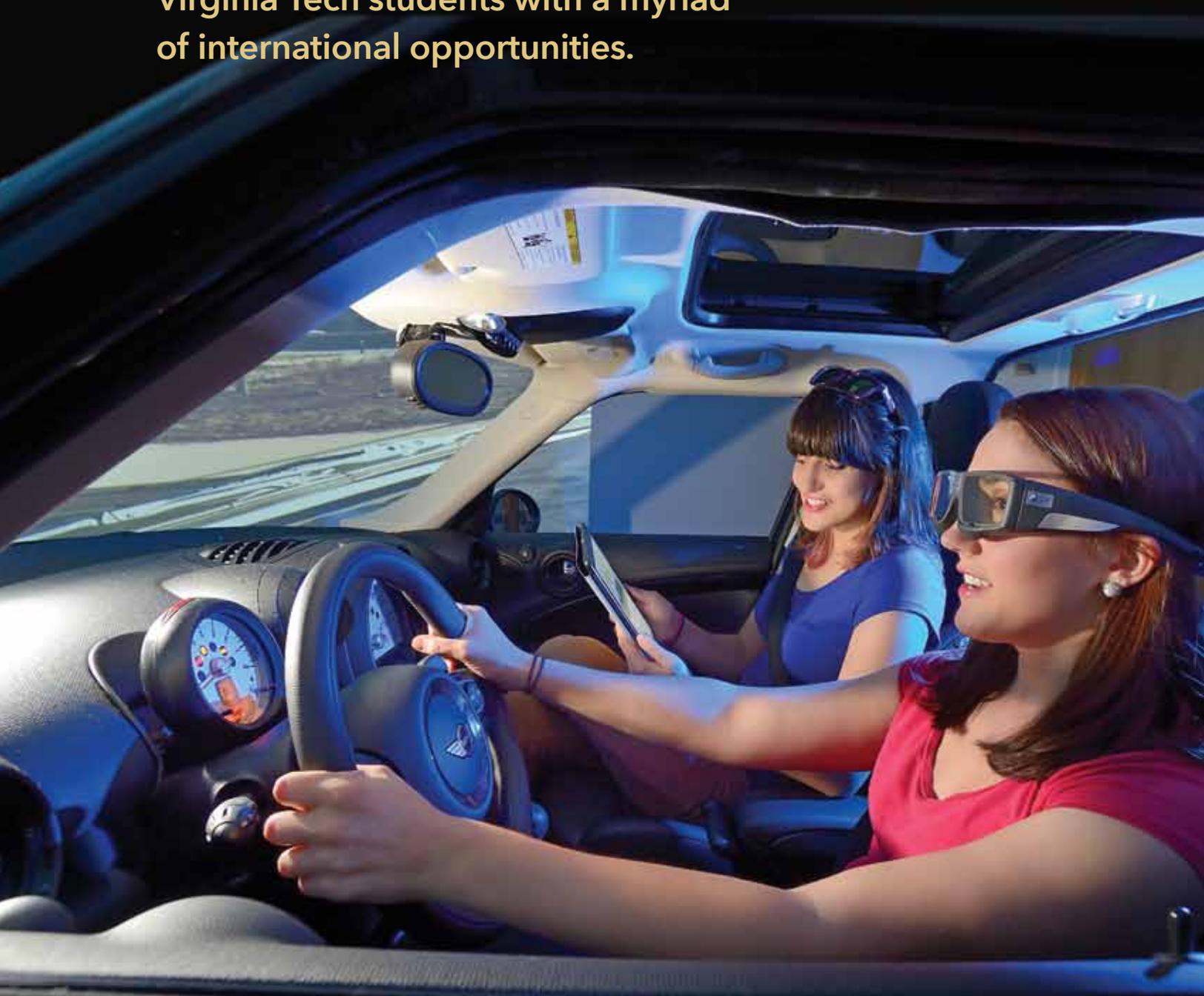


# ENGINEERING NOW

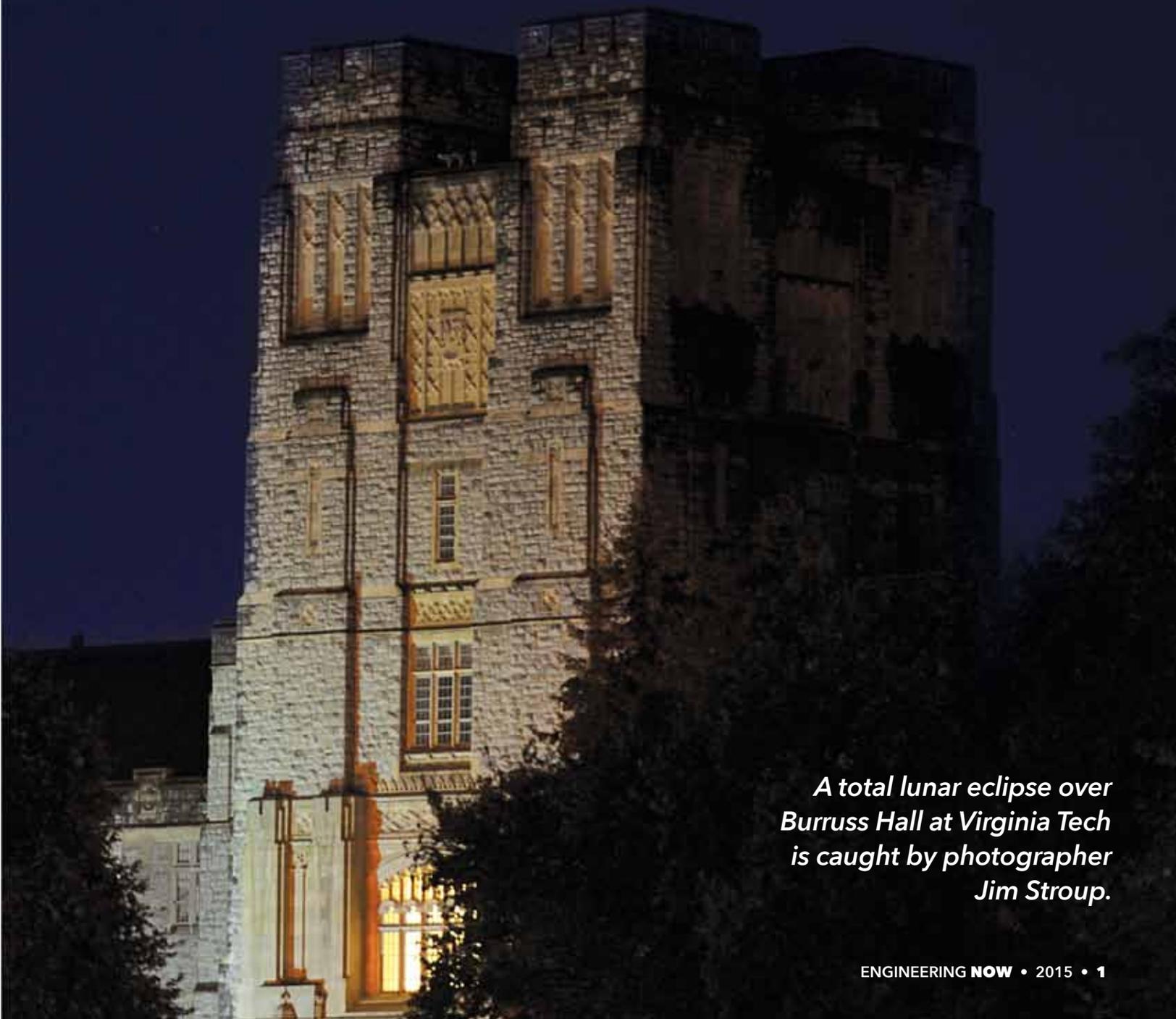
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The Office of Global Engineering, Engagement, and Research provides Virginia Tech students with a myriad of international opportunities.





# VIRGINIA TECH'S COLLEGE OF ENGINEERING EXTENDS ITS GLOBAL IMPACT



*A total lunar eclipse over  
Burruss Hall at Virginia Tech  
is caught by photographer  
Jim Stroup.*



*Two of the feature stories in this publication illustrate undergraduate engineering humanitarian research in African countries.*

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# ENGINEERING STUDENTS AT VIRGINIA TECH MAKING A DIFFERENCE IN GLOBAL SOCIETY

Engineering student design projects such as the ones featured in this publication speak to several humanitarian efforts in which Virginia Tech is involved. These members of the Generation Z, born between 1995 and 2015, and thought to still be too young to have made a societal impact, are proving this concept wrong.

The *Ut Prosim* ("That I May Serve") spirit of Virginia Tech students is part of the overall Hokie nation's esprit de corps. This sense of commonality is particularly prevalent in these international design projects as the students try to improve technology but take into account societal and cultural needs and restrictions.

Some of these featured students have now made multiple trips to several countries in Africa to develop lifesaving, critical biomedical resuscitators for infants in an effort to reduce the mortality rate and to help in agricultural improvements. With the goal of relying only on locally available materials and infrastructure, these students have contributed to building sustainable engineering solutions that are transferable to communities worldwide.

Overall, international initiatives for the College of Engineering are advancing rapidly during the tenure of Richard Benson as Dean of Virginia Tech's College of Engineering. He has made developing international programs a priority for the college, adding the position of director of global engagement. This position provides leadership for our global initiatives, and works closely with the College of Engineering faculty, students, and alumni.

The College of Engineering's newly designed Office of Global Engineering, Engagement, and Research (GEER) has created an international alumni advisory board. They represent a myriad of companies. From these partnerships a number of programs have been created which give students experience working in a global engineering context, including internships, externships, and short-term programs focused on global leadership.

At the student level, the Student Engineers' Abroad Council (SEAC) works to promote international opportunities for engineering students. Other student groups associated with international activities include Engineers Without Borders, Bridges to Prosperity, and



*The above countries in maroon signify the College of Engineering's study abroad locations.*

Students Helping Honduras.

The Department of Engineering Education (EngE) is proposing a global engineering minor that would hopefully increase the annual percentage of students involved in international experiences. EngE also provides leadership for the Rising Sophomore Abroad Program, offering a three-credit course in the spring of the freshman year followed by a two-week in country experience.

This program is designed to emphasize the importance of cultural competency, along with global teaming and leadership skills needed in today's global workplace.

The chart above provides an extensive overview of the countries where Virginia Tech's engineering students have studied abroad. In 2013-14, 172 engineering students participated in some type of overseas experience, visiting 33 different countries.

As GEER and the College of Engineering's global engagement evolve, we are constantly implementing new initiatives and partnerships to provide opportunities for our students to develop the skills necessary to be successful in

the global workplace. Recognizing the urgency to prepare engineering students with the skillset and mindset to address 21st century Grand Challenges, the College of Engineering is committed to providing opportunities for students to develop global and cross-cultural perspectives, empowering students to become leaders in addressing societal challenges in the U.S. and abroad.

In summary, Virginia Tech's College of Engineering is proud to take part in educating the next generation of engineering leaders with the passion, skills, and preparation to truly make a difference in our global society.

Respectfully,

Glenda Scales

Associate Dean for Global Engagement  
And Chief Technology Officer

# NO MIRACLES, ONLY SOLUTIONS

In Malawi, this baby's death was not unusual, but the tragedy spurred **Ashley Taylor** to use her engineering ingenuity

By Lynn Nystrom

As an infant died in a clinic in Malawi, Africa, 21 year-old Ashley Taylor watched, knowing that no miracles were in store.

In tears, she had already witnessed the doctor reaching for the resuscitator that was in the room. However, this life-saving machine had once again malfunctioned, a common occurrence in this African country.

The experience left Taylor, a mechanical engineering undergraduate student at Virginia Tech at the time, heartbroken, but determined to find a solution. She knew the death could have been avoided.

A resolute Taylor defined her course of action – use her mechanical engineering know-how to build a resuscitation device that used local materials easily found in hardware stores in Malawi and other developing nations. The device would need to be operated

without electricity since the country constantly suffered from black and brown outs. Cost would be another deal breaker.

Four mechanical engineering students joined her on the design project and “we hit the ground running,” said the native of Fort Chiswell, Virginia, where the 2010 census showed the population at 939. Obviously, Taylor knew something about small communities.

On her second trip to Malawi during the summer of 2014, she and another one of the students, Philip Repisky, visited eight unique clinics, soliciting feedback on their mechanical and biomedical engineering designs. The doctors were impressed.

The students had focused on only three main design needs: the ability to provide suction to clear an infant's airways of fluids or obstructions; positive pressure ventilation to inflate a baby's lungs; and continuous positive airway

pressure to keep its airways open.

“We knew the physics,” Taylor said, explaining how the team had to make the device safe by using an adjustable relief valve to prevent exceedingly high pressures from reaching the infant. They also knew the mechanics, and generated pressures through foot pumps that operated like bellows for a fireplace.

Their creative “MacGyver” approach resulted in a design that lessened the cost of the resuscitation equipment for Malawi by 98.5 percent. They had reduced the African country's \$6000 price tag (in the U.S. it can be closer to \$100,000) to \$82.51. She can even provide an itemized bill for the new prototype, called the Global AIR Device, that includes costs such as a 69 cents rubber washer, \$5.96 for a bellows foot pump, and \$1.80 for 10 washers.

The Global AIR Device also allows for its integration with any

*Continued on page 8*



*Ashley Taylor, left, works with Al Wicks, one of her advisors and a member of the mechanical engineering department.*



*Their creative “MacGyver” approach resulted in a design that reduced the cost of the resuscitation equipment for Malawi by 98.5 percent. They had reduced the African country’s \$6000 price tag (in the U.S. it can be closer to \$100,000) to \$82.51. She can even provide an itemized bill for the new prototype, called the Global AIR Device.*

electric pump, particularly useful for continuous positive airway pressure to keep the airways open in an infant. Most importantly, the undergraduate engineering design project met all target specifications of currently available resuscitation equipment, including positive pressure regulation, within a less than five percent error rate.

During the fall of 2014 the students made some refinements of the design in preparation for a small-scale implementation of the Global AIR Device during the summer of 2016.

“The end goal of Global AIR is to become a self-sustaining private sector business in Malawi or other developing nations,” Taylor said.

Serendipity may have played a role in Taylor’s original involvement in this project. Starting at the end of her freshman year, Taylor was conducting research with the Pediatric Medical Device Institute

(PMDI), a nonprofit entity led by Al Wicks, associate professor of mechanical engineering, and Andy Muelenaer, a Virginia Tech alumnus and a Roanoke-based pediatric pulmonologist. PMDI works with a consortium of children’s hospitals, mostly in Virginia and North Carolina.

Muelenaer was the person who informed Taylor he had a colleague in Mzuzu, Malawi who needed help. After learning about the internship, Taylor became determined to travel thousands of miles from home for the five-week opportunity.

Her parents were not quite as enamored by the idea. But Taylor’s passion for equality among basic human rights eventually persuaded them to give their reluctant agreement.

Virginia Tech’s “Scieneering” Program, a combination of science and engineering coursework, funded her first trip to Malawi. The second year, her department and

PMDI shared the costs.

Her first trip was an eye-opener. She counted 27 mosquito bites on her hands alone after one night of sleep. During her second trip, she recalled, “In some of the locations we visited, the water was polluted. Diarrhea was a huge problem. And malaria. There was no mosquito netting. A lot of malnutrition. The threat of HIV underlied everything. It was hard to swallow.”

“One nurse would be monitoring 50 children ... many premies don’t survive. During our first trip, only one machine in the entire country performed continuous positive airway pressure (CPAP), and while I was there they lost two babies at the place where this machine was due to a rolling black out and the generator did not kick in.” By the second trip, Rice University had installed several additional CPAP machines in hospitals around the country.

*Virginia Tech engineering student Ashley Taylor demonstrates the simplicity of the Global Air Device.*

If an existing resuscitator malfunctioned, Taylor noted that people knew how to fix it. But that was of little help since they had no means to get the needed parts. "The closest place to fix the current, more expensive models is in South Africa where they have a graveyard for medical equipment."

Despite the hardships and tragedies she witnessed, she was back on the plane the following summer, this time accompanied by Muelenaer and his wife, an infectious disease specialist, Repisky, and electrical engineering student Andrew Jung.

After they shared their prototype with the clinics, the repeating question from physicians became, "We know it works. When can we have it?"

That is hopefully the last question Taylor will have to answer on this project.



*Photo Credit: Logan Wallace*

# A STRANGE MIX ...

## England's lure of Harry Potter and a passion for engineering

By Lynn Nystrom

### THE WINDING INTERNATIONAL ROAD TO A CAREER PATH

Nadia Doutcheva, born in Bulgaria, moved to northern Virginia with her

family in 2000 and, when attending South Lakes High School, made the discovery that she loved math. Her dilemma was how to make use of the subject in her life.

Her colleague, Missie Smith, who hails from Mississippi, stumbled upon

a field called industrial engineering while reading one of her favorite books, *Cheaper by the Dozen*. The book was entertaining but she did not realize until later in life that it was really about this concentration within engineering.

Jill Streeter started her engineering



Photo Credit: Jim Stroup

track in eighth grade, growing up in the Boston, Massachusetts area, and at one point thought maybe she would build structures.

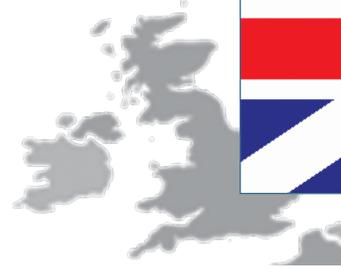
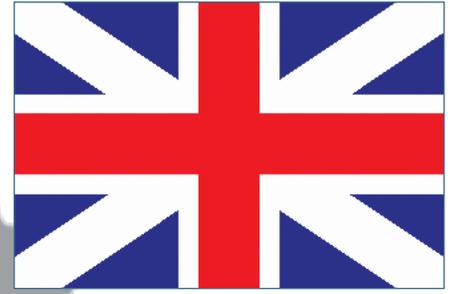
Smith attended Thomas Jefferson High School for Science and Technology in Northern Virginia, and then finished at the Mississippi School for Mathematics and Science. Both high schools are designed to meet the needs of the most academically gifted students. She moved into the study of human factors engineering while she was studying engineering at Mississippi State University (MSU).

At MSU, she spent four years as an undergraduate researcher with former Virginia Tech faculty member

Kari Babski-Reeves. "Dr. Babski-Reeves became my boss, my professor, my adviser, and a counselor. She offered me a spot in human factors engineering for my master's, and I was not ready to leave school," Smith said.

After her master's she took a job with International Paper Company of Memphis, Tennessee, and within six months was applying for her Ph.D. "Dr. Babski-Reeves had always spoken highly of Virginia Tech, and so I thought of applying there," Smith explained.

Streeter explained she "stumbled



upon Virginia Tech and just fell in love with the gorgeous pictures of campus that were on the Internet." As a freshman, she joined Hypatia, an engineering learning community, and met others in her major who

*Continued on page 12*



*Industrial and systems engineering faculty member Joe Gabbard, center, specializes in augmented reality and human computer interaction. With him are Missie Smith, left, and Nadia Doutecheva, right, who are working on future electric transportation systems.*

would become her friends and future roommates. At an Open House about the various curriculums she met another female who was working on cars. "It was one of the coolest things – the human factors aspect about designing cars," she recalled.

Following a Women in Engineering conference and a visit to Virginia Tech, Doutcheva used the same words as Streeter: "I fell in love with Virginia Tech after a visit to campus, and everything fell together." To help pay for her education, she worked an internship and secured a co-op position. It was the former with Volvo that introduced her to the human factors aspects of manufacturing automobiles. "I was asked to optimize three work stations, and I was able to balance the line and the operations so that the assembly became more efficient," Doutcheva said.

"I have always been passionate about the environment, and I really wanted to apply it to engineering. After speaking to many industrial engineers,

I realized that system efficiency and process optimization reduces energy, and saves time and waste. It excited me the most," Doutcheva added.

### **A MERGER OF TALENTS GOES INTERNATIONAL**

All three, coming from very diverse backgrounds, met at Virginia Tech when they applied for a competitive research experience in the United Kingdom at the University of Nottingham. By the time of their applications, they had formulated much more specific career plans. They shared the idea of working on future electric transportations systems as part of the International Research Experiences for Students (IRES) project sponsored by the National Science Foundation.

Streeter was already enamored with England, spending the summer of 2013 in London through a Virginia Tech English department program. So when she received an email about the IRES program, working with cars, human

factors, and returning to the Mother country, she was hooked.

Doutcheva, sporting a Harry Potter sweater when she was interviewed, admitted her love of this franchise, as well as Sherlock Holmes, English tea, the Beatles, and the British culture, especially the humor, in general. These affinities flamed her desires to go to Nottingham. A visit to Stonehenge and a trip to "see" the Loch Ness monster was also on her dream destinations list.

When both Streeter and Doutcheva were accepted into the IRES program, Smith, the graduate student, took them under her guidance for the ten-week summer program, a bonus to their resume building.

In turn, Smith was under the tutelage of Joe Gabbard, a Virginia Tech engineering faculty member who focuses on augmented reality and human-computer interaction. With Smith's specific interests in everyday objects like vehicles, she was learning about how the relationship between

*While at Nottingham, the students had some free time on the weekends to visit such places as the Parliament Building on the Thames River in London.*



Photo Credit: Richard Benson

augmented and virtual reality affects the way engineers design heads-up displays for automobile apps. For example, what are the perception, cognition, and attention challenges to driver safety; what methods promote environmentally-friendly driving styles?

Augmented reality is a view of a real-world, physical environment, supplemented by computer-generated sensory input such as audio, visual, or other types of data. By contrast, virtual reality is a computer-simulated environment that can mimic physical presences.

At the University of Nottingham one of its world-renowned research groups is its human factors group, similar to the international reputation Virginia Tech holds in this field. Nottingham faculty member Gary Burnett is Gabbard's counterpart in this IRES program. Burnett specializes in the development of technology for road-based vehicles.

Smith first met Burnett when he presented a fall 2013 seminar in Blacksburg as a visiting scholar. "His research sounded like fun. And a few weeks later I got the IRES email about the program and realized he was the professor. With Dr. Gabbard as the contact at Virginia Tech, it was a natural fit for me," Smith said.

By May of 2014 she had initiated a literature review of relevant research. She found that Nottingham already had numerous physical set-ups for the future in transportation systems, so she spent some of her time replicating similar facilities at Virginia Tech. By this time Streeter and Doutcheva had started working with Smith.

The IRES program started with three weeks at Virginia Tech followed by seven weeks at Nottingham. While in Blacksburg, they would Skype with Burnett from their lab setting on the Blacksburg campus.

"Jill started comparing head-up and head-down displays, using eye-tracking. We wanted to see how performance



*The International Research Experiences for Students (IRES) allowed Nadia Doutcheva, left, and Missie Smith, right, to learn from Joe Gabbard, standing, an expert in human factors engineering, and Gary Burnett of the University of Nottingham. He specializes in the development of technology for road-based vehicles.*

changed and what changes were needed," Smith said. The heads-up display might be shown on the windshield of the car so a driver could be watching the road while driving.

"No simulated wrecks occurred, but there were some close calls," Streeter acknowledged. When she returned from Nottingham, she went straight to work for BMW in an internship position, and discovered they were already involved in some of the same designs.

With IRES, "Nadia was also looking at the depth perception," Smith added. "Actually, my responsibility," Doutcheva said, "was to determine the effect of augmented reality on depth perception of a real world object. What was the difference between perception of the virtual graphic versus the real-world object. We had a cardboard cut out of Hugh Jackman. He was our "pedestrian-like object," she smiled. "We would track depth perception responses as the pedestrian (the cardboard Jackman) approached the vehicle simulation."

## STUDENTS WORK ON A FIRST OF ITS KIND

This study about depth perception using augmented reality, not virtual reality, was the first of its kind. "We found that there was a lot more variability. In the augmented reality simulation, the driver was wrong more often regarding how close the pedestrian was," Doutcheva added.

"It was a rough study and we have a long way to go," Smith predicted. (Smith will be headed back to Nottingham for a second IRES experience.)

The seven weeks the three spent in Nottingham fluctuated in intensity, depending on how the research fell into place. But on the weekends, they had opportunities to travel, and Smith and Doutcheva managed to make such side trips to Rome and Amsterdam for some weekends, watch the start of the Tour de France in Leeds, and visit other locations in England such as Bath and Cambridge. Streeter spent more time in the Nottingham area, exploring everything she could.

# BUILDING A SILAGE CHOPPER FOR USE IN SENEGAL IS NO EASY TASK

By Lynn Nystrom

A “roller coaster ride” is how one mechanical engineering student described the team’s attempts to travel to Senegal, Africa to test their innovative design for improving an aspect of the agricultural industry in the country.

The seniors were “up” when they learned they would receive some \$7000 in travel money from the U.S. Agency for International Development to meet the people they were hoping to help.

These same technical artists were “down” when their first scheduled trip to the African country was sidelined by the travel delays that were eventually due to program budget problems. Simultaneously, a public panic was brewing from the Ebola crisis that was happening mostly in Sierra Leone in the fall of 2014.

From their remote laboratory in Randolph Hall, where they had logged in dozens of hours on developing a prototype tool they were ready to test, the students were hearing the concerns

voiced by U.S. State Department and the Center for Disease Control about travel to the African continent. “But the Ebola virus never once alarmed our team or put us into any uncertainty about whether or not we would be willing to travel to Senegal,” said team member Josh Booth.

When Julia Jordan, also on the team, thought she would be going to Senegal in November of 2014, she was ecstatic. “I feel like the luckiest girl in the world. What an awesome opportunity for our team,” she said at the time.

But then USAID budget problems set in, and the trip was put on hold.

For Jordan and her six teammates,

that was devastating news. But they did not give up, and in late February of 2015 they finally boarded a plane with their design called a silage chopper. They had been provided 10 days notice that they could go, but in anticipation they had made sure they were continually up to date on all medical shots and passports.

This international senior design project, before it was even tested on site, had provided the students with numerous, invaluable real world experiences well beyond the technical components.

When they landed in Senegal, their lessons in cultural differences started.



Warren Elsea and Josh Booth, mechanical engineering students, work on a new prototype to cut silage for livestock in Senegal.

Photo Credit: Shelby Lum



Their faculty adviser, Kevin Kochersberger, associate professor of mechanical engineering, had already made two trips to Senegal in October, 2013 and the summer of 2014. The idea of engineers working on agricultural technology for Senegal

arose through a meeting with Ozzie Abaye, agronomist in the College of Agriculture and Life Sciences. As co-principal investigator on the USAID - Education and

Research in Agriculture (ERA) project, Abaye saw the benefit of including engineers in a silage production project. Senegal has a dry season that lasts nine months, and preserved feedstock in the silo can be critical in sustaining farm animals throughout the year.

Offered as a design project option for a team of 2014 seniors, the first

silage system was what Kochersberger described as a "spinning Cuisinart design." The students chose to convert a bicycle into a pedal-driven chopper to turn crop residue and grass into silage.

"I was really excited about demonstrating this technology ... but I soon found out upon my arrival in Senegal that it was very hard to find a bicycle ... Overall, it was a grueling experience, and the Senegalese people were very blunt, saying, 'You failed.' "

"That really inspired me," Kochersberger acknowledged. "It was an unforgiving environment. I had nothing to compare it to and found it challenging," he said. So he proposed

*Continued on page 16*

**David Ko, a mechanical engineering student, was a member of the senior design project to hopefully improve agricultural technology in a country almost 4,000 miles away.**



*Photo Credit: Shelby Lum*

another year of support from USAID/ERA for a new team of students to tackle the problem with new-found perspective.

It again became a senior design project, but with some history behind the new effort. When Jordan and the rest of the team landed at the Dakar Airport in 2015, Kochersberger was with them for his second try.

Yet, with all the planning, there was a new problem.

"We interacted with farmers of the Santamba village. We found, as we anticipated in traveling to Senegal for the very first time, that we really did not fully understand their user needs," said Booth, of Chesapeake, Virginia.

\*We explored the weld processes

used in Senegal, and we evaluated the dimensional replicability of numerous machined features, Booth added.

"After each of these milestones, we still had numerous questions that were not able to be answered from 4,000 miles away, and knew very well that our trip to Senegal would only begin to answer everything we were hoping to know."

The design they brought to Senegal was the result of working first with four different drawings, each prototyped and tested. But when they unpacked it in Senegal, reassembling it the first day, they discovered the pieces did not come together well. So, they stayed up all night, reassembling the machine. On the second day, this

silage chopper worked, and the team was excited.

"Our design was great in theory, and a great idea, but then we learned it was not adequately functional," Jordan said.

As the roller coaster ride experience continued, the students soon learned that even though the prototype chopped up silage, it did not have the necessary output to make the tool successful.

"The plant material in Senegal included a much larger variety than was previously described to us as being the most typically available plant material, which was sorghum. The issue was not that the stalky sorghum-like material wasn't there in Senegal,

*Eric Johnson and Julia Jordan employ technology that could be duplicated in what is called an "unforgiving environment" by their adviser Kevin Kochersberger.*



*Photo Credit: Shelby Lum*

*“We had good intentions. We did learn that failure can teach you and make you learn. It was an awesome opportunity to communicate with people.”*

~ **Josh Booth**, mechanical engineering student

because some of the plant material we used while in Senegal was very similar to sorghum. The issue was in the much greater variety of plant material that was being chopped. This factor was due to the season during which we arrived in Senegal being different from when the post wet-season harvest would typically occur, and when more plant material would be available like sorghum,” Booth added.

“We had good intentions. We did learn that failure can teach you and

make you learn. It was an awesome opportunity to communicate with people,” Booth added. “We used the failure of the device as an opportunity to finally communicate directly with the farmers, and better understand their acceptance criteria for a silage chopping device.”

The truly good news was members of two Senegal universities were present for the demonstration, and met with the Virginia Tech delegation and the agricultural

outreach agencies that were also in attendance. They discussed future partnerships where students would become more involved with the farmers. The students from both Virginia Tech and Senegal remain friends on Facebook.

The Senegal project is just one of about 42 overseen by Kochersberger, and maybe up to a half a dozen are international. One is the design of an intravenous delivery (IV) system that can support IV delivery in harsh environments.

Companies interested in sponsoring a senior design project can learn more about the program at [www.me.vt.edu/seniordesign](http://www.me.vt.edu/seniordesign) or contact Kochersberger at [kbk@vt.edu](mailto:kbk@vt.edu).

*Eric Johnson confers with his adviser Kevin Kochersberger, who had made two trips to Senegal prior to the students' visit in 2015.*



Photo Credit: Shelby Lum



Photo Credit: Jim Stroup

# WORKING BOTH SIDES OF THE ATLANTIC HELPS UNDERGRAD SOLVE SEEMINGLY IMPOSSIBLE CHALLENGES

*Mechanical engineering's **Brian Mongilio** has worked for famed engine maker Rolls Royce, stateside and in England.*



**By Steven Mackay**

Rolls-Royce is one of those corporations that instills awe, no matter what side of the pond – meaning the Atlantic Ocean – you reside on. Founded in 1906, the company that found fame quickly in building high-end cars eventually moved to also building airplane engines, the latter to equal international acclaim. Rolls-Royce would grow large enough to split into two separate entities more than 40 years ago.

That was some 20 years before Brian Mongilio was born.

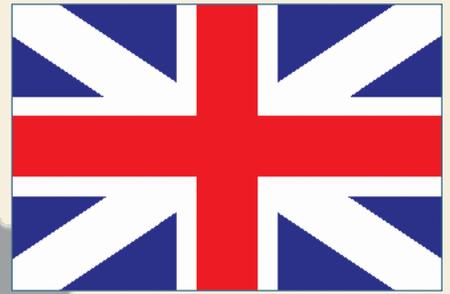
Mongilio, now a senior in mechanical engineering and a resident of Parkersburg, West Virginia, has found his engineering niche at the 100-plus year old company, interning at engine facilities near Petersburg, Virginia; Indianapolis, Indiana; and overseas in Derby, England. The latter location boasts some 12,000 employees, the largest employee footprint in the company's country of origin. It's also part of the Rolls-Royce International Internship program that includes Virginia Tech, the University of Virginia, and the Commonwealth of Virginia. He is one of six Hokie students to intern in Derby.

"Rolls-Royce was my first choice," said Mongilio, who hit on the company at a university-sponsored Connection Career Fair during his freshman year in 2012.

During summer 2012, Mongilio was in Indianapolis, working in repair engineering. Spring 2013, he moved to manufacturing at the Rolls-Royce Crosspointe Rotatives Facility in Prince George County. Fall 2013 brought Mongilio back to Indianapolis to focus on experimental testing. Summer 2014 was when Mongilio – for the first time in his life – left the U.S. soil and headed to Derby. There he worked on turbines.

As this magazine was going to press, Mongilio was prepping for the end of his junior year and another return to Indiana, where he would be assigned to project management in the manufacturing division.

Mongilio's repeated internships with Rolls-Royce are not unprecedented. The first Hokie engineering intern placed with the company took a similar path, said Nicole Sanderlin, director of global engagement with the college. "Brian



is a special case as he was recruited by Rolls-Royce for the international internship after spending a summer with them in Indianapolis," said Sanderlin. "The fact that he is returning for another internship with Rolls-Royce this summer speaks to his excellent performance while in Derby."

Hearing Mongilio talk about his projects at the three plants is akin to a rundown of a stack of *Popular Science* magazines on the best projects underway in the aerospace industry. He has been involved with the AE 1107: V22 Osprey, AE 2100: C130 Hercules, AE 3007: Civil: Embraer ERJ, Cessna Citation X; Defense: Global Hawk UAV; the Trent 500, 700, 900, and 1000 engines, all part of several Airbus planes, in addition to the Boeing 787 Dreamliner, plus the Trent XWB engine for Airbus A350 XWB. If the Trent 1000 engine rings familiar, a 14,000-pound model hangs in the atrium of Virginia Tech's Goodwin Hall.

"Due to the manufacturing environment, each day was a new set of challenges and problems to overcome to make a better product," said Mongilio. "The manufacturing at Rolls-Royce is at such a high technology level due to the advanced engines that we produce, I was always learning and exposed to some of the cutting edge advances in the industry. The experimental test rotation was especially challenging because the test article was a unique prototype and

*Continued on page 20*

**Brian Mongilio is joining the hybrid electric vehicle team after multiple work stints with the international Rolls-Royce Internship Program.**



Photo Credit: Steven Mackay

on a very tight deadline. This meant creating novel solutions for some problems that I'd never been faced with before. And again, being around a cutting-edge technology prototype is a project that generates a lot of excitement and interest for me."

Lessons learned along the way were many, but then one stands out – according to Mongilio – never be afraid to ask a question. Engineers will share. "One of the biggest things that helped me throughout my various positions was to ask lots of questions," he added. "The teams I worked in loved having me ask questions and get involved. For them, it was an opportunity to pass down important experience and develop the kind of engineer that they want to work with. It was a chance to get ahead of my peers and have skills that I wouldn't be able to develop otherwise."

(While in Derby, it was not all work for Mongilio. He traveled with a fellow Virginia Tech intern to several destinations, including Spain, Ireland,

Wales, Scotland, and London.)

Mongilio's senior year at Virginia Tech will bring him to a project that likely would have piqued the interests of Henry Royce and Charles Rolls. He'll join the hybrid electrical vehicle team, hosted in the Joseph F. Ware Jr. Advanced Engineering Laboratory and part of the mechanical engineering department.

There, Mongilio and his teammates will take apart a Camaro as part of the EcoCAR3 Challenge, turning the car from a gas-fired engine automobile to an electric battery-operated automobile. Challenges abound. The batteries for the car have to fit in the famously snug trunk of the Camaro and the car must still perform at the speed levels demanded by Chevrolet.

"I'll be on the mechanical sub-team that primarily will be responsible for finalizing and installing the new powertrain while maintaining the performance feel of the Camaro," added Mongilio.

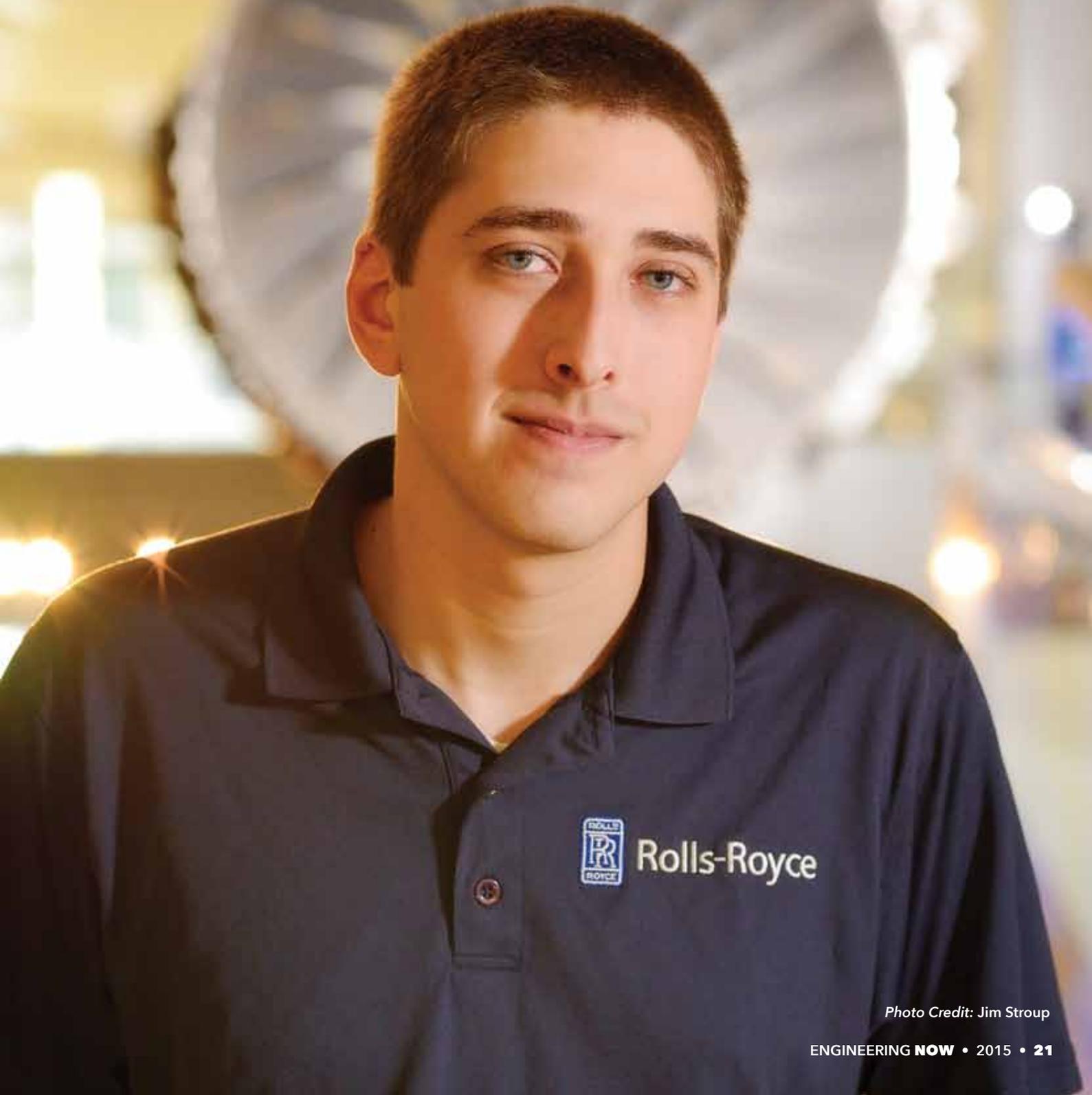
Early work on the Camaro will

be computer simulations. EcoCAR3 organizers will not deliver the physical automobile until December 2015. Then Mongilio will take what he has learned at Rolls-Royce, and do what engineers do best – solve impossible challenges.

Mongilio is already looking at his post-graduation plans as of this writing. "Hopefully ..., I'll be receiving a full-time offer to work with Rolls-Royce after graduation in May 2016," he said, adding that his series of internships have set his career path. "All of these experiences have been invaluable. The opportunity to not only get industry experience in a competitive field but be working on high-profile projects and be treated as a full engineer while there, will make the transition after graduation more seamless. I have the experience and confidence to begin contributing even on day one. All the other projects that I've had before this don't offer the depth or importance that the positions with Rolls-Royce offered."

**“All of these experiences have been invaluable. The opportunity to not only get industry experience in a competitive field but be working on high-profile projects and be treated as a full engineer while there, will make the transition after graduation more seamless.”**

**~ Brian Mongilio**, mechanical engineering student



*Photo Credit: Jim Stroup*

# INTERNATIONAL INDUSTRY IMMERSION = GLOBALLY PREPARED ENGINEERS

16-hour flight. 8,356-miles.  
The Great Wall. Tiananmen  
Square. Total immersion.

*Pictured, from left to right, are: Nick Pera, Eric Santure, James Webb, Cody Reed, Howard Chung, and Adwoa Baah Dwomoh. Pera, Santure, Reed, and Chung made up the Virginia Tech team. Webb is the information technology director for Boeing-China. Dwomoh, a materials science and engineering student, was there on an exchange program at Tainjin University.*

## BOEING ENGINEERING STUDENT LEADERSHIP CONFERENCE

波音工程学生领导力论坛

July 14-15, 2014



Photo Credit: Kim Lester

By Lindsey Haugh

In July 2014, Virginia Tech senior-level students and chaperones embarked on a journey across the North Pacific Ocean, from Virginia to China, the second largest country within the largest continent in both area and population. China is considered a leading country in the aerospace design and manufacturing industry.

In the fall prior, James Webb, a Virginia Tech alumnus and director of information technology of the Northeast Asia division of Boeing Engineering, suggested Virginia Tech become a partner in the program. At the time, the university's engineering international team's focus was on planning the Dean's Forum. Once that event concluded, Kim Lester, the global engagement specialist of the engineering program at the time, quickly shifted

gears and began to streamline the planning process in order to prepare for July's trip.

The Virginia Tech initiative was to provide its aerospace and ocean engineering students a glimpse into the Chinese engineering student's academic life in the university setting. It would also allow an introduction to Chinese culture and industry, thus emphasizing the importance of global context in educating the next generation of engineers. The outcome

for the students became an undeniably valuable first-hand collegiate experience paralleling an engineering professional working in today's ever-evolving global market.

The program was initially designed as a mechanism for six Boeing-sponsored aviation clubs to share activities. In a collaborative partnership with the Boeing Company, the program was restructured to include the University of California, Irvine (UCI) and Virginia Tech, offering a professional seminar for 108 undergraduate aerospace

engineering students at Tsinghua University in Beijing, considered the Harvard or Yale of China.

The expedited planning process was a challenge.

"The time-difference of 12 hours proved to hamper the convenience of communication," said Lester. "Obtaining a travel visa was complicated. The complex application required letters of introduction and a comprehensive itinerary. And planning an event in a venue you have never seen is another challenge in itself."

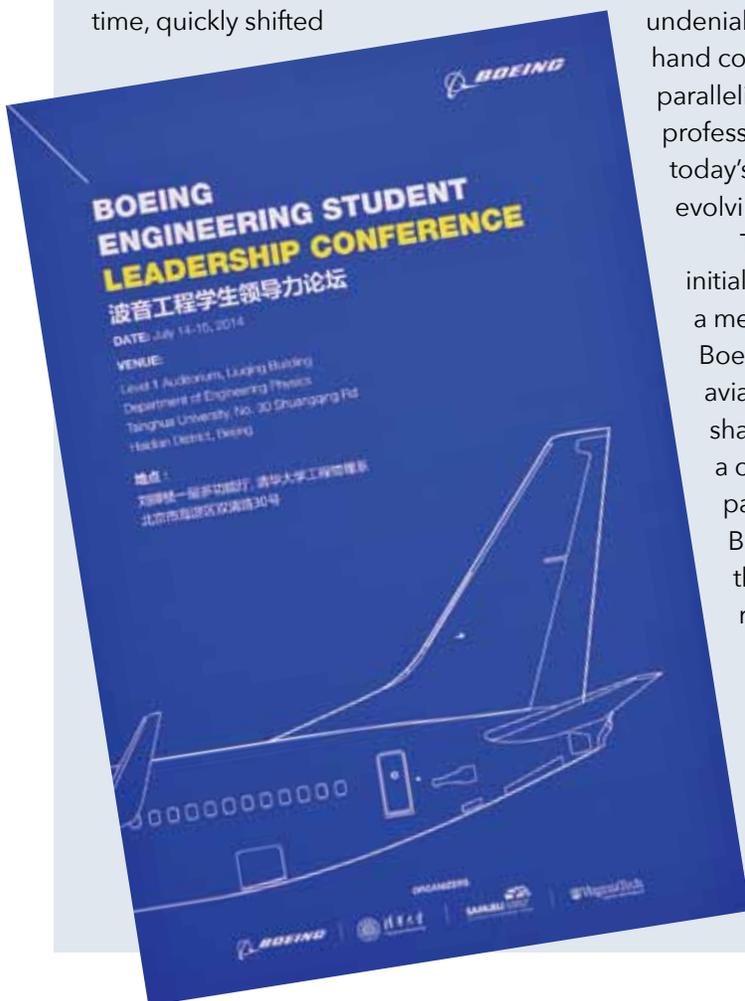
Students would also need to be selected for the program.

The Virginia Tech aerospace and ocean engineering (AOE) faculty, primarily Robert Canfield and Pradeep Raj, spearheaded the selection process and insured students representing Virginia Tech delivered a refined, professional presentation regarding their senior design challenge.

The students were required to have completed the department's two-semester senior capstone design project. Once selection had been made, Raj met with the students numerous times over the course of the few months leading up to July.

"Raj successfully imparted the idea that their presence as Virginia Tech engineering students might be the first for Chinese faculty

*Continued on page 24*





*Howard Chung, Adwoa Baah Dwomoh, and Eric Santure visit the Tsinghua Skyworks Studio.*



*Photo Credit: Boeing*

and students,” said Lester of Raj’s mentoring talents.

The concentration of the Boeing-funded program was a two-day leadership course, co-hosted by the three universities on the Beijing home base. Boeing, the world’s leading aerospace company and largest manufacturer of commercial jetliners and military aircrafts combined, provided the methodical expertise and the universities contributed pedagogical knowledge. Both American and Chinese students were audience to each other’s project presentations and participated in a career and leadership development discussion led by some of Boeing’s most influential international executives.

Howard Chung and Nick Pera, both May 2014 aerospace engineering graduates, part of a four-man student team, prepared to present to their Chinese audience, along with students Eric Santure and Cody Reed. As a

team at the conference, they gave an overview of the AOE department, their senior capstone design course, and the leadership challenges they faced.

“We utilized our own unique skill sets to work together in design teams. Hopefully, we were able to convey that to the Chinese students and faculty,” said Pera. “How they positively responded to us and likewise, in the end helps both groups in better understanding how each formulates engineering design and solutions. It’s a win, win.”

The engineering students recognized the need to be fluent in a second language, especially one as vastly different from English as Chinese.

“I think the biggest challenge for both the student groups – both American and Chinese – was definitely the language barrier,” said Pera.

English is taught starting in third grade in most urban schools. Students are required to pass an English

proficiency test to gain admissions to college.

Chung, raised in Kuching, Malaysia until college, was taught English as a second language and could comprehend most of the spoken Mandarin. He aided the Virginia Tech group immensely in basic communication.

“When I responded in Mandarin, there were a few laughs, but overall I definitely felt respect from my Chinese peers because I was trying to reach out and break past the barrier,” said Chung.

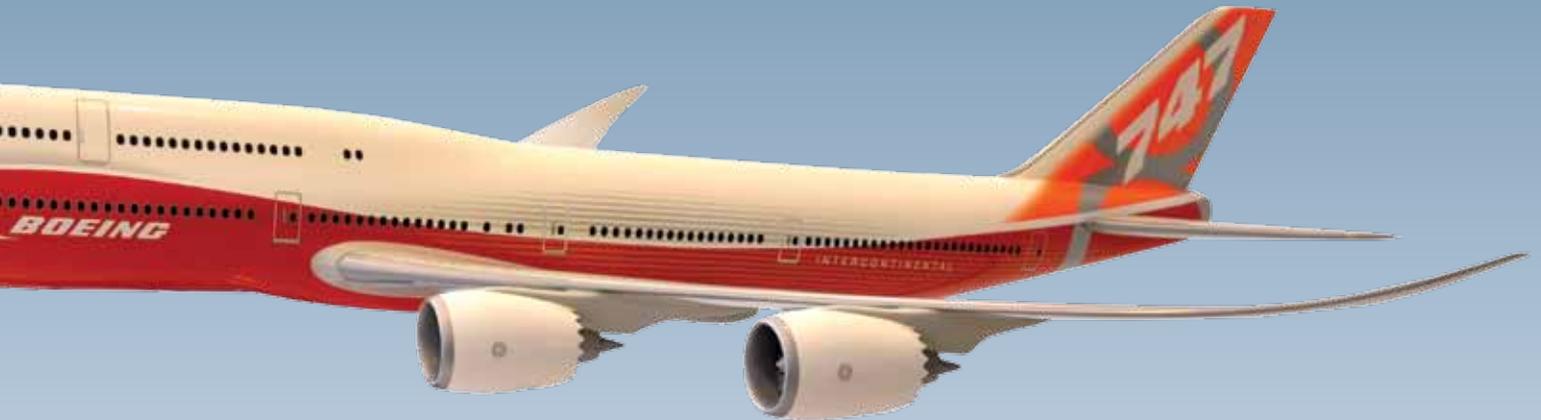
As an undergraduate, Chung had transferred to Virginia Tech on full academic scholarship.

“Not only did we discuss different engineering methodologies and solutions, but we also engaged in conversations concerning social lifestyle and history in China and in the United States,” said Chung.

In his graduate research, Chung advised by Michael Philen, AOE

**“We utilized our own unique skill sets to work together in design teams. Hopefully, we were able to convey that to the Chinese students and faculty. How they positively responded to us and likewise, in the end helps both groups in better understanding how each formulates engineering design and solutions. It’s a win, win.”**

~ Nick Pera, aerospace and ocean engineering student



associate professor, is researching multifunctional materials used in the application of structural health monitoring in aircrafts. Sensors embedded into the aircraft will alert operators of possible flaws within the aircraft structure, revolutionizing traditional inspection and maintenance process in aviation.

With graduation behind them, both students agreed a highlight of the program was the Boeing panel on career and leadership development. But they felt they learned more about the Chinese and their culture from traveling to various destinations in the country.

“Eating in their restaurants, using their transportation systems, and bargaining for souvenirs was fantastic,” said Chung enthusiastically.

Following the 48-hour program filled with industry speakers and student presentations, two weeks of travel commenced and the students and chaperones were immersed in

Chinese culture. Lester was part of the group.

“One day was spent in Jinan. It was 100 degrees and 95% humidity, but we hiked to the top of Thousand Buddha Mountain, which gave us a spectacular view and a nice breeze,” recalled Lester. “On the way down we stopped to see the sculptures and paintings in a cave.”

“An unforgettable and surreal experience was testing our fitness levels hiking a portion of the Great Wall of China,” said Chung.

Pera, originally of Alexandria, Virginia, said working for Boeing during an internship in the summer of 2013 in Huntington Beach, California was “dream come true.” The experience of the internship coupled with the Boeing program reaffirmed his long-term goal of obtaining a full time position with the company post-graduate school, “but hopefully closer to home, like the Charleston, South Carolina location,” Pera said with

optimism.

Since completing his undergraduate work, Pera was employed by the Federal Aviation Administration, but returned to Virginia Tech six months later. Working as a graduate assistant under Chris Fuller of the mechanical engineering department, Pera plans to complete a master’s program in December 2016.

For Chung, he is also focused on his research and hopes to earn his pilot’s license in the near future. He plans to complete his master’s program in May 2016.

“The students recognized four main benefits to participating in the conference and traveling abroad, including: increased cultural understanding, collaborative problem-solving skills, leadership skills, and understanding of the need to be proficient in foreign languages,” said Lester. “They expressed the desire for other students to have similar experiences in the future.”

*Virginia Tech's Center for European Studies and Architecture is in Riva San Vitale. Engineering students found this experience enlightening regarding different emphasis in coursework.*

# COMPLEX, GLOBAL PROBLEMS REQUIRE MULTIGENERATIONAL THINKING

Photo Credit: Larry Hinker



Photo Credit: Anne Wernikoff

*Engineering doctoral student Sheldon Masters examines research at the University of Applied Sciences and Arts of Southern Switzerland during the Global Perspectives Program tour.*

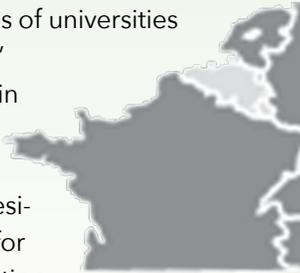
**By Cathy Grimes**

A global graduate research adventure that alumni have called mind-blowing, challenging, and fun marks its ninth anniversary this year, and industrial and systems engineering doctoral student Greg Purdy is one of its 2015 participants.

Purdy, of Portland, Oregon, is among 14 students in the Virginia Tech Global Perspectives Program (GPP), five of whom are graduate students in engineering fields. They will spend 10 days visiting universities in Switzerland and Italy, as well as exploring cultural sites and participating in research discussions and presentations.

"It's not like we're going to Zurich for a day," said Purdy. "We're going to all different types of universities and institutions."

Developed in 2005 and launched in 2006 by Vice President and Dean for Graduate Education Karen P. DePauw, the interdisciplinary program provides students the opportunity to explore differences in academic practices and higher education issues through collaboration with students, faculty, and administrators at institutes including the universities of Basel, Zurich, and Lugano and the



Polytechnic Institute of Milan. Tech's Center for European Studies and Architecture (CESA) in Riva San Vitale, Switzerland serves as a base camp for the GPP students. In addition to the visits to universities, the students explore cities and towns, museums, and castles, and learn about the regions' culture, history, and politics.

*Continued on page 28*

**“We’re moving to a point in time where the most complex issues are the ones you can’t solve by being in one field or one way of thinking. The problems are more chronic and more global. They’re multigenerational problems. I wanted to get that kind of perspective.”**

~ Sheldon Masters, environmental and water resources engineering student

Since 2010, Virginia Tech GPP students have worked with students from the University of Basel on collaborative research projects. Each student also must develop and present an individual capstone project.

### **PREPARING GLOBAL CITIZENS**

DePauw said the program, part of the Graduate School’s larger Transformative Graduate Education initiative, is a unique opportunity for students to prepare for careers as future faculty and global citizens.

“We talk with academic administrators, faculty, and students. We tour the universities – meeting rooms, buildings, and labs,” DePauw said. “We seek answers to our questions.”

The first GPP class comprised 10 students. Since then, more than 120 graduate students have participated, representing all eight of the university’s colleges. DePauw said a good percentage of the GPP students each year have been from engineering programs.

Environmental and water resources engineering doctoral student Sheldon Masters, who was named the 2015 Graduate School student of the year, was part of the 2013 GPP class. His capstone project, like those of all GPP students, was unrelated to his field of research, but dovetailed with his interests. Masters, who is from Mandeville, Jamaica, explored how ethics are taught in European universities compared to Virginia Tech,

which requires all graduate programs to include an ethics component.

“There were stark differences,” he said. “Ethics are more deliberately taught here than in Switzerland.”

He said discussions and the program’s excursions helped him understand how that corresponded to Swiss culture.

### **EXEMPLIFIES HANDS ON, MINDS ON**

There also are plenty of opportunities to explore active research in several fields, including engineering, during university tours. Masters said students not only work across differences in nationality and culture, but also backgrounds and disciplines.

“English was the first language, but you learned that the terms we use in one discipline are different across another profession,” Masters said

GPP 2014 alumnus Matt Chan, a civil and environmental engineering doctoral student from Hong Kong, China, agreed with Masters about learning to communicate effectively. He said the interdisciplinary nature of the program was as rewarding as the research.

“In general, and especially for engineering, the more you understand other disciplines outside your own, the more you will make a meaningful impact,” he said. “You talk to folks with different but similar experiences, and you compare issues and problems.

“In many ways the experience

exemplified Virginia Tech’s ‘hands on, minds on’ slogan.”

### **DAYS FLY BY**

Students can apply for GPP in the fall. To be eligible, they must successfully complete two Graduate School courses: Preparing the Future Professoriate (GRAD 5104) and Pedagogical Practices in Contemporary Contexts (GRAD 5114) and submit an application and essay. To help minimize the cost for course participants and to make the program more accessible, the Graduate School covers the majority of expenses.

Once selected, students attend tri-weekly meetings with the dean throughout the spring. The trips generally take place during the last week of May and the first week of June. The final on-campus meeting, held just before the spring semester ends, includes GPP alumni, who offer their perspectives and helpful advice about what to pack and where to go. Alumni at the April 30 seminar told this year’s students the 10 days would fly by and the schedule would be rigorous.

Masters, Chan, and other alumni noted the experience is deeply challenging and occasionally frustrating in addition to being fun and enlightening, as the students have so much to do in the limited time frame, into which they also must fold travel and time to think and absorb what they are learning.

DePauw said students keep journals and write about their

observations and personal reflections in addition to their group and individual research.

### EXPANDING HORIZONS

Since the first global perspectives trip in 2006, DePauw said the program has attracted the attention of universities across the United States. In 2012, she led a GPP trip for graduate school deans, and several universities have modeled their own programs on the GPP. The program also expanded from Europe to South America in 2012, when DePauw led a group of students to Chile for a week-long program visiting three universities.

"By any measure, the program has been a success," she said, noting that participants have visited universities in France and Germany as well as Switzerland and Italy, and several presentations and publications have resulted from research. Additionally, Tech and participating universities have developed strong connections and partnerships.

Masters and Chan said one of the highlights of their experience was presenting the capstone projects and group research at the Swiss Embassy in Washington D.C. Both said their experience challenged them and provided invaluable perspective not only about higher education, but their own work.

Purdy, who has discussed the program with several alumni, said GPP students all have described it as life-changing. "They all say they learned a lot and they can't really quantify the experience. You learn about culture, society politics, pretty much everything."

That education is important not only for graduate students who want to be faculty members, but for scholars who want to help solve global problems, Masters said.

"We're moving to a point in time where the most complex issues are



***Sheldon Masters, who successfully defended his dissertation in 2015, is a firm believer in having a global perspective when looking at complex issues.***

Photo Credit: Shelby Lum

the ones you can't solve by being in one field or one way of thinking," said Masters, who successfully defended his dissertation during the spring semester. "The problems are more chronic and more global. They're multigenerational problems. I wanted to get that kind of perspective."

For more information, visit the Global Perspectives Graduate School

web page (<http://graduateschool.vt.edu/GPP>), and the GPP Blog (<http://blogs.lt.vt.edu/globalperspectives/>). GPP students post regularly on Twitter (@GPPVT) and on Facebook (<https://www.facebook.com/GlobalPerspectivesProgramVirginiaTech>). The program also is developing iTunes and YouTube pages, and a Flickr photo stream.

*This view of Lake Lugano captures the picturesque city in the background.*



Photo Credit: Larry Hinker





*Virginia Tech's Student Engineers' Council (SEC), designated multiple times as the Most Philanthropic SEC in the country, has created a new \$120,000 International Humanitarian Engineering Endowment. The 2014-15 SEC Council, led by Matt Donaldson, encourages additional donations to help match this contribution that will provide for related expenses on international humanitarian projects such as the ones described in this publication on pages 6 and 14.*

*This endowment is the third created by the SEC in the last ten years. One is complete at \$500,000, and the second one will reach \$1 million by 2020.*



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