A LETTER FROM THE DEAN

Dear Alumni and Friends,

When I came to the Volgenau School of Engineering two years ago, people told me the school was Northern Virginia's “best kept secret.” Being the best is a good thing, but if we plan to start new programs, grow our student enrollment, hire more faculty, and expand our research enterprise, being a secret won’t help. I want this school to be the best, not the best secret.

As part of an ongoing effort to lose the secret and keep the best, we decided to publish an annual report. This publication tells the story of the Volgenau School of Engineering through narratives and numbers in six thematic areas: data analytics, cyber security, sustainability, robotics, health care technologies, and global outreach. The report illustrates each theme with stories and supporting details. Some themes are well established while others are still emerging, but each spans departmental and disciplinary boundaries and captures the depth and breadth of the work of the school’s faculty and students.

The continued exploration and study of these six socially relevant themes will solve real world problems, enhance people’s lives, and make the world safer, cleaner, healthier, and more prosperous. These efforts demonstrate that the Volgenau School of Engineering is a school for the world. I hope you will find the framework helpful for understanding our stories and sharing our news.

Best regards,

Ken Ball, PhD, PE
Dean
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VOLGENAU SCHOOL OF ENGINEERING—ENGINEERING A BETTER WORLD

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Harnessing the Power of Big Data

“The focus here will be graduating people who can go in and technically solve problems versus managing people who can technically solve problems.”
—ROBERT OSGOOD, PROGRAM DIRECTOR, DATA ANALYTICS ENGINEERING

Filling a Jobs Need with a Data Analytics Master’s Program

This fall, the Volgenau School became one of five schools in the country to offer a master’s program in data analytics engineering, a course of study created to meet a burgeoning demand for professionals who can extract insight from the flood of big data collected at a higher rate than it is comprehended.

As part of the graduate program, the school offers concentrations in applied analytics, data mining, digital forensics, predictive analytics, and statistics for analytics—or a combination of two or more concentrations—and concludes with a data analytics capstone course. Just about every Volgenau department is represented in the program, enabling students to approach the degree from any number of avenues.

In the past few years, corporations and government agencies have been clamoring for graduates versed with the kind of expertise that students in the 10-course, 30-credit master’s program will be able to provide. The State Council of Higher Education for Virginia approved the program in fall 2013, and the first students enrolled in fall 2014.

“Companies are desperate because data analytics are so critical to being competitive that they want to be able to apply the
data they have and be more nimble and have more foresight,” says Stephen Nash, senior associate dean of the school. “They need these people right now. It’s hard to get them because it requires training in a lot of areas. It’s four or five different degrees you would have to pull together.”

Most data analytics programs are based in schools of management, not engineering schools. Mason will be the only university on the East Coast north of Raleigh, North Carolina, to offer a data analytics engineering master’s program. No university as far west as Chicago has one.

A version of this story by Preston Williams appeared in Mason News on January 22, 2014.

### Accomplishment Details

#### 10 EDUCATIONAL PROGRAMS
MS in Data Analytics Engineering and BS in Systems Engineering, minor in data analysis

**Related Programs**
MS in Computer Forensics; BS, MS, and PhD in Computer Science; MS and PhD in Operations Research; MS and PhD in Statistical Science; Graduate Certificate in Data Analytics; and Graduate Certificate in Federal Statistics

#### 10 GOVERNMENT AND INDUSTRY PARTNERSHIPS
ACS Atlantic Consulting Services
C4I Consultants (Canada)
ESRI
Innovative Decisions Inc.
KaDSci
NBM Technologies
Research in Motion
Saab
Systematic Software Engineering
VT MÅK

### 25 YEARS OF EXPERIENCE
Much of the school’s scholarship in the field of data analytics can be traced to its close association with two centers, the Center of Excellence in Command, Control, Communications, Computing and Intelligence (C4I), and the Center for Air Transportation Systems Research (CATSR).

The C4I Center celebrates its silver anniversary this year and is the nation’s first and only civilian university-based entity offering a comprehensive academic and research program in military applications of information technology. The second center, CATSR, was founded in 2003. Its Air Transportation Laboratory provides a program of cutting-edge research, development, and education in the critical area of modern air transportation management.

### MORE THAN $53 MILLION RESEARCH EXPENDITURES (SINCE 1999)
The bulk of the more than $53 million of the school’s research expenditures associated with big data is closely associated with the activities of the C4I Center and the CATSR. Other research activities in various departments add to the total.

### Active Departments
Enhancing Cyber Security

“It is much easier for attackers to identify the weak spots and create attack plans that can take down an entire system in networks that use only one defense mechanism. To successfully defend our networks, we must be strategic and employ tactics of maneuvering and movement that constantly keep the attackers guessing.”

—SUSHIL JAJODIA, DIRECTOR, CENTER FOR SECURE INFORMATION SYSTEMS

Researchers Receive $6.25 Million to Prevent Cyber Attacks

Leading a team of researchers, Sushil Jajodia, director of Mason’s Center for Secure Information Systems (CSIS), which is housed in the Volgenau School of Engineering, received a five-year, $6.25 million grant from the Department of Defense to develop adaptive defenses against cyber attackers.

Jajodia is working with co-principal investigator Massimiliano Albanese, an assistant professor in CSIS, and researchers from Dartmouth College, Pennsylvania State University, and the University of Michigan. The project will develop a new class of technologies called Adaptive Cyber Defense, which will force adversaries to continually re-assess, re-engineer, and re-launch their cyber attacks.

Jajodia compares the tactics of a cyber attacker with those used by the military during warfare. Attackers, he says, do reconnaissance before an attack by scoping out their targets, which are typically computer networks of individuals or entire organizations.

The problem with current network defenses used today—firewalls and other intrusion detection systems—is that they...
are largely static. Therefore, attackers only need to create one successful attack strategy to infiltrate the system. Jajodia and his colleagues want to make things harder for adversaries. He likens the approach to shooting at a moving target, as opposed to a stationary one.

Mason was one of 15 academic institutions awarded a grant to perform multidisciplinary basic research. The awards are part of an annual competition conducted by the Army Research Office, the Air Force Office of Scientific Research, and the Office of Naval Research under the Department of Defense Multidisciplinary University Research Initiative. The program supports research by teams of investigators that intersect several traditional science and engineering disciplines.

A version of this story by Catherine Probst appeared in Mason News on October 16, 2013.

Mitigating Risk on America’s Rails
America’s trains move approximately 45 percent of American commerce, everything from coal to corn to chemicals, and when a freight train derails the consequences can spell disaster.

To make the railroads safer, Congress passed legislation that requires new train safety standards to be implemented by 2015. The U.S. Rail and Safety Improvement Act mandates safety improvement by instituting a system called Positive Train Control. This system monitors a train’s movements, speed, location, rail conditions, and other variables through a wireless system and wayside equipment and constantly transmits vital data to the train, thus reducing human errors.

There is, however, a trade-off with this technology.

“One of the most pressing problems with trains today is security,” says Duminda Wijeskera, professor in the Volgenau School’s Computer Science Department. "Traditionally, the nation used a signaling system that relied on rail workers being able to physically see the trains and the signal beacons."

With the implementation of Positive Train Control, in addition to the infrastructure challenges of implementing a wireless system across the nation’s rail lines, there are legitimate concerns that the wireless messages broadcast openly on a signal frequency band could be intercepted. For example, trains carrying hazardous chemicals that also pass through urban areas could be tampered with and cause serious danger to people who live in those areas.

Wijeskera’s work is funded in part by the Department of Transportation, and he has also worked on projects with Siemens. He and his team of graduate students have identified potential security faults and are now testing solutions. One of those students, André Abadie, successfully defended his PhD dissertation, “A Composite Risk Model for Railroad Operations Utilizing Positive Train Control,” in spring 2014 and was awarded a PhD in May.

Abadie, an active-duty military officer stationed at Fort Meade, Maryland, proposed a novel approach for composite risk management of rail operations. The model incorporated operational risk computed by the rail industry and cyber security risk introduced by Positive Train Control. The result of combining these two risk assessment models enhances both. The operational risk model factors potential Positive Train Control failure in its risk assessment and gains awareness of possible requirements for operator interventions. The system risk model factors operational risk as its severity metric, leading to possible requirements for automated risk

NOTEWORTHY ACCOMPLISHMENTS
- 10 Educational Programs
- 15 Years National Security Agency Center of Excellence
- Top 10 National Ranking
- More Than $38 Million Research Expenditures
mitigation by dynamic configuration change to the Positive Train Control radio.

"In the end, we think a flexible communication system can position railroads for the uncertainty surrounding their future operational environment, whether that is a result of regulatory constraints or fiduciary restraint," says Abadie. "Either limitation is best countered by a communication system that can do more, not more communication systems."

Accomplishment Details

**10 EDUCATIONAL PROGRAMS**
MS in Information Security and Assurance; Executive MS in Management of Secure Information Systems (joint program with the School of Business and the School of Policy, Government and International Affairs); PhD in Information Technology, concentration in information security and assurance; BS in Cyber Security Engineering (beginning January 2015); BS in Applied Information Technology, concentration in information security

**RELATED PROGRAMS**
BS, MS, and PhD in Computer Science; MS in Computer Forensics; Graduate Certificate in Applied Cyber Security; and Graduate Certificate in Telecommunications Forensics and Security; MS in Applied Information Technology with Cyber Security Concentration

**15 YEARS OF EXPERIENCE**
Established in 1990, the CSIS has the distinction of being the first academic center in security in an American university. The center is one of the National Security Agency’s original Centers of Academic Excellence in Information Assurance Education, a designation it continues to hold. In 2008, the National Security Agency established a new designation: the National Centers of Academic Excellence in Information Assurance Research (CAEIA-Research). CSIS has earned this new classification and is designated for both CAEIA and CAEIA-Research through 2021. In 2014, we established the Center for Assured Research and Engineering.

**TOP 10 NATIONAL RANKING**
Most of the top institutions, including Mason, are National Security Agency- and Department of Homeland Security-certified centers of academic excellence in information security. Their undergraduate- and graduate-level programs address both technical and theoretical issues in cyber security.

The Ponemon Institute, which administered the survey for Hewlett Packard, compiled the list of top universities based on responses from 1,958 security practitioners, of whom, 65 percent identified themselves as being at a supervisory level. From a list of 403 educational institutions, survey participants selected and ranked up to five institutions in descending order of preference. Respondents rated each school’s program based on their perception of the school’s academic rigor, faculty quality, and other measures.

**ACTIVE DEPARTMENTS**
Applied Information Technology, Computer Science, Electrical and Computer Engineering

**MORE THAN $38 MILLION IN RESEARCH EXPENDITURES (SINCE 1999)**
The bulk of the more than $38 million of the school’s research expenditures associated with cyber security is closely associated with the broad-spectrum research and development programs on various aspects of information systems security conducted by the CSIS. The CSIS serves as a knowledge resource in the area of information system security, develops courses dealing with information systems security, and provides technical support to industry and government in the information systems security area.

**Top-Rated Schools at a Glance**
University of Texas, San Antonio
Norwich University
Mississippi State University
Syracuse University
Carnegie Mellon University
Purdue University
University of Southern California
University of Pittsburgh
George Mason University
West Chester University of Pennsylvania
U.S. Military Academy, West Point
University of Washington
Building Sustainable Infrastructure

“People are suffering a lot because of those coastal storms, so if we can develop a fresh model, I think we’ll help those people living near the shore line because we can predict the storms, the surge, and the areas that are going to be affected.”

—MITHUN DEB, PHD STUDENT AND BAFOUR BEATTY SCHOLAR

Fellowship Winner Uses Coastal Flooding Model to Help His Homeland

To best help his native Bangladesh, Volgenau doctoral student Mithun Deb knew what he needed to do—leave his home country for the opportunity to conduct research that could help it.

Deb won the first Balfour Beatty Distinguished Graduate Fellowship for his study of coastal flood modeling on the Chesapeake Bay. The Chesapeake, in a way, is a stand-in for the Bay of Bengal, the source through the centuries of so many deadly tropical cyclones along the southern coast of Bangladesh.

Deb, who is working on a PhD in civil and infrastructure engineering, hopes that his research along the Chesapeake will be applied to the vast coastline along the Bay of Bengal at the northeastern tip of the Indian Ocean, where many Bangladeshis live precariously, routinely battered by devastating storms. About 80 percent of the country is flood plain, and 75 percent is less than 10 meters above sea level.

Deb had not been to the United States until he arrived here last August, but he already knew that the data he would need to study coastal flooding in this country was readily available from the U.S. Geological Survey website and other online resources.

In Bangladesh, there is no consistent source of such information, Deb says. That makes coastal flood modeling—and the answers those models could yield—far more difficult.

When researching U.S. schools, Deb discovered the coastal storm search modeling conducted at Mason by Celso
Ferreira, assistant professor of Civil, Environmental, and Infrastructure Engineering, who now is Deb’s advisor. Ferreira’s expertise, among other factors, attracted Deb to the university and its programs.

The Chesapeake research can help Deb and others develop models to better determine when storms will hit and where they will hit hardest, information that can be used to spur quicker evacuations and perhaps mitigate structural damage.

Deb visited Bangladesh this summer, including the southern coastline along the bay. Even though his tools and home are in Fairfax for at least the next few years, he wants the scope of socioeconomic vulnerability in his native country of about 157 million to remain fresh in his mind.

A version of this story by Preston Williams appeared in Mason News on March 3, 2014.

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**NOTEWORTHY ACCOMPLISHMENTS**
- First Balfour Beatty Scholar
- 510 Graduates (since 2002)
- 19 Corporate Sponsors
- More Than $2 Million in Private Gift Support

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**Green Computing—Rethinking Computer Design and Deployment**

When most people think of sustainability, the efficiency of a transistor isn’t the first thing that comes to mind. If we think of computers at all, we might consider the vast amounts of energy used in the data centers of Google and Amazon but not the energy consumed by our smartphones, notebooks, and personal computers.

But Houman Homayoun isn’t like most people. Homayoun, an assistant professor in the Department of Electrical and Computer Engineering at the Volgenau School of Engineering, believes that adjustments to these small components can have an exponential impact. The overarching theme of his research is green and sustainable computing. His research targets how to use computing resources in a more energy efficient and environmentally responsible manner.

“The current state of computing is not sustainable technologically, economically, or environmentally,” says Homayoun. “The energy consumed by computers grows as we ask them to do more and more. We need to rethink the way we design, deploy, and utilize them.”

The basic design of computers has remained the same for several decades. The brain and brawn of the computer are housed on a silicone chip. This microprocessor contains various components and one of the key components is its core. Simply stated, the core is the part of the computer that reads and executes instructions. For years, the computer industry has relied on adding more cores to increase computer power—from single to dual to quad and even 8- and 16-core processors. Now, the microprocessor industry faces a challenge called “dark silicone.”

“Dark silicone is a way to describe the part of the computer that must be powered off to keep the energy demands reasonable,” says Homayoun. “Sometimes as much as 50 percent of the silicone chip is not being used. The more cores we add to the chip, the more darkness we will have.” A good way to think about dark silicone is to imagine an office building with half the lights turned off at night—only some of the rooms are functional.

Homayoun and his team of researchers aim to address this problem by developing heterogeneous architectures, or systems that use more than one kind of core, to increase chip performance, efficiency, and lifetime reliability. Heterogeneous designs gain performance not just by adding cores, but also by incorporating specialized processing abilities to handle specific tasks. For example, one core could be designated for one task and when that function is dormant that section of the silicone could remain dark to conserve energy. Because the other cores would continue to work, performance would not be affected.

By enabling more diverse and customized designs, the researchers hope to push the efficiency envelope even further. “Our work seeks to build better computing systems with the goal of saving energy and improving performance. It focuses on the design challenges in high-performance computing systems.”

A version of this story by Martha Bushong appeared in Mason News on May 21, 2014.
Accomplishment Details

FIRST BALFOUR BEATTY SCHOLAR
In 2013, the Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering (CEIE) launched the Distinguished Balfour Beatty Graduate Fellowship with an annual gift to the department from Balfour Beatty Construction of Fairfax, Virginia. This $10,000 per year fellowship is used to recruit an outstanding CEIE graduate student and supplement his or her research assistantship. This fellowship further strengthens the department’s partnership with Balfour Beatty Construction.

510 GRADUATES (SINCE 2003)
19 CORPORATE SPONSORS
ATCS PLC
Atkins Global
Balfour Beatty Construction
The Christman Company
christopher consultants Ltd.
Dewberry
ECS Mid-Atlantic LLC
Fairfax Water
GeoConcepts Engineering Inc.
Kiewit Building Group
Lane Construction
Parsons Brinckerhoff
Pennoni
R. E. Daffan Inc.
Shirley Contracting Company LLC
The Engineering Groupe Inc.
Tri-Tek Engineering Inc.
Vanasse Hangen Brustlin Inc.
Washington Gas
Wetland Studies and Solutions Inc.
William A. Hazel Inc.

MORE THAN $2 MILLION IN PRIVATE GIFT SUPPORT
The shared vision, supported by an enviable partnership among industry, individuals, and the Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering has led to impressive philanthropic support. One noteworthy example is the addition of a new teaching laboratory that adds immeasurably to classroom learning, creates opportunities for developing critical thinking skills through independent study, and underpins higher-level experimental research.

Active Departments
The Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering (in collaboration with departments in the College of Science and world-class federal research laboratories in the National Capital Region); Electrical and Computer Engineering

Educational Programs
BS, MS, MEng, and PhD in Civil and Infrastructure Engineering

Engineering Students Team Up to Build Outdoor Workstation
George Mason University’s Fairfax Campus is a hub of construction, and a brand-new solar workstation designed and built by 10 Volgenau School of Engineering students is arguably the most original product of the activity.

The project started when Nathalia Peixoto, associate professor in the Electrical and Computer Engineering Department, asked students if they wanted to build something sustainable. Two years later, the answer to the question—an attractive, sustainable outdoor workstation—stands in front of Merten Hall.

“I teach electric circuits to electrical and computer engineering students,” says Peixoto. “This is probably the hardest class students take. It is also the first time they are confronted with hands-on projects that involve many aspects of engineering, integrating math and physics.”

Project leader Sam Steiner, who graduated with his bachelor’s degree in May, describes the solar table as “a place where students, faculty and staff can meet outdoors with the amenities of an indoor conference room. It also showcases renewable energy and sustainability as viable options to help reduce your individual carbon footprint.”

This project began with the idea of creating an outdoor charging station for computers and other devices. The Green Patriots campus organization was negotiating with an outside vendor, Enerfusion, for two SolarDok charging stations.

Steiner and the other engineering students—Viet Tran (electrical lead), Chris Dolan (civil lead), Shaun Dircks, Akrem Aberra, Robert Roldan, Jimmy Mejia, Mannan Javid, Bryan Steckler, and Stanley Bonta—believed they could build something with more features. Mason’s Office of Sustainability agreed to give them the chance.
The finished product includes seating for eight people, a table with six AC outlets, 12 USB ports, an LED television screen and Wi-Fi, all powered by a massive battery pack stored underneath the table. The solar canopy overhead provides shade on sunny days and is equipped with an auxiliary light fixture for cloudy days.

The table’s top and benches show how creativity and collaboration enhanced the structure’s appearance. The students considered a number of options and finally settled on recycled glass, concrete and steel. Every Thursday, for several months they collected bottles from local businesses Buffalo Wing University, Hard Times Café, and Cue Club, and spent weekends turning the discarded bottles into glass chips.

“We tried every possible way we could think of to break the bottles—throwing them, shaking them in bags, smashing them with rocks,” says Steiner. “After we finished, we found out that you can retrofit a clothes dryer, poke holes in the drum and do the tumbling with rocks.”

Jimmy Mejia’s green, gold, black and clear glass mosaic design is patterned after the George Mason Athletics logo. To achieve this effect, the students built a concrete form and poured the glass-infused concrete into the form. After the concrete set, they polished it and then covered it with layers of epoxy. The table is two inches thick, and if sliced, the glass would be sprinkled throughout (think of a fruitcake). The ultra-sturdy, 7-foot by 4-foot tabletop weighs nearly 1,000 pounds.

Students estimate assembly time for the table at 500 hours and for the total project 14,000 hours. The workstation took a number of semesters to complete, and Peixoto believes it is a great way to show people what electrical, computer and civil engineers can do together, as a team, over several years.

The students used their own time to build the station, and Steiner says finding enough time with the demands of the engineering curriculum was the most challenging aspect of the project.

“We really had to stick together,” he says, “but the fact that we were all taking many of the same courses around the same time helped us.”

Steiner says he wanted to give something back to his classmates and show them that “just like in their degree work, if you stay dedicated to your goals, do honest hard work and embrace teamwork, you can do anything you set out to do. Nothing worthwhile comes easy.”

A version of this story by Martha Bushong appeared in Mason News on June 18, 2014.
Empowering Robots

“Small drones are transforming the way that we do many dangerous and difficult tasks such as crop dusting, aerial photography, bridge inspection, and more. With drones, we can do these tasks more quickly, more safely, and more effectively than ever before.”

—CHRISTOPHER VO, PHD STUDENT, DEPARTMENT OF COMPUTER SCIENCE

PhD Student Promotes Drone Use and Safety

PhD student Chris Vo hopes someday that drones, small unmanned aerial vehicles, can be used safely and effectively for everyday applications, as well as for more advanced research.

Vo began studying robots as an undergraduate when he was involved with the Volgenau School’s RoboCup soccer team. Since then, he has earned a degree in computer science and is working on his dissertation on robustness, scalability, and performance in robotic motion planning with Jyh-Ming Lien,
associate professor in the Department of Computer Science. "It really surprised me how many applications there are for these small, inexpensive drones," says Vo. "Because of this, we will see them show up in our daily lives sooner rather than later."

The drones Vo builds and flies are not the kind you see in sci-fi thrillers or spy movies but rather rotor-propelled quad copters or hex copters. These drones use the same principles of lift as a helicopter, and Vo says an amateur pilot could learn to fly them with a few hours of practice. To become an expert, however, takes much longer.

"The hardest thing about manually flying drones," says Vo, "is learning to fly in third person. All of the controls are relative to the drone, so when the vehicle is flying toward you, the controls seem reversed. If you move the joystick to the right, the [unmanned aerial vehicle] goes left."

As the educational director of a Washington, D.C., area drone user group, Vo leads monthly workshops where he teaches users how to build drones and fly them safely.

This article ran in a slightly different form in the spring 2014 Mason Spirit.

NOTEWORTHY ACCOMPLISHMENTS

■ 22 Media Appearances
■ 12 Years Applied Robotics Club
■ RoboCup Competitors (since 2008)
■ Outreach to Four At-Risk High Schools

Accomplishment Details

22 MEDIA APPEARANCES

Between January 2013 and May 2014, Vo has appeared on television and in news articles explaining drone use and capabilities, as well as safety and legal issues.

12 YEARS APPLIED ROBOTICS CLUB

The Applied Robotics Club was started around 2001 by undergraduate students and Sean Luke, associate professor in computer science, who has been the club’s mentor since the beginning. The club actually predates the school’s Autonomous Robotics Lab.

The club’s goal is to give students access to the resources of the Autonomous Robotics Lab and encourage them to do sophisticated projects using those resources. This level of access and trust is unusual, and the club has been unusually successful in helping students continue on to robotics careers.

Long-standing club members have direct access to the lab, and many have secured jobs with the Naval Research Laboratory, Aurora Flight Sciences, and PhD and MS positions at Georgia Tech, Carnegie Mellon, and Mason. From feedback by former students, Luke says he knows students have been hired or offered graduate positions specifically based on their club efforts. The reason for the club’s resource access is based on Luke’s experience as an undergraduate student interested in doing robotics projects and the difficulty he had obtaining support. Since then, the club has grown and now boasts 40 students during peak activity times, but typical participation of members is usually about a half dozen.

ROBOCUP COMPETITIONS (SINCE 2008)

RoboCup is a large, international, autonomous multirobotics workshop and tournament with 2,500 participants. The workshop is among the most well-known robotics venues in the world. At Mason, a student team has participated in RoboCup since 2008. The Mason team consists of a mixture of undergraduate, master’s, and doctoral students who participate in the Kid-Size Humanoid robot soccer tournament at RoboCup.

The team’s lean budget means they have to demonstrate their individual and entrepreneurial spirit in a unique way. Instead of trying to win the competition, their goal has always been to demonstrate cutting-edge research that has never been attempted before at the venue. This practice is unusual at the competition, but it is what the RoboPatriots are known for.

OUTREACH TO FOUR AT-RISK MIDDLE AND HIGH SCHOOLS (BOTBALL)

Botball is a grade 6 through 12 autonomous Lego robotics competition for STEM outreach in schools nationwide consisting of 343 internationally registered school teams—approximately 3,000 students.

In 2013, Luke obtained a National Science Foundation grant to do multirobotics research. Part of this grant provided $10,000 per year for three years to pay for the costs for four
inner-city disadvantaged schools to participate in the program. The schools reside in some of the poorest and most disadvantaged neighborhoods in the nation's capital. Test scores at Kramer Middle School, for example, rank only 20 percent of the students as on grade level for math. The other schools have similar challenges. Ten Mason students and Luke work as weekly mentors for these four school teams and provide much-needed adult support and guidance.

**BOTBALL SCHOOLS**
Cardozo/TransSTEM (Washington, D.C.)
Kramer Middle (Washington, D.C.)
Jefferson Houston (Alexandria, Virginia)
George Washington (Alexandria, Virginia)

**Active Departments**
Computer Science; Bioengineering; Civil, Environmental, and Infrastructure Engineering; Electrical and Computer Engineering

**Educational Programs**
BS in Bioengineering and PhD in Bioengineering; BS, MS, and PhD in Computer Science; PhD in Electrical and Computer Engineering; BS and MS in Electrical Engineering

Three of the four robots that competed in the 2014 RoboCup competition with programmers from the school's Computer Science Department.
Inventing Health Care Technologies

“By using ultrasound techniques, we have developed a noninvasive and easily accessible method to objectively describe myofascial trigger points associated with neck pain.”

—SIDDHARTHA SIKDAR, ASSOCIATE PROFESSOR

Using Ultrasound Technology to Study Neck Pain

According to a report by the Institute of Medicine, the economic impact of the burden of pain in terms of lost productivity in 2010 was approximately $300 billion. Millions of Americans suffer from chronic pain, which can often be localized in soft tissues such as the ligaments, muscles, and fascia.

Patients with back or neck pain complain of trigger points or muscle knots, which are hard, painful nodules. These irritable nodules are often associated with referred pain, but not always. The reason why some hard nodules are spontaneously painful and others are not is unknown.

It is also not known why and how these trigger points form and what role they play in the pain syndrome. A major impediment to research on this topic has been the fact that these trigger points are diagnosed based on a subjective physical exam. Also, the only information that physicians have about pain severity involves the self-assessment from the patients themselves, which is notoriously nonquantitative. “Doctor, my neck pain on a scale of 1 to 10 is an 11!”

"By using ultrasound techniques, we have developed a noninvasive and easily accessible method to objectively describe trigger points,” says Siddhartha Sikdar, an associate professor of bioengineering and electrical and computer engineering in the Volgenau School of Engineering.
A variation of ultrasound called elastography measures the stiffness of soft tissues by assessing regional tissue compression in response to an applied vibration. The more compression, the less stiff the tissue. Another potentially important factor for the trigger point is regional blood flow, which can also be readily determined through Doppler ultrasound.

While the research will address fundamental questions about the biophysical nature of trigger points, it also has translational and clinical implications. Specifically, the work will help develop objective and quantitative diagnostic metrics for assessing various therapeutic strategies.

The effort is supported by a four-year, $1.974 million R01 grant from the NIH, which is led by Sikdar. Colleagues who are contributing to the research effort include Lynn Gerber, director of the Center for Study of Chronic Illness and Disability, College of Health and Human Services; Nadine Kabbani, assistant professor of molecular neuroscience in Mason’s Krasnow Institute for Advanced Study; Saleet Jafri of Mason’s School of Systems Biology, whose area of expertise is bioinformatics and computational biology; William Rosenberger, chair of the Department of Statistics; and Jay Shah, a physiatrist and staff clinician at the NIH.

A version of this story by Claudia Borke appeared in the Bioengineering at Mason newsletter.

NOTEWORTHY ACCOMPLISHMENTS
- Mason’s First NIH K-Award
- First Graduates (Class of 2013)
- Top Job in America
- Approximately $2 million R01 NIH Grant (2010–14)

Active Departments
Bioengineering; Computer Science; Electrical and Computer Engineering; Statistics; Systems Engineering and Operations Research

Educational Programs
BS and PhD in Bioengineering; BS and MS in Electrical Engineering; BS in Applied Information Technology with Concentration in Health Information Technology; PhD in Electrical and Computer Engineering; MS in Biostatistics; PhD in Statistics

Accomplishment Details

FIRST NIH K-AWARD
Wilsaan Joiner (pictured above) of the Bioengineering Department received $977,000 from the NIH for his project, “Role of the Saccadic Eye-Movement Corollary Discharge in Stable Visual Perception.” This is the first time a faculty member from Mason has received the highly competitive and prestigious NIH Pathway to Independence K99/R00 Award.

FIRST GRADUATES IN CLASS OF 2013
The first six bachelor’s degree students majoring in bioengineering graduated in spring 2013. With a current enrollment of 164 undergraduates, the department expects continued and sustained growth in the future.

FIRST RANKED JOB IN AMERICA
In 2013, CNN Money and Fortune ranked the profession of biomedical engineer as best in the United States. The ranking was based not only on salary (median $87,000), but also on the job satisfaction of the people in the profession. The article highlighted the fact that jobs in this field are expected to grow by more than 61 percent over the next 10 years.

APPROXIMATELY $2 MILLION R01
Sikdar’s team has had its grant extended for one year, and a renewal proposal is being developed. They are preparing an application for a new R01 to do a full, randomized clinical trial based on this pilot study. NIH R01 grants are among the most prestigious and competitive awards in biomedical and health sciences research, which makes Sikdar and his team’s accomplishment even more impressive.
Engaging Globally

“Student-driven extracurricular activities are invaluable for developing skills in engineering and teamwork. It’s about the why as well as the how.”

—DEBORAH GOODINGS, CHAIR, SID AND REVA DEWBERRY DEPARTMENT OF CIVIL, ENVIRONMENTAL, AND INFRASTRUCTURE ENGINEERING

Student Project Provides Water to Remote Villages

In 2010, Engineers for International Development (EfID) began with an idea—connect engineering students with existing needs for simple infrastructure improvement outside the United States. Since then, EfID students, advisors, and professionals have traveled to Nicaragua and Peru to work with villagers in remote rural communities. These villagers are often compromised in their health and well being by their insufficient access to clean water, and while they recognize the problem, they frequently lack the engineering knowledge and materials to correct their problem. That’s where EfID fills the gap. The student-led organization links Mason undergraduates and professionals with remote villages to implement sustainable solutions.

For Kenex Sevilla, a 2014 civil engineering graduate, the motivation to take these trips stems from the satisfaction he receives by serving. Other students join EfID because they find the work rewarding; it provides opportunities to apply classroom learning to real-world problems and allows them to visit faraway places. But what students don’t anticipate is the transformative effect these projects have on their sense of the power of engineering and their responsibility as engineers.

Originally from Nicaragua, Sevilla, EfID president, has a unique perspective on student involvement and community service. As an undergraduate, he participated in international service trips to San Isidro, Peru, and Sabana Grande, Nicaragua, which improved each community’s access to water.
“I felt a weight lift from my shoulders when the last pair of pipes was installed and the pump turned on for the first time,” says Sevilla. “When I saw water delivered to six stations throughout the Nicaraguan community, I knew these pipes were a conduit not only for water flow, but also for communal development and life. When we finished our workday, we gathered a team of students and the villagers into a huddle, where I thanked each of them for their time and effort. I think EfID changes the way an international community views Americans because we work right there with them.”

Only 20 years ago, Sevilla lived in a neighboring Nicaraguan city where he experienced the hardship of insufficient access to water and other basic utilities. As a child, he accepted his situation with no thought for change. Eventually, he went on to attend Mason as an engineering student, where he realized he could change the communities that face situations similar to those with which he grew up.

Sevilla’s story is not unique; many of the EfID team members share similar experiences. Even though not every member of EfID travels overseas, they all share in the feeling of success of the group. In the future, the EfID members look forward to collaborative projects in the United States and overseas. EfID is exploring project possibilities with the Appalachian Trail Conservancy and in Bangalore, India; Esteli, Nicaragua; and Puerto Cabezas, Nicaragua.

Bioengineering student Kathryn Snyder contributed to this story.

**EFID TRIPS HOURS SERVED**

<table>
<thead>
<tr>
<th>Year and Season of Trip</th>
<th>Length of Stay</th>
<th>Approx. Time (Mason design + in-country)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer 2010</td>
<td>10 days</td>
<td>2000 + 100 hrs</td>
</tr>
<tr>
<td>Summer 2012</td>
<td>10 days</td>
<td>2000 + 100 hrs</td>
</tr>
<tr>
<td>Summer 2012</td>
<td>10 days</td>
<td>2000 + 100 hrs</td>
</tr>
<tr>
<td>Winter 2013</td>
<td>5 days</td>
<td>200 + 50 hrs</td>
</tr>
<tr>
<td>Summer 2013</td>
<td>10 days</td>
<td>2000+100 hrs</td>
</tr>
<tr>
<td>Summer 2013</td>
<td>10 days</td>
<td>2000 + 100 hrs</td>
</tr>
<tr>
<td>Summer 2014</td>
<td>10 days</td>
<td>2000 + 100 hrs</td>
</tr>
<tr>
<td>Total</td>
<td>65 days</td>
<td>12,200 + 650 hrs</td>
</tr>
</tbody>
</table>

**22 STUDENT ORGANIZATIONS**

American Society of Civil Engineering  
Applied Robotics Club  
Armed Forces Communications and Electronics Association  
Association for Computing Machinery  
Association of Energy Engineers  
Biomedical Engineering Society  
Chi Epsilon Civil Engineering Honor Society  
(by invitation only)  
Design Build Institute of America  
Engineers for International Development  
Game Analysis and Design Interest Group  
Information Society Movement  
Institute of Electrical and Electronics Engineers  
International Commission on Systems Engineering  
Mason/Linux User Group  
National Society of Black Engineers  
Patriot Hackers (formerly ECHO)  
Society of American Military Engineers  
Society of Hispanic Professional Engineers  
Society of Women Engineers  
Student-Run Computing and Technology  
Theta Tau Professional Engineering Fraternity  
Veteran Engineering and Technology Students

**NOTEWORTHY ACCOMPLISHMENTS**
- 12,850 Hours Served  
- 22 Student-led Organizations  
- 4 Continents  
- $150K Grants and Aid Obtained

**Accomplishment Details**

**EFID FUNDING SOURCES AND AMOUNTS**

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Mason Provost’s Office</td>
<td>$105,000</td>
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<tr>
<td>Office of Scholarship, Creative Activities, and Research</td>
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<tr>
<td>Civil Engineering Advisory Group</td>
<td>$25,000</td>
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<tr>
<td>External to Mason</td>
<td>$15,000</td>
</tr>
<tr>
<td>Total</td>
<td>$150,000</td>
</tr>
</tbody>
</table>
ACTIVE DEPARTMENT
The Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering

EDUCATIONAL PROGRAMS

University College Dublin, Ireland
In keeping with Mason’s focus on the global classroom, the Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering has developed an agreement with the University College Dublin in Ireland for a one semester, fully articulated, civil engineering undergraduate study-abroad program in the junior year. Specific courses have been pre-approved to be taken for credit toward the BS in civil and infrastructure engineering.

Many students including recruits and incoming freshmen have expressed interest in the program, says Liza Durant, associate department chair. The first students expect to gain acceptance for fall 2014.

University of Technology, Sydney, Australia
This partnership is based on a memorandum of understanding that allows undergraduate and/or graduate exchange (one semester or one full academic year) from each institution to spend time at the other. The Australian school offers a combined bachelor’s degree designed to provide opportunities for students interested in medical science, the scientific basis of engineering and technology, and the technology itself. The Volgenau School’s Bioengineering Department is encouraging students to investigate the opportunity.
Salma Mahmoud and Sidra Khan work on circuitry that will power the automatic arm they developed as part of their Bioengineering senior design project.

Academic Programs for the Future—A New Definition of Excellence

The 2014–15 academic year marks the launch of four new academic degree programs.

**Bachelor of Science in Mechanical Engineering**
- Providing hands-on experience in areas of energy and sustainability
- Creating pathways from Northern Virginia Community College and Historically Black Colleges and Universities in Virginia

**Bachelor of Science in Cyber Security Engineering**
- First of its kind in the world
- Educating engineers who will build secure infrastructure systems from the ground up

**Master of Science in Data Analytics Engineering**
- One of five programs nationwide
- Focusing on the technologies and methodologies of data analytics for solving big data problems
- Providing flexible study options

**PhD in Bioengineering**
- Spans engineering and computational concepts applied to problems in biomedicine
- Focusing on biomedical imaging, computationally driven biomechanics, nanotechnology, and neural engineering
- Providing training in translation, entrepreneurship, regulatory/economic policy, and program management
Volgenau School of Engineering—30 Years of Excellence

Since its beginning in early 1985, the Volgenau School of Engineering has grown to become a comprehensive school of engineering. Its curriculum has expanded to include interdisciplinary programs of study with the flexibility that today’s students need. Its research enterprise garnered more than $19 million in research expenditures in 2013. Its faculty and students earn national honors and perform international service. We are proud of the school’s three decades of excellence and anticipate decades more.

For many years, our fund raising has focused on bricks and mortar—the buildings, classrooms, and laboratories we needed. Now, we shift our perspective and concentrate on a different set of choices. Our priorities to celebrate 30 years of excellence will focus on students, faculty, and annual giving.

You can help us continue to define excellence by contributing to this campaign. Our students, our faculty, and our school depend on your investment. Look for more information about this effort on the website at www.volgenau.gmu.edu/partners to see how you can help.

FUND-RAISING SUCCESSES OF 2014

The Eleanor and Bill Hazel Endowed Chair in Civil Infrastructure Engineering

In 2014, we raised gifts and commitments exceeding $3 million to establish the largest endowed chair at the university. The Eleanor and Bill Hazel Endowed Chair in Civil Infrastructure Engineering empowers the Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering to recruit distinguished faculty whose teaching and research address the most forward-thinking approaches in the field.

Beck Foundation Faculty Fellow in Engineering

The school established the first faculty fellowship in engineering, the Beck Foundation Faculty Fellow in Engineering. As part of a new and innovative program, this fellowship will be awarded to recruit tenure-track assistant or associate professors for a five-year term to help support them until they achieve tenure.

PRIORITIES

- Provide a secure future for our students by establishing student scholarships.
- Support teaching and scholarship of our faculty with faculty fellowships and endowments.
- Strengthen our resources by increasing the number of annual gifts.

Five-Year Goal
$12,000,000

Five-Year Total
$15,839,115

FY2014 Gifts and Pledges Goal
$1,460,000

FY2014 Gifts and Pledges Total
$3,581,605
Gifts and Pledges by Gift Use 2014

- Endowment Giving: $2,998,550
- Planned Giving: $46,400
- Restricted Giving: $338,682
- Unrestricted Giving to Department: $107,304
- Unrestricted Giving to School: $90,669

**TOTAL:** $3,581,605

Source: George Mason University Central Development

Gifts and Pledges by Purpose 2014

- Facilities: $10,400
- Faculty: $3,046,152
- Other: $49,175
- Research: $151,291
- Students: $123,615
- Unrestricted Operating: $200,972

**TOTAL:** $3,581,605

Source: George Mason University Central Development

Top Gifts and Commitments in FY 2014 Greater Than $50,000*

<table>
<thead>
<tr>
<th>Donor</th>
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<tbody>
<tr>
<td>William A. Hazel Family Foundation</td>
</tr>
<tr>
<td>Dr. Long V. Nguyen and Ms. Kimmy Duong</td>
</tr>
<tr>
<td>Mr. and Mrs. Sidney O. Dewberry</td>
</tr>
<tr>
<td>Mr. and Mrs. John M. Toups</td>
</tr>
<tr>
<td>Mr. Charles B. Ewing Jr.</td>
</tr>
<tr>
<td>Hitt Contracting Inc.</td>
</tr>
<tr>
<td>The Pruitt Corporation</td>
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<tr>
<td>Mr. William A. Moran and Mrs. Suzanne S. Moran</td>
</tr>
<tr>
<td>The Clark Construction Group</td>
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<td>Alban CAT</td>
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<td>Clark Enterprises Inc.</td>
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<tr>
<td>Mr. Stephen M. Cumbie and Druscilla French PhD</td>
</tr>
<tr>
<td>Mr. and Mrs. John T. Hazel Jr.</td>
</tr>
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<td>Superior Paving Corporation</td>
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<td>Luck Companies Foundation</td>
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<td>MBL Technologies Inc.</td>
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<tr>
<td>Shirley Contracting Company LLC</td>
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<tr>
<td>Anne and Ronald Abramson Family Foundation</td>
</tr>
</tbody>
</table>

*In descending order

Your investment helped us exceed our five-year goal by more than $3 million. Thank you for your support.
New Faculty Profiles

Oscar Barton Jr., PE
Professor and Director, Mechanical Engineering

Dr. Barton received a BS in 1984 from Tuskegee University and an MS in 1987 from Howard University; both degrees are in mechanical engineering. In addition, he earned a PhD in mechanical engineering from Howard University in 1993.

Prior to coming to Mason, Barton served as professor and department chair of mechanical engineering at the U.S. Naval Academy, Annapolis, Maryland, where he coordinated interdisciplinary majors, programs, and professional courses with other department chairs. His research explores composite structural mechanics, approximate closed-form analysis, and variational methods.

Barton is a member of ABET, where he has been an Engineering Accreditation Commission commissioner since 2013 and chairs the ASME Committee on Engineering Accreditation. Over the course of his career, he has received numerous honors, including a Letter of Appreciation from the Director of Engineering and Weapons, a Letter of Commendation from the Superintendent, and the Navy Meritorious Commendation.

Monson Hayes
Professor and Department Chair, Electrical and Computer Engineering

After receiving an ScD in electrical engineering and computer science from MIT in 1981, Dr. Hayes joined the faculty in the School of Electrical and Computer Engineering at Georgia Tech. From 2006 until 2011, he was an associate chair for the School of Electrical and Computer Engineering and associate director of Georgia Tech Savannah. Prior to coming to the Volgenau School, he was professor emeritus at Georgia Tech and a Distinguished Foreign Professor at Chung-Ang University in Seoul, Korea.

Hayes has been internationally recognized for his contributions to the field of digital signal processing. He has published almost 200 articles in journals and conference proceedings and is the author of two textbooks. His current research projects include face recognition for personalization, lane tracking for driver awareness, hand and gesture recognition for multimedia applications, and equation recognition for handheld devices and the classroom.

He has served as associate editor and publications board chair and secretary-treasurer for IEEE Transactions on Acoustics, Speech, and Signal Processing and associate editor for the IEEE Transactions on Education. Hayes has also served as general chair of the 1996 International Conference of Acoustics, Speech, and Signal Processing, and general chair of the 2006 International Conference on Image Processing.

Hayes's international experience includes three years teaching and researching at Georgia Tech Lorraine (Metz, France), as well as experiences at Shanghai Jiao Tong University (Shanghai, China), Universidad Carlos III de Madrid (Madrid, Spain), and Seoul National University, Korea University, and Chung-Ang University (all three in Seoul, Korea).

Zhi Tian
Professor, Electrical and Computer Engineering

Dr. Tian received a BE in electrical engineering from the University of Science and Technology of China, Hefei, China, in 1994, and an MS and PhD from Mason in 1998 and 2000, respectively. From 1994 to 1995, she studied in the graduate program of the Department of Automation at Tsinghua University, Beijing, China, and from 1995 to 2000, she was a graduate research assistant in what is now known as the Center of Excellence in Command, Control, Communications, Computing, and Intelligence (C4I) at Mason. Prior to coming to the Volgenau School, she was a professor at Michigan Technological University in Houghton, Michigan.

Tian's general interests are in the areas of signal processing, communications, detection, and estimation. Her current
research focuses on compressed sensing for random processes, statistical inference of network data, cognitive radio networks, and distributed wireless sensor networks. She received a CAREER Award from the National Science Foundation in 2003.


Kai Zeng
Assistant Professor, Cyber Security

Dr. Zeng received a BS in communication engineering in 2001 and an MS in communication and information systems in 2004 from Huazhong University of Science and Technology in the People’s Republic of China. In 2008, he received a PhD from Worcester Polytechnic Institute in Worcester, Massachusetts.

Zeng most recently taught at the University of Michigan-Dearborn, where he was an assistant professor in the Department of Computer and Information Science. He was a postdoctoral scholar at the University of California, Davis (Department of Computer Science) from 2008 to 2011. While on the faculty, he taught computer science courses related to network security and computer networks.

In 2012, he was awarded a five-year National Science Foundation CAREER Award for research titled Toward Reliable and Efficient Network Monitoring in White Space. His research has been funded by grants from the National Science Foundation and the Air Force Research Laboratory.

Zeng has been a member of the IEEE, where he has served as a journal reviewer and associate editor. He has published numerous scientific papers and presented his research at conferences worldwide.

Parag Chitnis
Assistant Professor, Bioengineering

Dr. Chitnis received BS degrees in mathematics and engineering physics from West Virginia Wesleyan College in 2000 and an MS in mechanical engineering from Boston University in 2002. In 2006, he received a PhD in mechanical engineering from Boston University under the supervision of Professor Robin Cleveland. His dissertation focused on interaction between acoustic shock waves and kidney stones for the purpose of understanding the mechanisms of stone fragmentation in lithotripsy and treatment optimization.

From 2006 to 2008, Chitnis was a postdoctoral research fellow in the department of mechanical engineering at Boston University. His research involved a study of bubble dynamics in response to acoustic waves with the goal of mitigating cavitation-induced damage to the mercury-based spallation neutron source located at Oak Ridge National Laboratory.

Since 2008, Chitnis has been working at the F. L. Lizzi Center for Biomedical Engineering at Riverside Research as a research scientist. He has been involved in multiple projects involving biomedical imaging, thermal-ablation therapy, and targeted drug delivery. He is the principal investigator for an NIH-funded project on developing an ultra-fine resolution photoacoustic microscope for imaging the retina.
**Volgenau School Fast Facts**

**MISSION:** Solve real-world problems, enhance people’s lives, and make the world a safer, cleaner, healthier, and more prosperous place to live.

**ACCREDITATION:** Accredited by ABET Engineering Accreditation Commission

**FOUNDED:** Began in 1985 as the School of Information Technology and Engineering

**ENROLLMENT:** 5,211 (headcount total, fall 2013)

**FACULTY:** 156 (includes research faculty)

**ALUMNI:** 17,009

**ACADEMICS:** The Volgenau School of Engineering’s programs cover a wide array of disciplines, including electrical and computer engineering; computer science; systems engineering and operations research; civil, environmental, and infrastructure engineering; statistics; bioengineering; and mechanical engineering.

**POINTS OF PRIDE:** First school of engineering in the United States with scholarship focused primarily on information technology-based engineering

- First philanthropically named school and building at Mason
- First philanthropically named department and chair at Mason
- More than 25 years of experience in working with big data and cybersecurity
- More than $19 million in research expenditures in 2013
- Strong and growing relationships with corporations and industry

**RANKINGS:**

- 6th nationally for return on investment by Affordable Colleges Online
- 7th nationally for cybersecurity by Ponemon Institute
- 12th best graduate program by GraduatePrograms.com