Volume 36 | Number 3 | September 2015

ENGINEERS' FORUM

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ON THE COVER

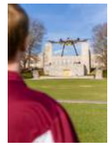

Photo / **C.A.M. Gerlach**
The Cooperative Autonomous Robotics Design (CARD) presents their hexacopter design to students with a live demonstration on the drillfield. CARD hopes to "automate the future" with their innovative designs.

Check out Virginia Tech CARD at:
facebook.com/VirginiaTechCARD

Photo / **C.A.M. Gerlach** 7

Features

Letter from the Editor

As the new Editor-in-Chief of Engineers' Forum, it is my privilege to welcome our readers to another year at Virginia Tech! I hope you all are as excited as I am for a new semester, one hopefully filled with unique opportunities and the chance to create new and lasting friendships.

First off, I would like to take the time to commemorate the late Dr. Paul Torgesen. A former professor, dean, and president at Virginia Tech, Dr. Torgesen was an icon in our school and community for 58 years. Known to many as a "professor's professor," he was revered by students and faculty alike and will be greatly missed. Dr. Torgesen is survived by three children and grandchildren.

Despite this loss, our science and engineering departments have been hard at work on new advances in their respective fields. Want to find out how we are minimizing sudden leaks in pipes? Kristine Mapili investigates civil engineers' efforts to tackle the decades-long problem of erosion corrosion. Check out how print media, like the Engineers' Forum and college newspapers, are transitioning into the age of the Internet in Alex Papp's article. Let C.A.M. Gerlach take you on a tour inside a tornado at Tech's new virtual reality facilities. For our leisure readers, Ben Gingras brings us a story of love and space travel that is sure to tantalize your imagination!

We also covered two exciting regional engineering competitions so you can find out how well our Hokies placed in the ASCE's steel bridge contest at VMI in Sean Pili's report, or hear Vidya Vishwanathan's take on the out-of-this-world projects presented at the American Institute of Aeronautics and Astronautics student conference held here at Virginia Tech.

Finally, keep an eye on our Facebook and Twitter feeds for more updates and content from the Forum this year. We depend on readers like you to make the best magazine possible, so thanks for tuning in!

Editor-in-Chief
Nahu Dimitri

ENGINEERS' FORUM

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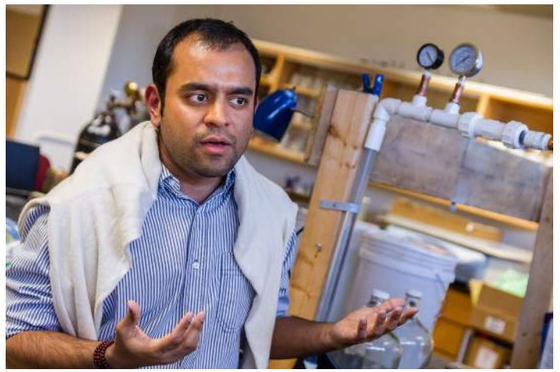
PUZZLING PIPES

CIVIL ENGINEERS PLUMB CORROSION MYSTERY

KRISTINE MAPILI, CIVIL ENGINEERING

Photo / **C.A.M. Gerlach**

Copper is widely used for piping material because it is corrosion resistant, easy to plumb, and expected to last several decades. However, some copper pipes can fail in a few years or even months due to a phenomenon called erosion corrosion. This has been a known problem for several decades, and is a serious issue due to the billions of dollars spent on installing copper pipes in US buildings each year. Unfortunately, the phenomenon is poorly understood. Siddhartha Roy, a PhD student in Civil Engineering, investigates this phenomenon in Dr. Marc Edwards' lab in Durham Hall. In order to do this, Roy recreates conditions known to cause erosion corrosion by varying water chemistry, temperature, velocity, and other variables to find which is responsible for the erosion corrosion of copper pipes.



In the 1960s, a group of researchers at Michigan State University investigated copper pipe failures in dorm buildings. They found that soft water was responsible for pipe failures. It then became common knowledge that hard water containing calcium carbonate, which formed a protective layer on the insides of pipes, was better for pipe systems than soft water without calcium carbonate.

However, there was a recent case in California that defied the assumptions as hundreds of leaks occurred in dorm buildings within two years of construction. Hard water flowed through the pipe systems, but the large number of leaks did not make sense since hard water was thought to protect copper pipes from leaking. Researchers found that hard water in a hot water system (which consists of a pump and a heater that heats up water and constantly circulates the water so that when the tap is opened, hot water comes out instantly) for large buildings results in the precipitation of larger hard particles of aragonite or calcite. When these particles flow into the pipe loop and circulate, they impinge on the wall, stripping away the protective layer of calcium carbonate, exposing the copper to the water, resulting in an accelerated rate of corrosion, hence the term erosion corrosion.

"Pipes, I think, are underappreciated as infrastructure because they're essential to our everyday life"

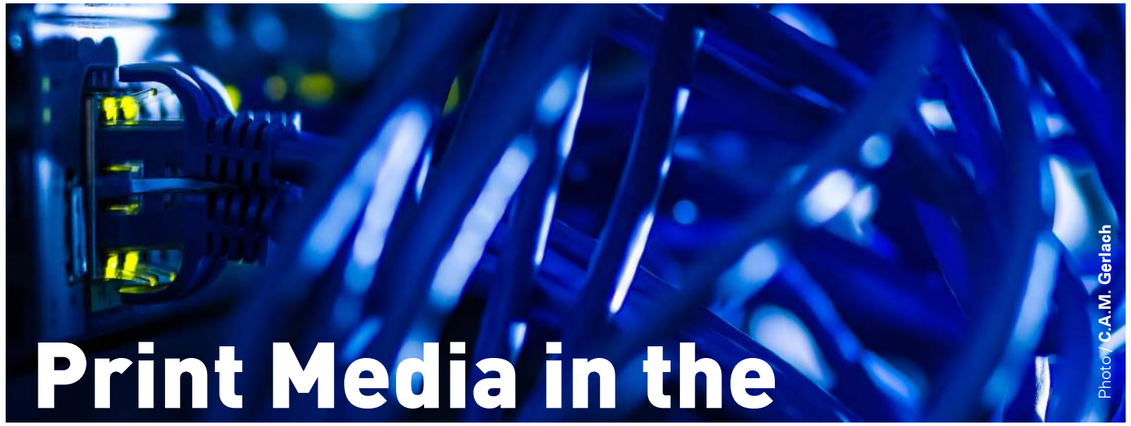
Photos / C.A.M. Gerlach
Clockwise from left: **1.** Roy explains his investigation of erosion corrosion, a phenomenon that is responsible for a large number of pipe failures across the United States and around the world. **2.** Roy holds aragonite particles that have precipitated from calcium carbonate in hard water. These particles have been found to be responsible for erosion corrosion damages in a real copper pipe system. **3.** Roy shows brass elbows that have been damaged by erosion corrosion. While brass, an alloy made of copper and zinc, may be stronger than copper, Roy has found that brass is also not immune to erosion corrosion.

Metal corrosion occurs when an exposed metal is in contact with an electrolyte, such as water. When this happens, a battery is formed. When water flows through copper pipes, the copper ions separate from the pipe, leaving behind an electron within the pipe surface. The copper atoms then undergo what is called an oxidation reaction, and the oxidized metal becomes soluble in the adjacent water solution. The oxidation of the metal is termed corrosion. This process repeats over and over and with time, a hole can form in the copper. Copper is expensive, and hundreds or thousands of dollars are needed to replace parts or all of the system when failures occur. Copper corrosion is especially a problem for drinking water systems.

Soft water has been known to be bad for copper pipes, but Roy's work has demonstrated that hard water, in some cases, can be just as bad or even worse. Previously, he ran experiments with slurries containing large amounts of particles and found that they did cause the pipe to fail, typically around the elbows, where there is higher turbulence due to the rapid change in velocity of the water. Roy also found that failures could occur in long, straight sections of pipes, but the turbulence does not look significantly different. This has led him to believe that there is still a missing piece to the puzzle. Perhaps other factors can play a role, but there are many that have yet to be investigated.

Photo / C.A.M. Gerlach
Siddhartha Roy, a PhD student in Civil Engineering, has successfully demonstrated in the lab that aragonite particles present in hard water can cause pinhole leaks in copper pipes.

With millions of miles of unseen pipe underground, most people do not realize the importance of copper piping in our lives. "Pipes, I think, are underappreciated as infrastructure because they're essential to our everyday life," Roy says. "You get your water every day and you don't think even think about what happens when water goes down the drain. It just magically occurs for the most of us."



Print Media in the Digital Age

Alex Papp
Civil Engineering

Magazines and newspapers have experienced a turbulent market in recent years, with stiff competition from a growing body of media websites. With a wealth of information freely available on the Internet, print media has been trying to retain its audience while assuring subscribers that they are still worth a read. Radio was certainly not killed by television, and Netflix did not destroy the market for cinema as each form of media has a unique role in society. However, as the market continues to evolve, print publications will have a less exclusive role in the reporting industry, and this means some papers will either be forced to close or to adapt to the new market.

Unfortunately, collegiate media has been particularly susceptible to this uncertain market. Many collegiate newspapers, such as those of Boston University, have had to cut back on the frequency of printing. Others, such as those of the University of Oregon, have ditched print all together in favor of online publication.

The survival of these college media outlets is critical. Aside from providing an outlet for contributors to write and share their thoughts, they also afford crucial experience for tomorrow's journalists. Michael Stowe, a former Roanoke Times Editor now working at Virginia Tech, has hope for the industry's future. He witnessed firsthand the decline in print readership over the years, and believes that strong digital content is the answer. Unlike prints, digital articles only require bandwidth, which is far cheaper than the printing and distribution fees associated with print newspapers and magazines. Digital articles are also available wherever and whenever their readers need them - be that on the bus to class or writing a research paper at two in the morning. Additionally, the archive of available articles means thousands of newspapers available at your fingertips with far less environmental waste. With the booming digital age, switching to the online format is both environmentally friendly and technologically advantageous.

However, making the transition can be difficult for some. Printed newspapers and magazines have long been a staple of American life. Many college newspapers have been in service for decades, including the Collegiate Times, which has printed for 112 years. Ending such a legacy can be difficult for some, as it represents a significant portion of the school's history.

Fortunately, many readers continue to favor the physical presence of a printed newspaper over that of a screen. Therefore, print does not have to be abandoned. Less frequent printing can offer dedicated readers the same product they have always enjoyed while continuing to meet the demand for those who do not have as much time for the daily news. Many publications, both college and not, have reduced their printing to once every few days, or even a few times a semester. While the website and social media can act to deliver news immediately and offer online exclusives, less frequent printing can highlight major stories and act as a review.

Online technology offers a number of new formats for reporting the news and social media is particularly prominent in colleges across the country. With a high user base and near instantaneous feedback, newspapers and magazines can reach new audiences while getting information to readers without the delay of printing. Without the newsstand, attracting viewers to your articles is crucial, and having a strong presence on websites like Twitter and Facebook ensures you keep readership high while getting the information out in the public. The Collegiate Times assigns Twitter accounts to many of their contributors and developing social media resources has been a major focus for the Engineer's Forum over the last year. Another prominent online format is blogging. Whether offering insight into the internal affairs of the magazine or a perspective on campus events, blogs offer a more informal opportunity for the organizations to discuss topics with their

Photo / Courtesy of Engineer's Forum
Virginia Tech Engineer's Forum magazine homepage. Check us out on the web at *www.ef.org.vt.edu/*

readers. With these new tools, journalists and writers must always ensure that they continue the journalistic integrity of their predecessors. Social media can often sensationalize an issue or fail to paint the whole picture. Writers must be honest and objective in what they post, and viewers, in return, are expected to read without judging headlines alone. For digital media to be successful, it must match the professionalism of traditional print.

Many collegiate newspapers have already made significant changes in the way they print and present information, and more changes are likely on the horizon. As Stowe sees it, traditional newspaper jobs will continue to decline, but the market for digital journalists will continue to grow. As long as we have an interest in news stories, there will be a need for journalists. As he sees it, "The right business model likely involves fewer print editions, stronger digital content and some type of support/partnership with either an academic college or student affairs."

The Engineers' Forum continues to print without issue, thanks to readers like you, our staff, supporters, and advertisers. We, too, have invested in our online presence and encourage you to visit us at our website and check out our social media. Print media may have stagnated, but there are more ways than ever to find out about what matters to you.

Photo / **Logan Wallace—University Relations**

Weather Channel meteorologist Jim Cantore has reported from hurricanes, blizzards, flooding and other extreme weather of all sorts, but he and severe storms expert Dr. Greg Forbes are about to be part of an on-air first. "Dr. Forbes, take it away," barks Cantore, as his counterpart leads them toward a powerful tornado in the distance. The pair dodges past a wall of heavy rain and large hail, as Dr. Forbes provides a play-by-play description for hundreds of thousands of viewers on television and online. "If I look up, I can see I'm walking underneath some softball-size hail aloft—if that hit me in the head, that could kill me," he remarks, as the two meteorologists proceed gingerly toward the heart of the storm. As they pass into a forebodingly calm region closer to the tornado, a dull roar begins to fill their ears, and objects start to swirl around their feet. "I'm going to look down to the southwest and—oh my, there's the tornado!" exclaims Dr. Forbes. Sure enough, behind curtains of rain and debris, a whirling column of air is visible mere meters from the men, extending up toward the sky.

While this all may sound like a scene out of a Great Plains disaster film, the protagonists are in fact thousands of miles away, in no danger of being swept up in the tempest. Cantore and Dr. Forbes are inside the "Cube," a four-story-high "living laboratory" facility within Virginia Tech's Moss Arts Center. A partnership between Virginia Tech's Institute for Creativity, Arts and Technology (ICAT) and its Center for the Arts, the Cube's array of bleeding edge equipment allows visitors to immerse themselves in virtual worlds, including today's tornado.

Top to bottom: **1.** The wing of Virginia Tech's Moss Arts Center where the Cube is located. This newly built, four-story facility housing the tornado visualization is the one of the largest of its kind in the world. **2.** The interior of the Cube "living laboratory" space, photographed prior to a music performance. Alongside the 2013 Moore tornado, the Cube's unique capabilities host a variety of artistic and scientific endevours.

More ominously, the actual storm being depicted is all too real. No mere movie-plot fantasy, it is a 3D reconstruction of the tornadic supercell that hit Moore, Okahoma, on May 20, 2013. This violent twister caused 25 deaths, 377 injuries, and two billion dollars in property damage, obliterating no fewer than 1,150 homes in the process. As Forbes explained, he hopes the power of such a realistic visualization will help reduce these impacts by motivating people to take life-saving action in the event of the real thing.

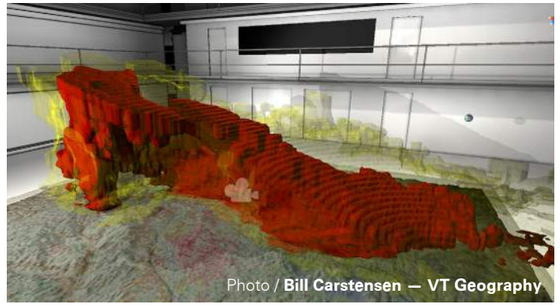
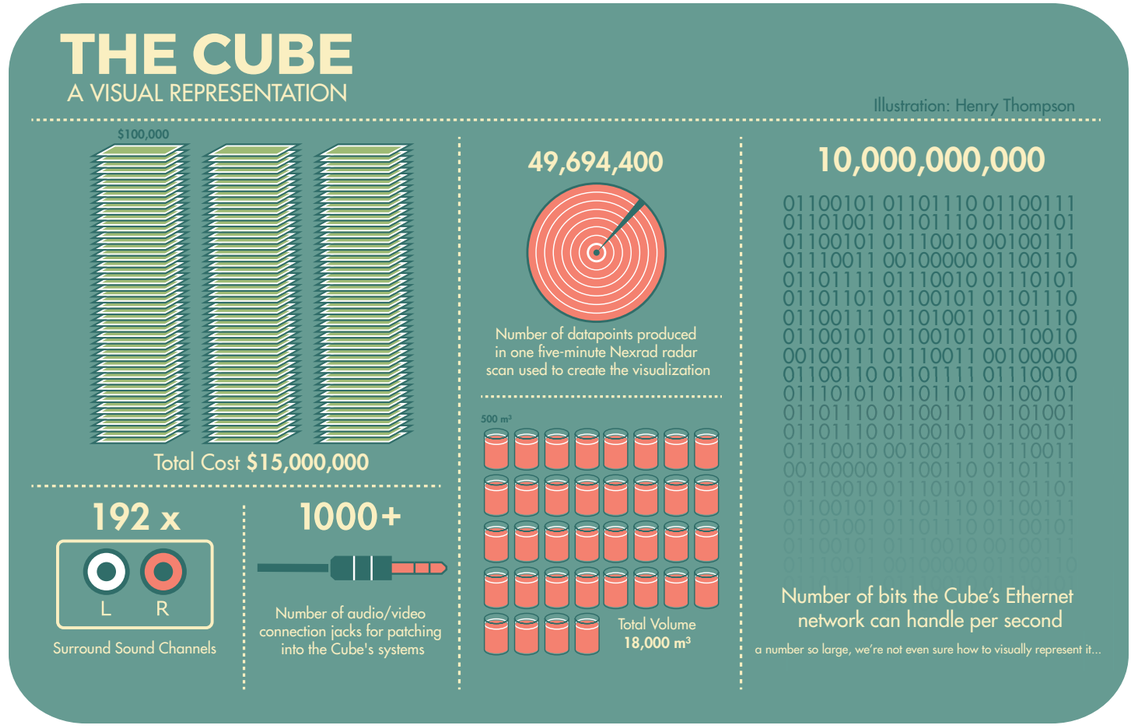


Photo / **Bill Carstensen — VT Geography**

A 3D visualization of the tornadic storm modeled in the cube, based on radar reflectivity data roughly measuring precipitation, with red areas being most intense. The tornado itself is contained within the cylindrical red mass of heavy rain and debris to the far left.

The Cube is brand-new, having officially opened in late January of this year. However, it is only the most recent product of Virginia Tech's pioneering research into virtual reality—dating back to the mid-'90s, when the first CAVE was introduced. This facility allowed stereoscopic-glasses-wearing users to experience 3D visualizations projected on the walls and floor of a three-meter-by-three-meter box. Later, as derivatives of the original CAVE popped up throughout the country, it was upgraded in 2010 into the Visionarium VisCube with higher resolution, but visitors were still constrained into that same nine-square-meter space.

Not to be confused with its predecessor, the 2015 Cube is far larger, enclosing a room 15 meters long by 13 meters wide and 10 meters tall, which works out to 20 times the floor area and around 70 times the volume of its smaller counterpart. This immense size means there is a huge amount of space to track, and requires an immense sound system to fill it all with precisely directional audio. The Cube's systems are more than up to the challenge, however, with an array of 24 cameras to track the movement of an equal number of individual targets, Oculus Rift 3D headsets to monitor head position and project stereoscopic imagery into the user's eyes, and a 360-degree surround sound system composed of no less than 147 distinct speakers, including nine highly directional models projecting audio in an extremely tight cone. Combining such cavernous size with exceptional capability, it is little wonder ICAT claims the Cube is "unique in the world."



As for the tornado visualization component, "The project grew from a happy coincidence of activities," as the geography department chair, Dr. Bill Carstensen, describes it. After Virginia Tech's meteorology program began in 2012, senior instructor Dave Carroll demonstrated 3D weather radar projections to Dr. Carstensen, who admitted, "[Even] on a 2D screen, they were pretty cool." Shortly after, the geography department head got the chance to hear ICAT's director, Dr. Benjamin Knapp, describe the possibilities for collaboration with the forthcoming Cube.

Upon consultation, the two decided the tornado visualization would be a great match for the new facility's groundbreaking capabilities, as well as the strengths of Carstensen's department. From the beginning, Virginia Tech's meteorology program has focused on the fusion of traditional weather sensors, such as radar, and emerging ways to visualize the large amounts of resulting spatial data through Geographic Information Systems (GIS). To Drs. Carstensen and Knapp, this project seemed a perfect way to merge to two to provide informative graphics and visualizations.

Meteorology students Kenyon Gladu, now a senior, and Trevor White, a graduate student, were brought on board to help with the programming and development, completing the project's core team. According to the Dr. Carstensen, the goals for the project were twofold: "We want to learn whether a 3D immersion in a radar point cloud will help meteorologists both learn about storm genesis, formation and decline. We also want to see whether or not a more impressive visualization of a storm will make a more meaningful illustration for the public who consume weather reporting on TV or the internet."

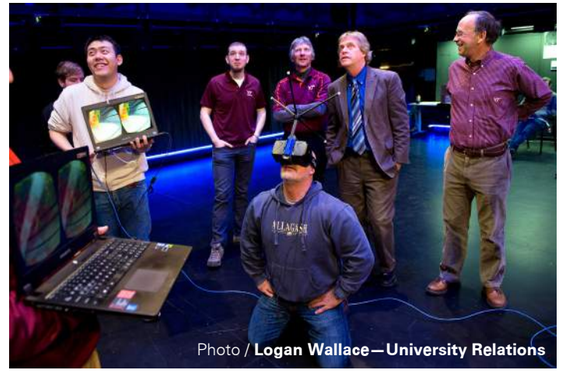


Photo / **Logan Wallace—University Relations**

Weather Channel meteorologist Jim Cantore (kneeling) looks up into the Moore 2013 tornado visualization, as project team members (from left) Run Yu, Trevor White, David Carroll, and Dr. Ben Knapp and Bill Carstensen look on. Cantore and Weather Channel meteorologist Dr. Greg Forbes visited the Cube February 5th to showcase the storm demonstration live on-air.

The team quickly decided to use the 2013 Moore, Oklahoma tornado to showcase the project, and after acquiring archived National Weather Service (NWS) radar data, Gladu "did a thorough analysis of the 3D structure" of the storm and plotted its track, so that the various types of data could be successfully integrated. White then re-wrote NWS visualization software to properly render the storm in 3D, and computer science graduate student and ICAT team member Run Yu helped translate that output so it could be viewed in the Cube. Meanwhile, Dr. Carstensen led the effort to integrate mapping and GIS data into the mix, which could be projected under visitors' feet.

According to those experiencing the result, the project was a stunning success. Says Kathryn Prociv, a Weather Channel producer and recent Virginia Tech grad who was instrumental in getting the Cube featured on air, "It is a beautiful marriage of geography, meteorology, graphics and computer science. No one else in the world has done this, and it [came about] because of the interdisciplinary relationship we have at this university," adding that she expects it to fully captivate the interests of viewers. In an interview with the Collegiate Times, Dr. Forbes remarked, "Virginia Tech meteorology is in uncharted waters. They are doing things that have never been seen before with any other meteorology program." Its interdisciplinary approach also benefited those students participating in the research. As Gladu describes, "this project has really given me an opportunity to experience another field that I didn't really get to dabble with in the past."


Photo / **Logan Wallace—University Relations**

Left to right: **1.** Weather Channel meteorologist Jim Cantore (with headset) shares his impressions of the 2013 Moore tornado visualization with geography department chair Dr. Bill Carstensen, as ICAT director Dr. Ben Knapp (wearing tie) looks on. Cantore and Weather Channel meteorologist Dr. Greg Forbes broadcast live from the Cube, allowing hundreds of thousands of viewers to experience the 3D storm. **2.** Weather Channel meteorologists Dr. Greg Forbes (left) and Jim Cantore answer questions from Virginia Tech meteorology majors about their experiances. The pair visited the students prior to their broadcast of the tornado visualization in the Cube on February 5th.

Photo / **C.A.M. Gerlach**

Beyond captivating viewers on television, such visualizations have a multiple uses as research and forecasting tools. As Carroll, the meteorology instructor, remarked to the CT, "The Cube can be used for a land-falling hurricane, or maybe a big snow storm where we can actually display land surface on floor and bring the hurricane in real time out over the land and estimate which areas may be flooded. It could be very important for city officials to help evacuate people." While the project is still relatively young, the visualization has already allowed meteorologists to detect a curious "hole" through the tornado, nearly invisible to two-dimensional viewing methods, which could indicate "stronger winds moving through the storm than we were previous aware of," as Gladu relates. Given what was found within a mere snapshot from a single event, he muses, "who knows what we could figure out with more data?"

As for the future, the team has several ideas. "One of our next tasks is to properly animate and allow interactivity with the entire set of Moore 2013 tornado radar data," Gladu says. In the longer term, "we'll be able to expand to incorporate other high impact weather events like hurricanes, and simulate 3-D wind fields that can be used to better study the winds of any weather event. My hope is to give researchers and operational meteorologists another way to view, study, and identify features in storms that were previously undiscovered." For students, the Cube could become an invaluable teaching tool, allowing future atmospheric scientists to actively explore and experience severe storm cases, rather than simply reading about them out of the static, flat pages of a textbook.

Back in the Cube, after his own virtual journey through the tornadic thunderstorm, Dr. Forbes had a more succinct but no less enthusiastic response, remarking, "This may be the future of forecasting."

Added Prociv, "You get to walk through a 3D tornado. It doesn't get more amazing than that."

Check out the Cube at
www.icat.vt.edu/content/cube-0

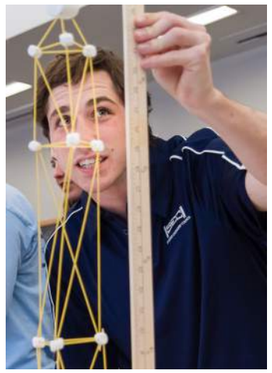
VIRGINIA TECH E-WEEK

Virginia Tech's engineering design teams were hard at work in the last academic year and participated in E-Week, a recruiting and showcasing event hosted by the Student Engineers Council. This multi-day fair in the spring offers these clubs a chance to present their work to other students, while providing visitors an opportunity to explore and potentially join different groups. Many different specialties were featured, ranging from drones and trebuchets to vehicles and bridges. One of our photographers stopped by the event and captured some of the action.

Photo / C.A.M. Gerlach
The Cooperative Autonomous Robotics Design (CARD) presents their hexacopter design to students with a live demonstration on the drillfield. CARD hopes to "automate the future" with their innovative designs.

INTERESTED?

For those of you who are interested in joining a design team in the fall, we strongly encourage you to visit Gobblerfest on September 4th, where many of these same groups will be present. The design teams at Virginia Tech are eager to accept new recruits, so don't hesitate to contact them if you are interested in joining!



Photos / C.A.M. Gerlach
Clockwise from left: **1.** Students from the VT Society of American Military Engineers stand in front of the trebuchet they designed and constructed for competitions. **2.** In addition to serving as a recruiting event, one of the E-Week days was dedicated to team building. **3.** VT Baja SAE drove their off-wheel vehicle on the Drillfield for E-Week. Their goal is to build and subsequently race a specially designed "Baja Car" based on rules set by the Society of Automotive Engineers. **4.** Multiple teams comprised of design team members competed in a spaghetti tower contest in which large structures had to be created with limited materials. **5.** Many of the structures turned out to be quite tall and complex. The winners of the contest were awarded $50 per team member.

The Garden

By Ben Gringas

Wisps of smoke rose from the smoldering gun as he worked. Beads of sweat collected on his brow; more as a result of what was on his mind than of what presently resigned itself to the will of his hands. Yet it was his hands and her mind that would deliver them, he was sure of it. As a result, to see him toil was to see purpose personified, if not for his sake, for hers. Two arms embraced him from behind. A warm neck rested on his shoulder and a soft chin nuzzled into the valley of his collarbone, her temple against the square of his jaw. He wiped his brow with his soiled sleeve and paused in his work.

"Stop, I'm filthy."

"There's only enough water for bathing once a week; of course you are," she mused, holding him tighter.

He reached down and squeezed her hand, turned himself around, and held her by the shoulders. His eyes, normally deadened by the cruelties that pervaded his experience, were always revived upon looking into hers. Hers had never once lost their luster, even when left dripping from grief. They transported him back to a place and time that now existed worlds away from the gray plumes that occupied the skies overhead, barring the sun. Cracks formed in the grime that had caked in the seams of his face; he smiled, momentarily lost in a fleeting reverie.

"I've made the reparations to the avionics system, as you asked. With your help, we'll test it of course. I also made you this." He reached down to retrieve something from his shirt pocket. It was a heart made of metal.

"Did you use the welder for this?" she smiled, unable to help herself.

"I found the scrap in a workshop adjacent to the wind tunnel downstairs. Two old, prototype fins. And yes, I used the welder to join the two pieces."

"You know that we can't afford to waste the energy on such trifles, Adam," she sighed. "This facility's back-up generators will only last a month longer, at best. The hydroponics station is drawing enough power as it is, but even more pressing a concern is preserving the liquid hydrogen. Were we to devote the entirety of the remaining power to that end, we would still be left with a week of boil-off, and of course, we've discussed at length that once boil-off begins, we are at its mercy…"

"Evelyn, I know."

She grew silent. He drew her close. Yet the closer he held her, the more he felt as though she would slip through his fingers. He lived in a state of perpetual trepidation, endured as a result of having all that was dear to him secured not by the health of an economy, or even the laws of men, but by the strength and dexterity of his hands. They ached.

"We're close," she said.

Instinctively, he looked rightward through one of the bombshell holes in the far wall of the wing that they currently occupied and glimpsed the rocket, as if her words might conjure a wind to return the evanescent work of man to dust in one fell swoop. Even the jagged, silhouetted edges of the hole through which he peered seemed a set of menacing, blackened teeth that threatened to swallow away that obelisk rising above the Earth. The thought made him shudder and look away.

"When I was a boy, I dreamed of being an astronaut," he said, closing his eyes. "My father spoke to me of his days growing up, when commercialized spaceflight was born. Those dreams were dashed for me, of course, when the war came, but to think I might still…"

"We will."

"To think we'll go up…there," he said, arching his head back and opening his eyes. The ceiling was blackened by a fire extinguished long ago. White flakes of ash clung to its surface, and for a moment, he imagined them to be stars, recalling memory of them from childhood.

"Yes, we're going to go there, Adam. And once there, we'll rendezvous with the transfer vehicle that was assimilated prior to the start of the war," she said.

"You believe the flight codes are still accurate?"

"I do, but if not, you were the finest pilot I ever knew." At this, his tremors stopped and his chest swelled.

"Tell me again what will happen once we arrive in orbit around the black hole," he said, his voice shaking with childlike wonder.

"We'll encroach upon an orbit of an altitude between 200 and 250 kilometers above the Schwarzschild radius. At this position, our time will pass magnitudes slower relative to Earth time. Since we cannot see into the future, it is a simple guessing game. When will humanity have recovered itself and rebuilt? A hundred Earth years? One thousand Earth years? Or do we wait for the remnants of fallout to have completely decayed? That could be hundreds of thousands of years… more likely millions if I had data to analyze pertaining to the extent of the atmosphere's irradiation. Regardless of what we eventually decide, we can choose our altitude above the event horizon such that the passage of our time relative to that of Earth is convenient for us to control."

"And what if, when we return, humanity has not recovered? Earth will endure, I am sure, but people…"

"Are we not human? If we return to find Earth empty, then WE will recover."

"Evelyn, I have been your instrument to guide, and look at the threshold upon which we stand as a result. But even you must question…to see the conclusion of mankind's presence on this Earth around us now…"

"You can't say 'conclusion' if we know that we, at the very least, still exist," she stated.

"Who is to say that what we see is not the ultimate conclusion? You would argue that dissemination of our knowledge to our descendants will prevent this history from being repeated, but after we are dead and gone, our story will pass from history to legend, legend to folklore, and folklore to children's tale. Language will evolve, as it has, and the fewer people who can refer to any original record that we leave behind, the less validity it will have in the eyes of the public. The more degrees of separation between we, the dead, and they, the living, the more our truth will be driven further into abstraction. Regardless of what we return to, whether we rejoin a fledgling society or begin one anew, we face this dilemma," he paused, his whole being bracing against itself:

To you from failing hands we throw
The torch; be yours to hold it high.
If ye break faith with us who die,
We shall not sleep…

"So what would you have us do? Fly into the singularity? Choose death now, and be done? You know suffering Adam, but you forget joy, love," she exclaimed. "In Flanders Fields, John McCrae. And what of this?" She spoke aloud:

We are the Dead. Short days ago
We lived, felt dawn, saw sunset glow,
Loved and were loved…

"Loved and were loved," she repeated softly, looking down at the metal heart that she held. It felt unpleasantly cold there, in her delicate palm, yet its polished surface collected what rays of light managed to penetrate the clouds and caused a faint shimmer.

Illustration / **Yelena Djakovic**

Miles Harnad / Industrial and Systems Engineering

WARE LAB TEAM SUMMARIES

Formula SAE

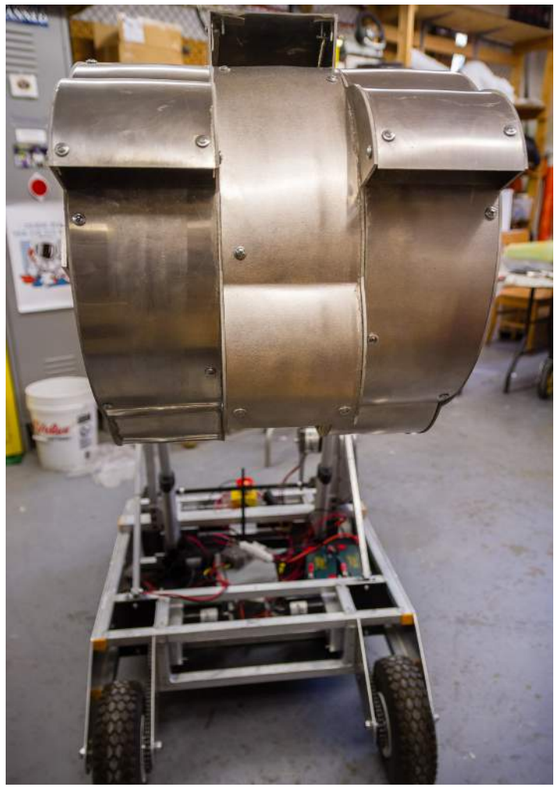
It is hard to ignore the Formula SAE team in the Ware Lab here at Virginia Tech. Comprised of mechanical, aerospace, electrical, and many other diverse disciplines of engineering, the Formula team is one of the largest and most competitive teams in the area. Those passionate about putting together a top-end race car will be amazed by the Formula SAE at Virginia Tech. Building a car from scratch is not easy, making it go from zero to 60 MPH in less than four seconds is unthinkable. But with strong leadership, organization, hard work, and a whole lot of excitement, Formula gets the job done each year as they race over 120 teams from around the world!

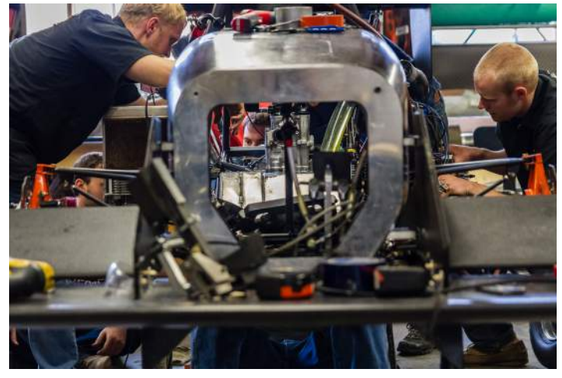
SAE Aero Design

The SAE Aero Design team is a relatively new challenge presented to the hardworking engineers of Virginia Tech. Using their own remote-controlled gas powered plane, the team must drop a three pound package onto a target no bigger than 50 feet. And did I mention that they have to drop it from over 100 feet in the air? Being the largest and only gas-powered aircraft in Ware Lab, the need for constant innovation and thoughtful collaboration is ever present. From the initial concept phase of the aircraft to the late nights working on avionics design, hitting that bullseye is like nothing else in this world.

Astrobotics

No other team in the Ware Lab can say it is designing a project that is literally "out of this world." Each year, Virginia Tech Astrobotics constructs an autonomous mining robot to navigate a given course and gather all of the necessary rocks for points. Known for its great diversity, Astrobotics combines aerospace engineers who want to keep the design light with mining engineers who want the project to be larger. Put the two together and the best of both worlds shows up in the design! The previous robot design is impressive, but considering all the work and talent on this team, its success is not that surprising.





Photos / **C.A.M. Gerlach**

REPORT BY

SEAN PILI

JUNIOR, STATISTICS

Photo / C.A.M. Gerlach
Photographed prior to the competition in Virginia Tech's Ware Lab, one of many parts of the steel bridge awaits being shipped off to the event.

ASCE'S STEEL BRIDGE CONTEST

For the first time since 2010, Virginia Tech's Steel Bridge Team won the ASCE Regional Competition held on April 11, 2015, at the Virginia Military Institute in Lexington, Virginia. The key to the team's recent success was the idea to divide responsibilities between three co-captains instead of leaving all tasks to just one individual. Under the new organizational system, the team was much more efficient than in previous years.

"They've been a good team, [but] over the last few years they've needed to re-organize the team leadership a little bit," said Dewey Spangler, manager of the Virginia Tech College of Engineering's Ware Lab (a facility that enables undergraduate students to design, test and complete innovative engineering projects). "There used to be one team leader, and they did everything," said Spangler, "[but] their planning needed to be improved. They have stepped up [this year]."

Virginia Tech's 2014-2015 Steel Bridge Team was comprised of 50 undergraduate students and was led by three senior civil engineering students: Rachael Truban, Joe Whartenby and Mike Bauer. Each co-captain managed a separate aspect of the project.

Rachael Truban acted as team communications expert, treasurer and project manager. Truban requested approval for all the team's meetings, balanced its finances, and made sure all group members were completing their designated tasks on time. "Truban [gave] everyone updates in emails and [provided] a schedule," said Spangler.

Photos / Andrea Ruano
Top: Co-Captain Rachel Truban (2nd from left, background) oversees the unpacking of VT's bridge. **Left:** Constantine Panagakos (left) wears a harness to suspend the bridge at waist height, allowing him to keep his hands free and help co-captain Joe Whartenby (right) connect the bridge pieces.

"WE FELT LIKE WE WERE FIRING ON ALL CYLINDERS. WE HAD GOOD COMMUNICATION AND CHEMISTRY. WE GOT ADRENALINE FROM THE CHEERING"

Joe Whartenby supervised the fabrication of the bridge and was one of five members who assembled it during the competition. The team used two different software packages for fabrication: AutoCAD and ARiSA.

"AutoCAD is for drawing [the bridge] out. ARiSA is [used for] more structural math," said Jonathan Paquette, a current Virginia Tech Steel Bridge team member, who was voted a 2015-2016 co-captain. "Structural analysis of the bridge: [running] simulations. You don't have time for simulations [while fabricating the bridge]," explained Paquette when asked to elaborate on how ARiSA was used for the project.

Photo / Andrea Ruano
Post assembly: Whartenby, (left) Panagakos (standing), Colebrook (center) , Farell (front right) , and Bauer (right) inspect the bridge before the load-test. (Andrea Ruano)

The team also used AutoCAD to create a sketch of the bridge. Members then plugged the dimensions, design, and weight of the bridge into ARiSA to test its wind resistance, how much weight it could withstand, etc. The use of ARiSA saved the team the time and effort of having to build the bridge before testing it. ARiSA also allowed the team to weed out bridge designs that looked promising but were not as structurally sound as members would have liked.

Co-Captain, Mike Bauer, supervised the design of the bridge and was another one of the five members of the team who assembled the bridge during the competition. Bauer wished it to be known that fellow teammate, Brett Farmer, assisted in fabrication of all the bridge's connections.

Whartenby, Bauer, as well as and teammates Jonathan Colebrook (2016 co-captain), Brendan Farrell (Senior CEM) and Constantine Panagakos (CEM), were members of the group that built the bridge during the ASCE regional competition.

The build was one of two graded activities that took place during the competition. The other assessment was a load test (conducted after the bridge was assembled). The results from those assessments were factored in with other criteria to make up the six scoring categories for the competition. Scores from the following six categories were combined to give an overall assessment of each team's bridge: Display, Construction Speed, Lightness, Stiffness, Construction Economy and Structural Efficiency.

Virginia Tech ranked first in five of the six categories (all but Construction Speed) and first overall in the competition. Although Virginia Tech's Steel Bridge Team did not have the fastest construction speed, the team that did (Marshall University) was disqualified because its bridge failed to hold the required weight during the load test.

Virginia Tech had the second fastest construction speed time at approximately 26:40. This was a huge victory as it usually took the team over 30 minutes to build the 1/10th scale bridge, resulting in a minor penalty.

"We felt like we were firing on all cylinders. We had good communication and chemistry. [We got] adrenaline from [the] cheering," Farrell said when asked what the atmosphere was like during the build-test.

Thanks to this year's new organizational system, Virginia Tech's Steel Bridge Team was so far ahead of schedule that it was able to do multiple build-tests before the competition. Though the best practice run was around 34 minutes, practice paid off as the team finished below the 30-minute mark during the competition.

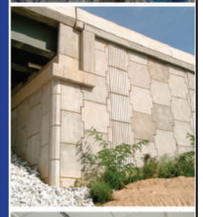
As shown in the picture below, three members of the assembly team wore harnesses to suspend the partially built bridge, allowing them to keep their hands free to assemble the bridge, while two other members sprinted back and forth with more pieces.

Virginia Tech was the only team to use this innovation, which allowed it to work more efficiently than its competitors. As soon as Virginia Tech's bridge was assembled, it was inspected by judges for scoring and sent directly to the area where the load test would be conducted.

To pass the load test, the bridge had to hold 2600 pounds without the bridge showing any physical signs of stress or buckling. Virginia Tech was one of the final teams to compete, so the team knew that if its bridge passed the load test, it would win the regional event and qualify for national competition for the first time in five years.

As the full weight was placed onto the bridge, VMI's gymnasium erupted into a chant of "Let's go, Hokies!" and Virginia Tech's Steel Bridge Team congratulated each other on a job well done.

Unfortunately, the team did not place at the ASCE National Student Steel Bridge Competition held on May 23, 2015, at the University of Missouri in Kansas City. However, given its exemplary achievement at this year's regional competition, Virginia Tech certainly has the momentum to follow up with another brilliant performance in 2016.



HOKIES REPRESENT

AIAA REGION 1 STUDENT CONFERENCE

Vidya Vishwanathan, Aerospace Engineering

Flight AIAA landed at Virginia Tech this March to hold the 2015 Region I Student Conference. The American Institute of Aeronautics and Astronautics (AIAA) is an organization dedicated to celebrating the aerospace profession and collaboration. Each year, the institution holds conferences for students all over the country to present their aerospace research and projects before a panel of judges. Region I consists of colleges and universities along the Atlantic coast from Maine to Virginia. Virginia Tech was given the honor of hosting this prestigious conference this year, and over a third of the presenters were Hokies. The Virginia Tech AIAA Student Chapter organized the entire event to properly welcome the visiting students while showcasing the professionalism of the Hokie engineering department and the beauty of our campus in spring. President Timothy Sands formally initiated the 2015 conference events with a speech on determination and aerospace excellence.

The projects were judged within five categories: undergraduate, masters, team, exhibition, and community outreach. The participants were given 10 minutes to present their projects and had to endure up to five minutes of grueling questions from a plenary panel of judges. Virginia Tech Masters student, John Ikeda, presented about performing 3D flow imaging using Mie scanning. “I was a little nervous before presenting, but I do enjoy it. I like talking to people and explaining things. I have been told that I smile and convey more enthusiasm than most technical presenters, which I believe helps the audience engage more with the subject,” said Ikeda about his experience. Although one may associate the aerospace field with aircraft and rockets, many of the presenters tested the boundaries of what is encompassed by this discipline. For example, there were projects that ranged from the aerodynamic design of hypersonic air vehicles to something more bio-inspired, such as a study of the aerodynamic ability of a robotic caudal-fin. One group of Virginia Tech students presented a project that was inspired by the flight of a seagull and the degrees of flight freedom. They studied and developed a bio-inspired, kinematically accurate robotic bird and were awarded second place in the team division for their outstanding efforts.

Photos / C.A.M. Gerlach
The conference presentations were held in Goodwin Hall to exhibit the merit of engineering as well as the beauty of campus at Virginia Tech

Photos / C.A.M. Gerlach
Left to right: 1. Kathryn Thornton delivers a speech on her Space Shuttle experiences and her opinions on the future of space exploration. 3. Masters student representing Virginia Tech presented on 3D Flame Measurement using Tomographic Chemiluminescence. 4. Dr. Fay Collier, project manager of the Environmentally Responsible Aviation Project of the Aeronautics Research Mission Directorate, was a guest speaker at the AIAA Region I Student Conference awards ceremony.

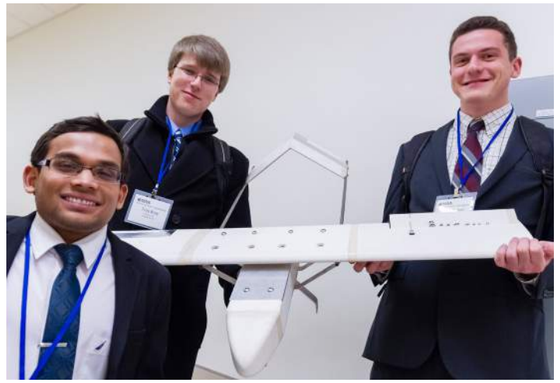


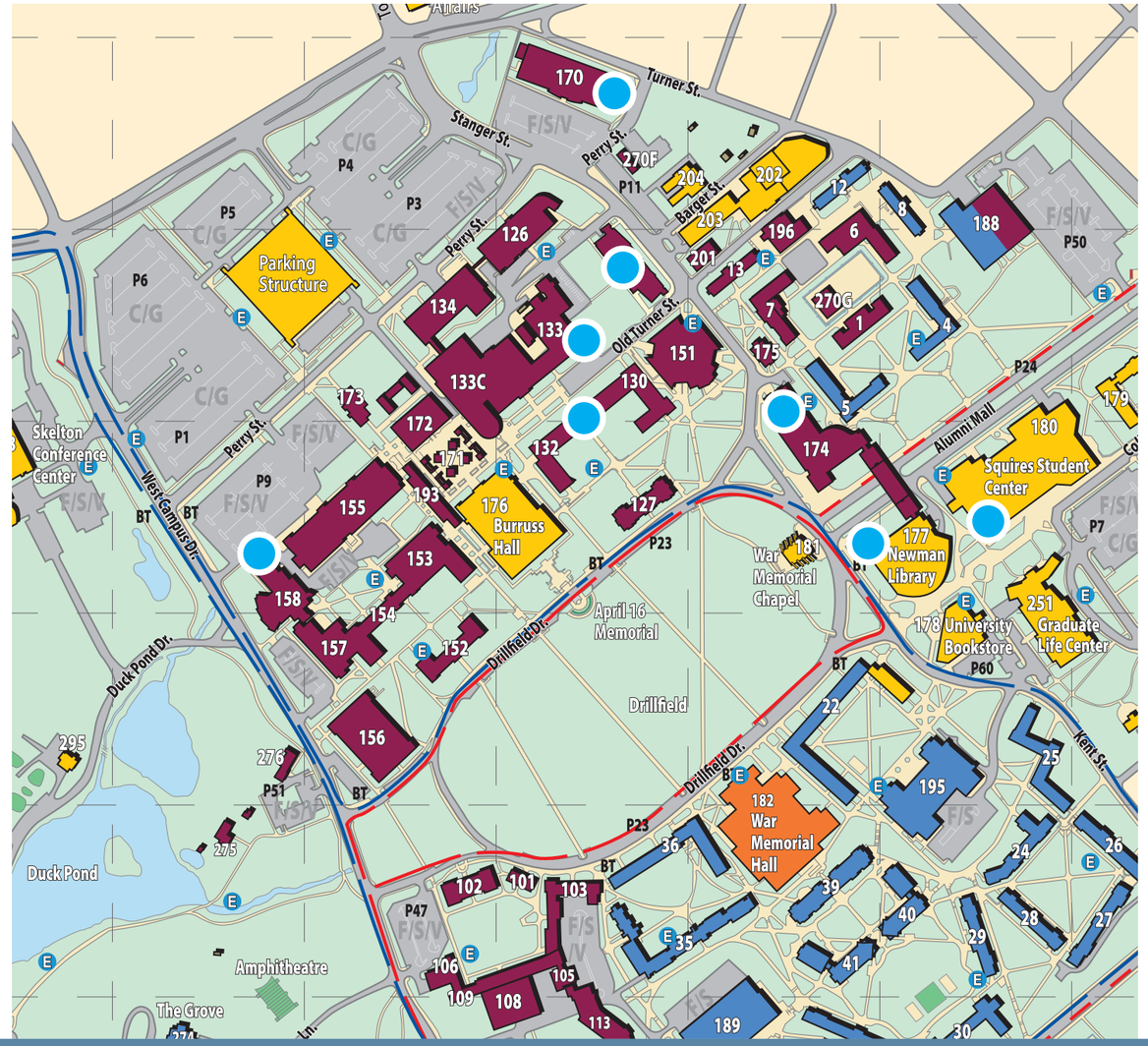
Photo / C.A.M. Gerlach
First place winners in the Community Outreach category, Elaine Khuu, Paul Kennedy, and Matt Turk presented on their Atmospheric Teaching Experiment (ATEx).

"When they called us up for first for the team Division I was so ecstatic, I could barely pay attention to the other winners"

The next day the participants partook in a luncheon with guest speaker, American scientist, and former NASA astronaut, Kathryn Thornton. In her speech, Thornton described her experiences as a mission specialist aboard space shuttles Discovery, Endeavour, and Columbia, as well as her views on the future of manned and unmanned space exploration. The conference's awards ceremony, held in the Bowman Room at the Merryman Athletic Facility, showcased another guest speaker, Dr. Fay Collier, the Project Manager of the Environmentally Responsible Aviation Project of the Aeronautics Research Mission Directorate. Collier addressed the development of new and existing engine and airframe technologies that enable noise and emission reductions for future subsonic aircraft operating in the air transportation system.

Over the two days of the conference, 15 Virginia Tech presenters swept the judges away with their stellar performances. These presenters secured first and second place wins in the team category as well as a first place award in the community outreach category. Megan Burns was a member of the team whose project on the implementation of flexible matrix composite actuators into the eSPAARO unmanned aerial system won first place in the team category. "After the presentation, I was unsure about how well our slides went, but the judges seemed to love our live demonstration of our flap working so I felt we had a good shot at winning… When they called us up for first for the team Division I was so ecstatic, I could barely pay attention to the other winners," said Burns about her team's winning project.

Flight AIAA's next destination for the 2016 Region I Student Conference is Worcester Polytechnic Institute in Worcester, Massachusetts. The immense success of the 2015 conference held at Virginia Tech has set a high bar for the 2016 conference planning staff, and we hope that Hokie representation at these conventions will only continue to grow.



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Dr. Paul Torgerson

October 13, 1931 –
March 29, 2015

President, Virginia Tech
1993 – 2000

Dean, College of Engineering
1970 – 1990

Photo / **C.A.M. Gerlach**

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