He and Nyika, a master’s student from Zimbabwe, are testing DHPs in Herrick Labs’ psychrometric chamber to provide performance data under a variety of environmental conditions and to generate computational efficient models for building simulations.

Their research is focusing on common types of buildings in the U.S. and simulating various climate zones to test performance.

Holloway, a master’s student, is examining the advantages and disadvantages in terms of performance and comfort characteristics of ductless and ducted types of heat pumps in varied residential settings.

So what attracted this diverse group of students to earn advanced engineering degrees at Purdue? All agree it is the school’s world-class reputation and the ability to do innovative research not only with renowned professors but also the ability to work with researchers at sponsoring companies.

“We have great interaction not just with other graduate students but other stakeholders, including researchers in other laboratories or companies working on similar projects,” Cheung says. “We interact and share the experience and that provides feedback for us to improve our experiments.”

Holloway agrees, saying that sponsors are interested in the outcome of their research. “They want to find out how unbiased research being conducted in an academic setting can be distributed. When we speak to them, they are very encouraging.”

Nyika, who earned his undergraduate degree in mechanical engineering from the University of Missouri-Columbia, was drawn to Purdue because he wanted to work on graduate research related to energy efficiency. Though he hadn’t worked in the area of thermodynamics, Braun’s project fit well with his interests. In conventional ducted heat pump systems, a single-speed compressor cycles on and off much like a refrigerator, compromising efficiency, and a fan has to force the air into different rooms, consuming much more power.

“You learn a lot in the process of doing experiments that is transferable to other projects,” Nyika says. He plans to work in the area of energy efficiency as it relates to building design after graduating in December.

Cheung, who is midway through his doctoral studies, wants to focus on modeling equipment besides testing it. After graduation, he wants to work in industry to gain experience but sees an eventual career as a researcher.

Holloway, who is the only one of the three with a background in HVAC installation and mechanical systems design, will defend his research this summer. He hopes to take all of the knowledge and experiences gained at Purdue and apply it toward a company or research program that has similar interests in energy efficiency and HVAC systems.

“We know this has a big impact on the world today — everyone needs cooling and heating,” he says. “We want to make it better for them.”

*DELLA PACHECO*
Gayatri Adi, a doctoral student in mechanical engineering, at work in Herrick Labs. (Photo by Mark Simons)
Call it a clock in progress. But this time-piece, now on working display on the second floor of the Roger B. Gatewood Wing, has its own history dating back to the beginnings of Purdue and the School of Mechanical Engineering.

Originally installed in Heavilon Hall — Purdue’s first mechanical engineering building, in 1896 — the four-faced clock (each 7 feet in diameter) stood for the “one brick higher” philosophy after the first Heavilon Hall burned down four days after its 1894 dedication. In 1896, the clock and chimes were installed in the new tower, courtesy of the Ladies’ Matinee Musical of Lafayette and the class of 1895.

That clock paced faculty, staff and student lives for nearly 60 years. When the building was demolished in 1956, the clock and bells went into storage.

In 1991, restoration efforts began. Jack Fessler, the late professor of veterinary clinical sciences, worked with machinists on new parts and cleaned and polished the clock. The original bells were placed in the Purdue Bell Tower in 1995, where they remain. The clock was on nonworking display in the Materials Sciences and Electrical Engineering Building from 1997 to 2004.

Keith Hawks, building consultant and professor emeritus of mechanical engineering, was instrumental in finding a permanent home for the historic piece. “The atrium was built around the clock,” he says.

Galen King, professor of mechanical engineering and horologist, was charged with getting it running again for the building’s dedication in October. “Right now we have the timekeeping train running, but not in the final form we want it to be,” King says.

Working with Michael Sherwood, a machinist and manager of technical services in Mechanical Engineering in PEARL, King eased his Sisyphean winding task, which until recently was needed every 11 hours. “I can get about four and half days out of it now,” he says. “Normally I wind it on Friday mornings and again on Monday afternoons.”

King hopes to have it self-winding and in full working order soon. Purdue Bands and Orchestras donated chimes that will sound each quarter hour, and the single face will soon be reunited with a backside. All to tell students in the commons not only what time it is but also what time has passed.


time and time again

The original Heavilon Hall clock is up and running in the Gatewood Wing.

*William Meiners and Mackenzie Greenwell*
The School of Mechanical Engineering dates back to the very beginnings of Purdue University. Originally housed in Heavilon Hall (left), the school was, and continues to be, a cultivating ground for learning, discovery and engagement. Take a peek inside these pages to see where we are now.