DISCOVERY

RESEARCH AND INNOVATION AT FLORIDA TECH

SPRING 2019

Buggin' Out

'Ewww' Factor Aside, Cockroaches Bring Benefits to Lab Work and Learning

Plus

Cybersecurity 2.0

CubeSats: Small Package, Big Impact

60 YEARS

MESSAGE FROM THE PRESIDENT

Research to benefit all mankind: five simple words, but no simple task.

As you will read in the following pages, however, Florida Tech continues to earn its reputation as one of the best research universities in the country.

Our faculty and students work hard to fulfill that core value, and from the seas to the skies, from computer circuits to cancer cells, they are making an impact.

You can see that variety of research in this magazine, and you can see how our people embody what it takes to conduct research that makes a difference.

You can see that it takes vision to identify what must be changed or improved, what problems must be solved. You can see it takes patience to remain focused amid the methodical, deliberate and sometimes unglamorous work that forms the backbone of research. You can see, as well, that none of that would be possible without a work ethic that keeps these men and women busy in our labs and facilities year round.

As the biochemist and Nobel laureate Albert Szent-Gyorgyi put it, "Research is to see what everybody else has seen, and to think what nobody else has thought."

I am proud to say that happens at Florida Tech every day, where we are relentless in our pursuit of answers.

Dwayne McCay, Ph.D.
President

MESSAGE FROM THE SENIOR VICE PRESIDENT FOR RESEARCH

It has been a busy and energizing six months since I first joined Florida Tech. Although I had some inclination of our research areas and potential for growth, I continue to be surprised by the talent and advancements in research at our university.

The research magazine highlights just some of the discoveries and advancements made by our faculty and researchers as they continue to grow our research portfolio.

It is noteworthy that this year marks Florida Tech's 60th anniversary. We were founded in 1958 as a night school for technicians at the Cape, and later opened a campus in Jensen Beach, so naturally our early research was focused on space and the oceans.

It is fortuitous that we are once again in the middle of an exciting time in research with the resurgence of the Space Coast. Our research continues in our core areas but has now expanded to include other disciplines.

We have highlighted just a few of the exciting areas in this issue of *Discovery*. As an example, within our College of Psychology and Liberal Arts, one faculty member is challenging the norm with her use of cockroaches in classroom experiments. Elsewhere, we explore how we continue to expand our research in cyber security, with the space-related topic of CubeSats, and in aviation safety.

But what unifies all of these topics is something that has not changed since our earliest days: an innate curiosity and a desire to improve the world around us.

Thank you for taking the journey with us, and enjoy the *Discovery*.

Gisele Bennett, Ph.D.
Senior Vice President for Research

DISCOVERY MAGAZINE

Florida Tech
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Dwayne McCay, Ph.D.
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Florida Tech faculty and students are working with CERN in Geneva, Switzerland, on an upgrade of the Compact Muon Solenoid experiment by building and testing panels that will form large rings of particle detectors within CERN's Large Hadron Collider, the largest and most energetic particle accelerator in the world. The work takes place on campus in Florida Tech's High Bay Lab.

We're Listening.

Send comments or suggestions to editor Adam Lowenstein at adam@fit.edu.

SMALL PACKAGE, **BIG IMPACT**

By Ryan Randall

FLORIDA TECH'S GROWING CUBESAT PROGRAM OFFERS GATEWAY TO RESEARCH, COLLABORATION

Over the years, technology has gotten smaller while its power has increased.

Cell phones are much smaller than the brick-shaped versions of the 1980s and have more processing power than early NASA computers. Computers themselves are smaller. Cameras, video game consoles, projectors—all are well-known examples of this phenomenon.

But the trend is taking hold in something else that is not a household gadget: satellites.

Called CubeSats, these devices can be as small as 10 cubic centimeters—though some are comprised of multiple 10-centimeter units—and can weigh as little as 3 pounds.

Starting at about $10,000, CubeSats are far less costly than standard satellites, where a standard Earth-sensing satellite can cost several hundred million dollars. CubeSats are also easy to assemble, integrate and test and can be launched for a price lower than primary missions – about $700,000 for a six-unit CubeSat.

They are increasingly sharing something else with those other shrinking doodads: a growing ubiquity as a powerful research tool.

Florida Tech has joined a sizable cadre of universities in utilizing CubeSats in the classroom. Led by aerospace, physics and space sciences research professor Francis Bourne, the university is taking CubeSats' academic focus and pushing it further, to the realm of space research.

"As platforms grew larger, the objectives grew beyond educating students," Bourne said. "There is now nascent interest in providing real services on real missions."

INDUSTRY TO ACADEMIA

Bourne came to Florida Tech in July 2016 after more than three decades at Harris Corporation, the Melbourne-based technology innovator, including the last five as head of research and development at the company's government communications systems division.

His time at Harris included opportunities to interact and collaborate with "really smart" people in different areas—a practice he is working to replicate at Florida Tech. He believes CubeSats may be the vehicle to make that happen.

"We can create real opportunities focused on both science and deliverables," he said.

One project involves an old friend: Harris Corporation.

Florida Tech and Harris are working on a technology demonstration of a high-powered CubeSat payload that consumes four times the power of a normal payload. (Bourne was not allowed to say what the payload does.)

That energy-gobbling payload creates challenges for Bourne and his graduate students to solve, involving power management and generation, thermal management and more. The challenges of the small space foster creativity, such as how to manage the heat created by the energy consumption without having to generate more power to do so.

One grad student was exploring surfaces, paints and blankets.

"With thermal management we want to keep things simple, so the more passive we can make those kind of management schemes, the better," Bourne said. "I don't want to power things up to manage heat inside the spacecraft, so I'd rather do that with surface treatments or paints, these kinds of things."

LAB WORK

CubeSat design is a collaborative effort between multiple disciplines to ensure the components work with one another.

In addition to space and engineering research, Bourne sees CubeSats as a powerful tool for the science community. For Earth science and heliophysics questions, swarms of smaller satellites can gather more detailed data points than one large satellite. They are also a great financial solution to standard Earth-sensing satellites.

"These kinds of platforms provide an inexpensive, cost-effective way of addressing these interests," Bourne said.

As Florida Tech furthers its CubeSat research, Bourne is developing the CubeSat Integration Lab in the F.W. Olin Engineering Complex. There, students have a place to plan and implement new concepts as they work on satellites.

Other faculty have utilized CubeSats to further their research.

Daniel Batcheldor, head of the Department of Aerospace, Physics and Space Sciences, used a CubeSat attached to the International Space Station as a technology demonstration for a detector that will go on space telescopes for imaging planets surrounded and obstructed by a star's light.

The construction and launch of the satellite took two years, and while there were delays in the process, it was still shorter than traditional satellite development and launches, which can take approximately seven years, according to the International Cost Estimating and Analysis Association.

ATTITUDE ADJUSTMENT

Florida Tech is going beyond simply launching CubeSats. The CubeSat development program is developing small satellites that have attitude control, an aeronautical measurement of the orientation of an object with respect to its frame of reference to another.

"That's a challenge in something that's very small, because the hardware that you need in order to control the attitude of a spacecraft is quite large right now, so the miniaturization of those components is something that has to take place," Batcheldor said.

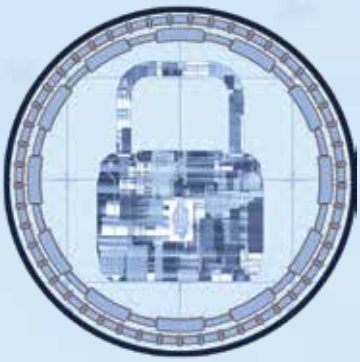
Communication is another aspect the program is analyzing, as it can be difficult establishing a connection between a large satellite dish and a CubeSat. One solution being researched is the use of lasers to transmit data.

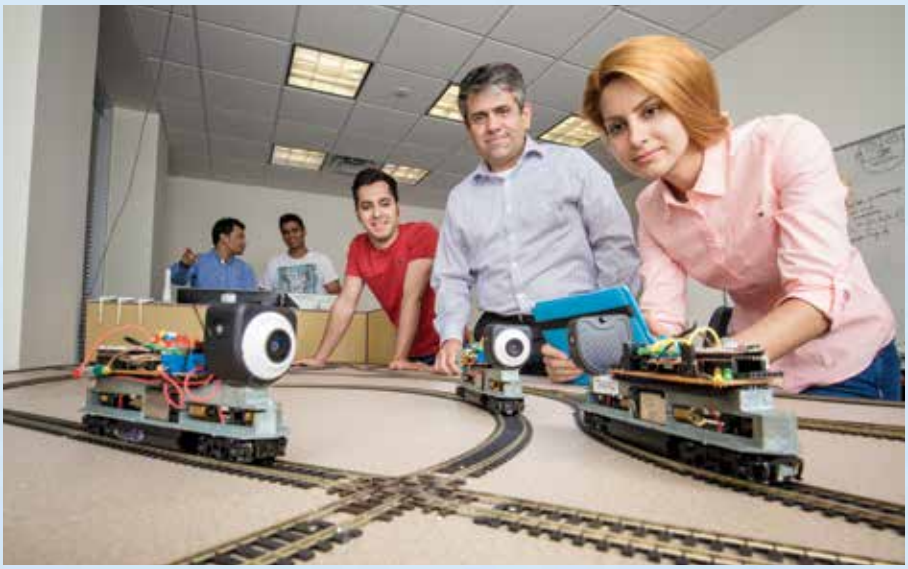
While the technology behind CubeSats is growing, these devices are still seen by government as a secondary payload, launching with other materials on a rocket. There aren't any launch vehicles dedicated to CubeSats, though Bourne imagines that may happen within the next five years. ◆

Creating New Pathways in Cybersecurity

By Ryan Randall

Florida Tech is entering a new frontier of cybersecurity through biometrics and artificial intelligence.





Threats to the security of computer systems networks are constantly changing and evolving in response to advances in computer network defense practice and capabilities. Maintaining this balance in favor of network defenders is becoming increasingly difficult, as the scale, scope, complexity and volume of computer attacks continue to increase beyond the capabilities of conventional cyber defense tools and human operators.

Florida Tech is on the cutting edge in cybersecurity, conducting research that reduces the information and work overload on human network defenders by using artificially intelligent automation to handle many tasks while elevating the network defender into the role of guiding and directing automated defenses. This research integrates autonomous cyber defense, machine learning, artificial intelligence, biometrics and human-computer interaction to expand the capabilities and effectiveness of human network defenders to make the job of the attackers more difficult, expensive and, ultimately, ineffective.

AUTONOMOUS CYBER DEFENSE

When viewing the security of any infrastructure, cybersecurity professionals such as Florida Tech's dean of the College of Engineering and Science, Marco Carvalho, look at the many areas that need to be addressed. They start by protecting a single infrastructure and protecting a collection of infrastructures, for example national critical infrastructure such as the military and power grids. While they are a collection of national assets that work together, each component has its own infrastructure that needs to be analyzed individually. Florida Tech's research investigates building fast, intelligent systems that can adapt and scale to address both areas.

"Our research focuses on the development of the infrastructure and capabilities that allow a network of intelligent sensors and defenses to work together—either within an organization or between organizations—to collect information, make decisions and take appropriate security actions autonomously," Carvalho said. "By distributing security information across enterprises, we can take advantage of the successes and failures in defenses made by others without having to withstand the attack ourselves."

Adopting a system that accounts for multiple enterprises can pose challenges, Carvalho said. For example, if a credit card transaction company takes an action against an attack, that decision may be felt by an airline. Florida Tech addresses this problem by creating automated capabilities using artificial intelligence and machine learning that enable continual improvement and that is managed by a "command and control" system directed by the network operator. This architecture allows organizational defenses to scale and address attacks quickly and with an automatic approach—a critical factor given that some electronic attacks can take just a fraction of a second. Distributing the security response across infrastructures can radically reshape the cyber defense environment, Carvalho said, enabling protection of enterprises from threats they have not yet seen and detecting coordinated attacks earlier and with greater accuracy.

Left: Florida Tech College of Engineering and Science Dean Marco Carvalho instructs students at F.W. Olin Engineering Complex.

Right: Cybersecurity research focuses on infrastructure development and a network of sensors and defenses working together to collect information and work autonomously.

Florida Tech's approach can dramatically increase the defensive capabilities of organizations and reduce the overload of computer network defenders. This innovative approach has led to success, as the school received a $1.6 million, three-year award from the Department of Homeland Security's (DHS) Science and Technology Directorate in 2018 that will have Florida Tech developing a federated defense ecosystem to further test and refine this powerful and important capability. The new funding builds on previous work funded by DHS.

BIOMETRICS

The advancement of artificial intelligence, better known as AI, has also adapted to new threats. With the ability to learn and figure out user behaviors, even simple things like the time and location of a user logging into a work computer remotely can be analyzed. Going a step further, biometrics such as fingerprint and face recognition as seen on iPhones, are able to strengthen the authentication of users beyond a password. Michael King, associate professor in the department of computer engineering and sciences, has been deeply involved with biometrics since 2002.

King has seen the technology evolve, going from gaining access to computer systems and buildings in controlled settings to identifying potential terrorists in surveillance footage after the Sept. 11, 2001, attacks. Recently, King has seen increasing interest in the user behavioral component being factored into biometric technology, such as how a device is used once the user has been authenticated. Known as soft identifiers, this area is being examined with an eye toward allowing and continually authenticating user access on factors other than an iris or face.

When looking at cybersecurity, King looks at three fronts: How can the accuracy and security of biometrics be improved; what information is available online that may be used to provide an enhanced view of a person's identity; and what information should be better protected in the interest of privacy. With much more personal information available online, King researches how deep an identity goes.

"There are some of the more traditional categories relative to biographic data, such as name, date of birth and Social Security number, that many people are aware of and make a concerted effort to protect," he said. "But with the advancement of mobile technologies and social media, third parties can now derive tremendous insight into a person's behavioral activities. It's important to characterize how the availability of such data affects cybersecurity and privacy."

HUMAN-MACHINE INTERACTION

Building on research conducted with Carvalho, Thomas Eskridge specializes in human-automation interaction. Eskridge and his team are working on ways to better control the autonomous security system and on strengthening security as a team rather than as an individual.

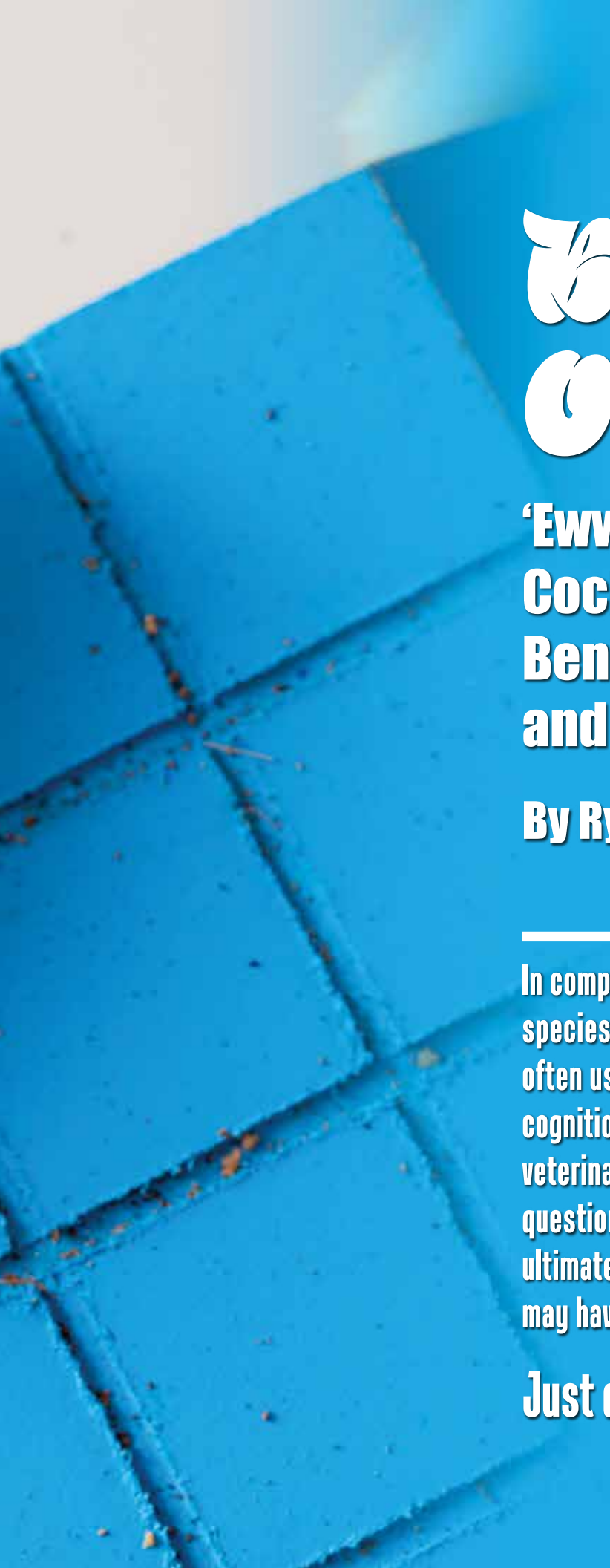
"There are two basic ways to exert that control. One is to have the automation tell the human what it's doing, so those are visualization systems; and the other is the human to tell the automation what to do, what context it's in and how to work, which are knowledge representation systems," he said.

Both of these methods are critical to allowing human network defenders to understand the capabilities and limitations of available defenses, and to direct automated responses to current and predicted attacks.

"The biggest issue facing autonomous cybersecurity systems is that they don't have context," Eskridge said. "An automated system is going to look at its network and say, 'I see another failed login attempt by a user, so I'm going to block this user and report him to the other organizations in my security group.' While this is the appropriate action to take in most situations, it doesn't know if there are other conditions that might change the response."

For example, there are times when a network operator does not want to block malicious users right away, allowing for opportunities to gather more information about the threat. Florida Tech is building interfaces where the network operator can identify contexts and update the automated system to operate within these contexts, enabling robust and resilient protection of the network infrastructure.

Through the use of advanced automation, integrative biometrics and adaptive human-machine interaction, Florida Tech researchers are leading a new wave of cybersecurity that will adjust and adapt to—as well as shape—cybersecurity operations in an ever-changing climate. ◆



Buggin' Out

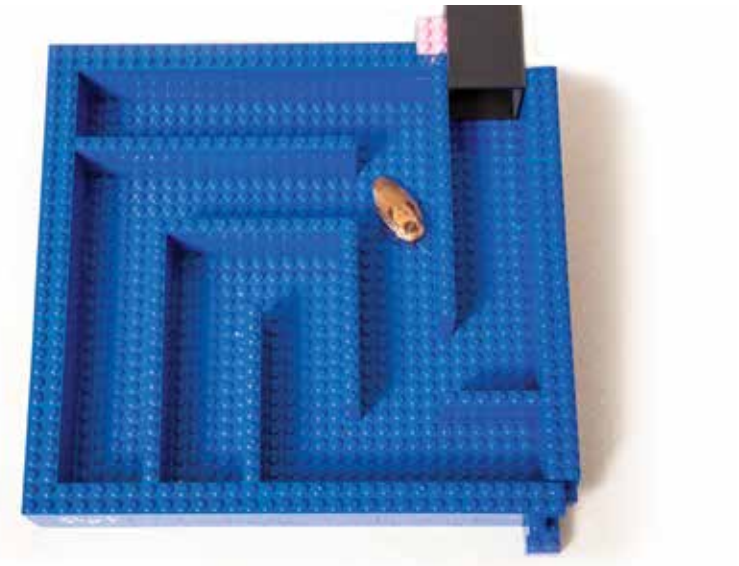
'Ewww' Factor Aside, Cockroaches Bring Benefits to Lab Work and Learning

By Ryan Randall

In comparative psychology research, species such as mice and pigeons are often used to learn about behavior and cognition. But given the requirements of veterinary care and storage and the ethical questions associated with the animals' ultimate fate, a Florida Tech psychologist may have found a new option.

Just don't step on it.

Utilizing cockroaches as testing subjects is a new frontier that has a world of potential.



In her fall physiological psychology classes, Darby Proctor, assistant professor in the School of Psychology, introduced Blaberus discoidalis roaches to learn about neuroscience. The idea stemmed from a desire to provide an interactive experience for the students who are dealing with many complex concepts. Proctor uses equipment and electrodes that attach to a roach's leg and can manipulate the neurons and electricity moving the limb. Students can then see the electrical activity via an iPad. This is the same process that works in humans.

"Now they get to see this thing happening, instead of me just telling them, 'Really, there's electricity in us,'" Proctor said.

The insects are an ethical and cost-effective learning alternative. Once their days participating in the classroom are over, they can be housed in terrariums until the end of their lives.

Utilizing cockroaches as testing subjects is a new frontier that has a world of potential.

Proctor and Marshall Jones, director of College of Psychology and Liberal Arts online programs at Florida Tech, are working on a website that will serve as a source for other universities to implement roach experimental work in their undergraduate classes. However, with limited published research on roach experimentation, Florida Tech will also develop methodology to guide other classes so they can replicate the experiments in their classrooms.

In her classroom, Proctor teaches about action potential and neurons through the roaches in multiple ways. Utilizing a small, backpack-like attachment worn by the insects, students are able to deliver an electrical impulse to the roach's antennae via Bluetooth, controlling the movement of the roach for a brief period. This is part of Proctor's lessons used in a

Through past research utilized by Florida Tech Assistant Professor Darby Proctor and her students, they've learned that roaches may be a strong active learning alternative to the potentially inhumane and more costly processes involving vertebrates, such as rats and piegons.

Below: Roaches retire to life inside well-equipped terrariums.

neuroprosthetics lab, showcasing muscle input used in robotic prosthetics for humans.

"That little electrical signal is mimicking an action potential, the electricity their neurons would fire," Proctor said. "And because it's such a simple model organism, we can hijack the neurons in their antennae to mimic what they would feel if they ran into something. You're basically tricking them and giving them the signal that they've run into something, so then they turn."

Looking for multiple ways to utilize the roaches, Proctor also uses the insects in her animal behavior and comparative animal cognition classes. After going through the basic processes of cognition, Proctor lets the students design an experiment with the roaches to gain experience with the concepts.

Last semester, her students decided to create a traditional maze out of building bricks with a food goal at the end. Similar to experiments done with rats, the goal was to see if the roaches could learn the path to get to the food without too many mistakes, thus showcasing they had the basic cognitive process of long-term memory.

The test didn't prove to be successful. The roaches didn't seem to be motivated by food the same way rats or other mammals were; some even gave up in the middle of the maze. However, the maze gave way to another idea of testing, this time using a T-shaped maze. By simply giving the roaches a choice of going left or right, the students were able to analyze if the insects had another cognitive process, behavior lateralization.

These student-designed tests also showcased real-life issues in scientific testing.

"It's really cool for the students to see that even though we as scientists want to do something and plan an experiment a certain way, sometimes we learn that doesn't work. But every time you fail, you learn something new," Proctor said.

Rob Hampton, a professor at Emory University's department of psychology who has done work with cockroaches before, said the ability to do more studies with the roaches will benefit students at Florida Tech.

"It's a great endeavor she's started there because it's getting more and more complicated and less common to have laboratories where students actually get to do hands on work with any organisms," Hampton said. "By getting things started with the cockroaches, it opens up a lot of opportunities."

The Blaberus discoidalis species Proctor uses comes from the Caribbean and is noninvasive, slower than normal roaches and, at approximately 2 inches, large enough to handle for tests. They live for about two years and don't fly, putting students more at ease.

The housing for the roaches is also important to Proctor. They live in a tank complete with their own 3-D printed-house, soil, water and yes, a running wheel to keep them stimulated. The roaches retired from experiments live out the rest of their lives in this habitat.

"Being in psychology, we always want to give our animals enrichment so they don't get bored – if cockroaches can even get bored," Proctor said.

Through his own work and an analysis of Proctor's, Hampton he sees a bright future in the use of the insects.

"The cockroach is a relatively simple beast but there's going to be all kinds of surprising things it will do and be capable of adapting to that they're going to find by watching closely," he said. "You get a bunch of students in there, they're going to find things that no one has seen before." ◆

Research at Florida Tech:
A Vision for the Future, An Eye on the Past

By Ryan Randall

When Florida Tech opened its doors on Sept. 22, 1958, as Brevard Engineering College, founder Jerome P. Keuper's vision was to have a school that could supplement NASA and help solidify the area's emerging role in the space program.

With more than 340 alumni working for NASA, multiple partnerships across industry, a leading curriculum in physics and space sciences, and a faculty boasting multiple astronauts, Keuper's vision has been realized. But the modest university he founded has evolved into much more than Countdown College: a thriving institution with world-renowned research in marine biology, autism, lightning and other areas.

As Florida Tech celebrates its 60th anniversary, Discovery takes a look at how research at the university has developed and what the future may hold.

ESTABLISHING RESEARCH

In 1987, Lynn Weaver was named Florida Tech's third president. Included in his vision for the university was an enhanced focus on research. So it was that in April 1988, Allan Mense was named Florida Tech's first vice president for research.


Allan Mense

Mense and Weaver were no strangers. When Mense was an undergraduate at the University of Arizona and later earned his master's degree in nuclear engineering there, Weaver was the department head. Over the years, the two kept track of one another.

Mense was chief scientist for the Department of Defense's Strategic Defense Initiative when he was contacted by Weaver, and his eventual hiring jump-started the university's research efforts.

Mense initiated and executed programs that resulted in research funding increasing by 400 percent in less than three years. He negotiated agreements with research institutes and industry, federal and state laboratories as well as international organizations, and represented university interests in Washington, D.C.

Seven major institutes and labs at Florida Tech, including the Space Research Institute and the Academic and Research Computer Center, reported to him.

The process involved in enhancing the university's research took collaboration, of course. Mense and his team analyzed other universities' strategies and spoke with faculty members on what they'd like to see from the school and how the Research Office could better assist them. Some of the changes involved giving senior faculty more teaching assignments in order to free up the younger faculty members to focus on research.

"President Weaver told me the kind of balance he was looking for was generally that a faculty member over their first five years needs to put a third of their time into teaching, a third into research and a third into internal university activities, such as being on faculty senate," Mense said. "What we tried to do for new faculty was give them much more time to get their research going and tried to back them out of academic administrative things."

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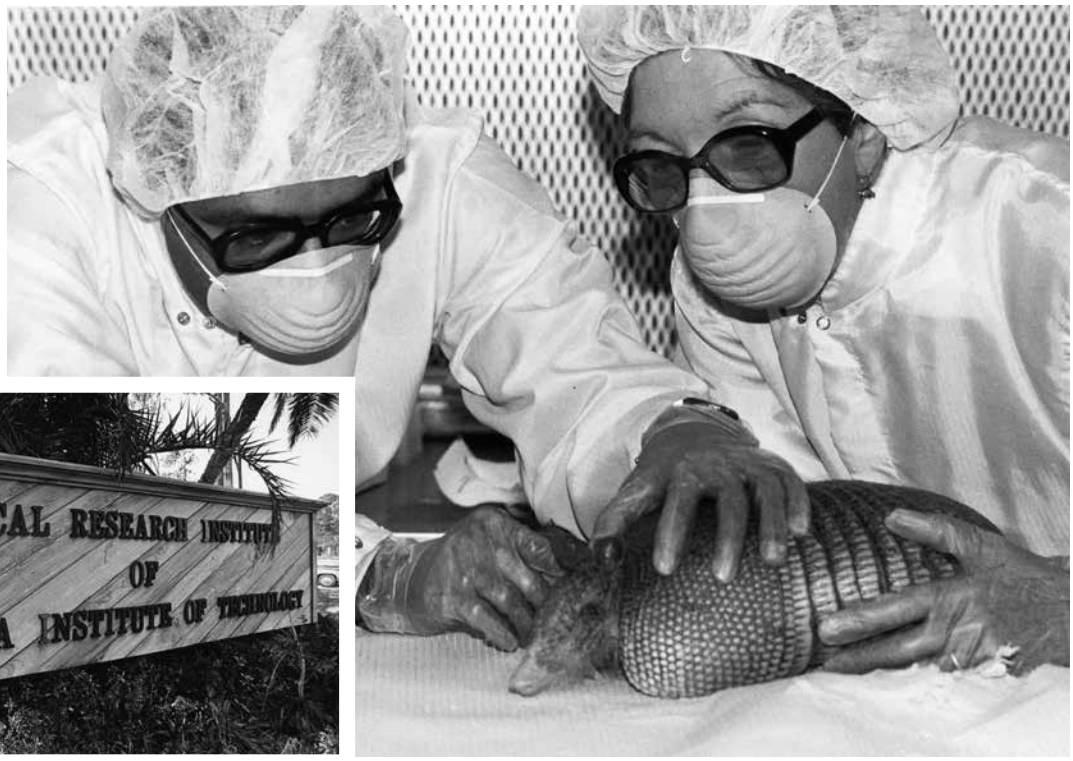


Early research at Florida Tech included work by Eleanor Storrs (right), a research professor at the university's Medical Research Institute. Storrs conducted a wide-ranging series of experiments on leprosy and other infectious diseases using armadillos.

continued from page 14

For Mense, a school with a strong focus on research not only benefited the university's growth, but also had a tremendous effect on the students' learning.

"I always indicated to faculty the need to be academically current on research in order to be better teachers and to convey the latest information to our students in an energetic way," he said. "Even if you're teaching a freshman class in chemistry, the research examples you bring to class are the items that energize the students."

PUSHING RESEARCH FORWARD

With Mense and his staff instrumental in turning Florida Tech into a strong research university, and with those efforts further strengthened in the intervening years, Gisele Bennett has her own vision for how to develop research even further.

Gisele Bennett

"Our past research areas provide a foundation for growth in the next 60 years," she said.

Bennett joined Florida Tech in April 2018 as senior vice president of research. She was previously with Georgia Tech as the associate vice president for research and faculty integration, a professor in the School of Electrical and Computer Engineering and the Glenn Robinson Chair in Electro-Optics. She was awarded the position of Regents' Researcher, a position that is approved by the University System of Georgia Board of Regents. She brought more than 22 years of research experience to Florida Tech, with 17 years in research administration.

Bennett credits President Dwayne McCay as a driving force in her decision to join Florida Tech, noting his enthusiasm about the potential for the university and the school's successful graduates and talented faculty. The opportunity to grow programs in Florida Tech's healthy research environment was another factor in her decision.

"Florida Tech has a history in sea- and air-related research," Bennett said. "Our location on the Space Coast was to be a vital asset to grow our expertise in aeronautics and space research and our ocean- and lagoon-related research. This continues to be true. However, we have expanded these areas to include cybersecurity, human-centered design research, advanced manufacturing and innovative design, and applied behavior analysis."

Bennett believes Florida Tech's growth will continue in these areas and will be expanded to include artificial intelligence and advanced algorithms in sensor systems, unmanned aerial systems, laser technology for defense and an increase in data science research—not to mention research tied to the growth in industry in Brevard County.

"The explosion of industry in the Space Coast area provides opportunities for Florida Tech to support and enhance our industry partners' research through technology and agility in our responsiveness," Bennett said. "Our University-Corporation Alliance for Success provides the catalysts for identifying research and education engagements with our partners."

These relationships are of such importance to the university that Bennett's team has a vice president for research for corporate and government relations, Gretchen Sauerman, who oversees those programs, among others. ◆

Notable Florida Tech Alumni

AVIATION

Greg Donovan '91
Executive Director, Orlando Melbourne Int'l Airport

Scott Henderson '88
Vice President, Test and Flight Operations, Blue Origin

Capt. Kay P. Hire '91
First Florida Tech Alumna in Space

Huntley Lawrence '85
Director, Port Authority of New York and New Jersey

Mike Moses '91
President, Virgin Galactic

Capt. Sunita Williams '95
Astronaut

ATHLETICS

Tom Bohrer '86
Rower on U.S. Olympic Teams in 1988 and 1992, won two silver medals

Jeanne Flanagan '79
Member of the American Women's Eight Team that won the Gold Medal at the 1984 Summer Olympics in Los Angeles

Daniela Iacobelli '09
Professional Golfer

Tim Wakefield '89
MLB Pitcher, Two-Time World Series Champion, Boston Red Sox

BUSINESS

Tom Folliard '89
Former CEO (retired), current non-executive chairman, CarMax

Jorge Mesquita '83
Executive Vice Tresident and Worldwide Chairman, Johnson & Johnson

Elizabeth Webbe Lunny '93
Vice President of Media, The New York Times Co.

EDUCATION

Tracey Bailey '88, '95 M.S.
National Teacher of the Year, 1993

Johnny M. Moore '02 Ph.D.
President, Pierpont Community and Technical College

MILITARY/CIVIC

Deborah Ayers '74
County Engineer, Cumberland County, New Jersey; First female county engineer in the nation

Gen. Ann Dunwoody (Ret.) '87
America's First Female Four-Star General

Judge Catharina Haynes '83
Federal Judge appointed by George W. Bush

Kathy Meehan '92
Mayor, Melbourne, Florida

TECH

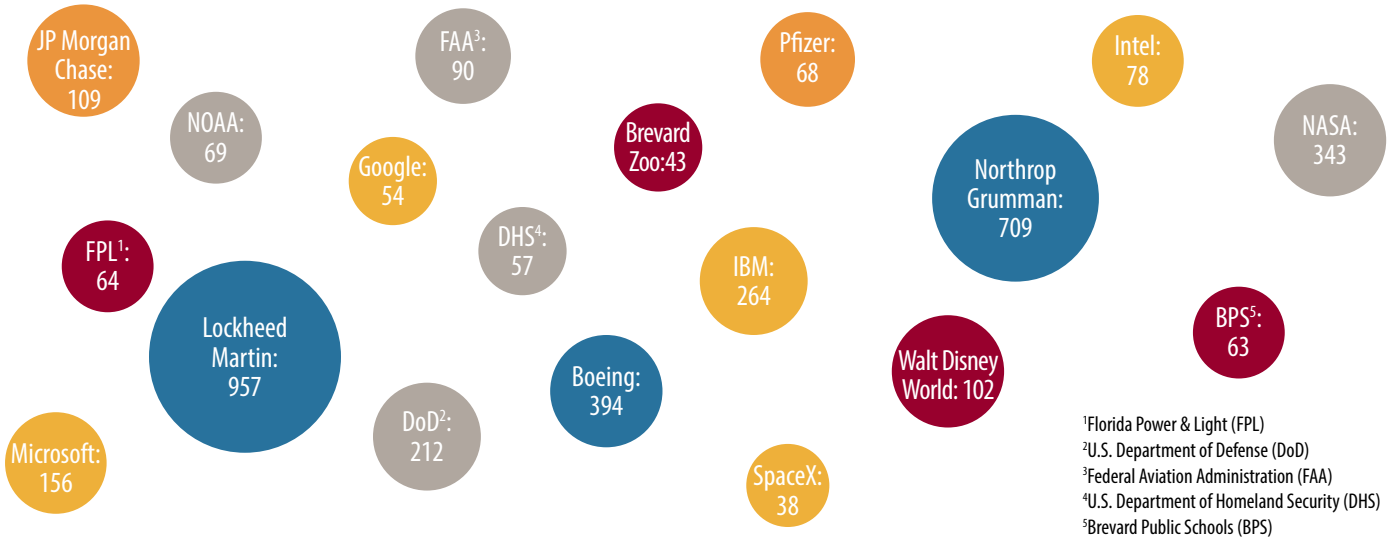
Tino Alavie '86, '88 M.S., '92 Ph.D.
President & CEO, Qvella Corporation

Steven Atkin '94 M.S., '01 Ph.D.
Chief Technology Officer, IBM

Hugh Thompson '98, '99 M.S., '02 Ph.D.
Chief Technology Officer, Symantec

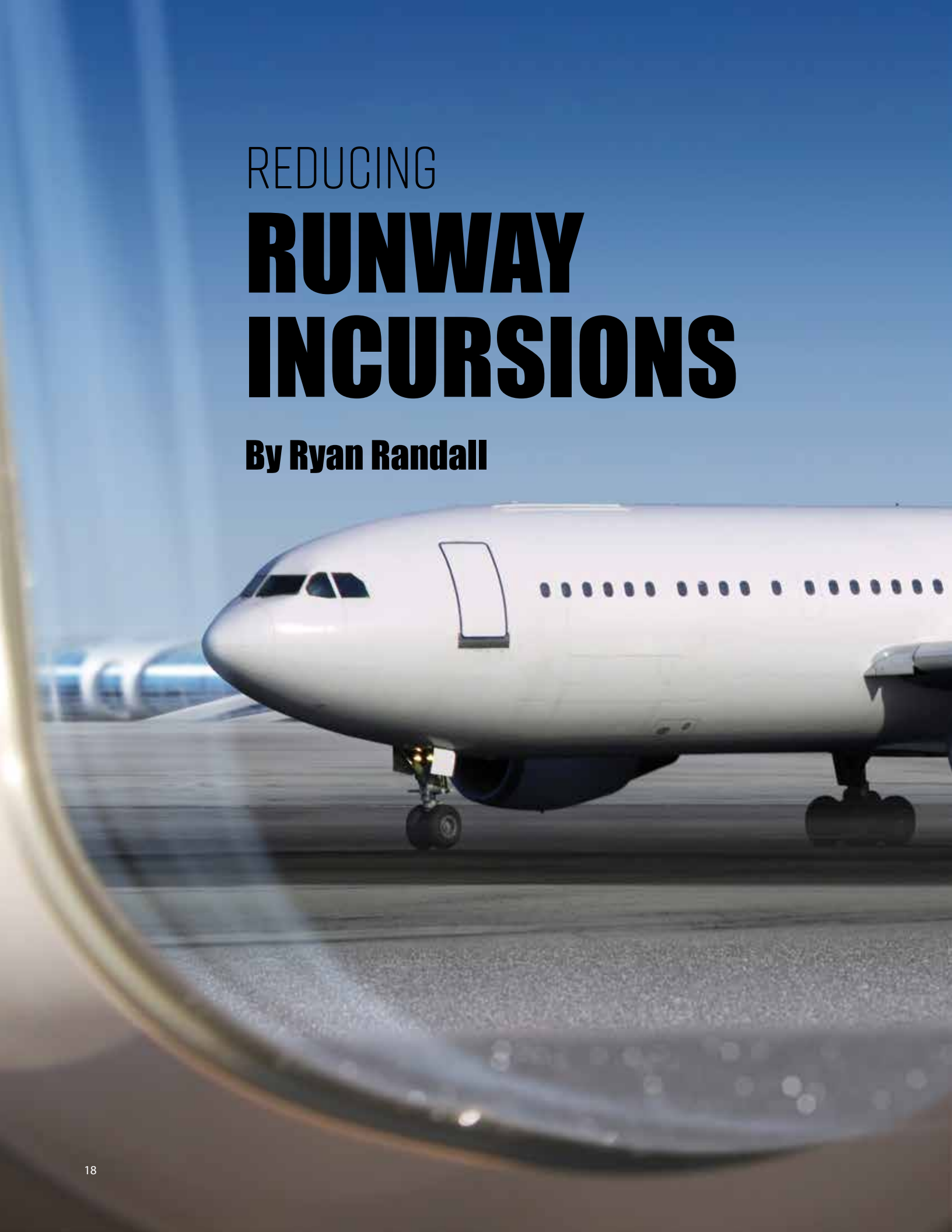
Vik Verma '87
CEO, 8x8 Inc.

Where Florida Tech Alumni Work



[1]Florida Power & Light (FPL)
[2]U.S. Department of Defense (DoD)
[3]Federal Aviation Administration (FAA)
[4]U.S. Department of Homeland Security (DHS)
[5]Brevard Public Schools (BPS)

Source: Florida Tech Office of Development, current as of 8/20/18



REDUCING RUNWAY INCURSIONS

By Ryan Randall

If you've flown even occasionally, you likely experienced the downside of a runway incursion. You find yourself sitting in your plane, parked at the gate or taxiway as the situation plays out beyond those tiny oval windows.

A runway incursion is when a plane, vehicle or even pedestrian is on the runway without permission. The danger is that there is a second aircraft landing or taking off at the same time. The Federal Aviation Administration (FAA) has five categories for incursion severity, ranging from no other aircraft on a runway to an actual collision, but most any of them will, at least temporarily, keep a plane from taking off.

Researchers at Florida Tech conducted research to better understand runway incursions, help develop ways to curtail them and improve the flying experience for many travelers.

Through the FAA's Center of Excellence for General Aviation, known as the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS), Florida Tech was selected to participate in three studies on runway incursions and how to decrease their frequency.

The first study, led by Florida Tech College of Aeronautics professor Donna Wilt, working with a team from Florida Tech, Hampton University and Purdue University School of Aeronautics and Astronautics, analyzed the root causes of general aviation runway incursions. Data show most runway incursions are attributed to inadvertent actions by pilots during general aviation operations. Researchers used qualitative interviews and a nationwide questionnaire to hear directly from pilots on what they believe are the causes and solutions to runway incursions. They also analyzed aviation safety databases from the National Transportation Safety Board and the NASA Aviation Safety Reporting System to identify trends specific to general aviation operations.

The interviews and questionnaires gathered over 1,400 suggestions from pilots, which the team organized and compiled. Specific recommendations for improvements included changes to communication procedures between pilots and the control tower, better methods to disseminate airport information, improvements to pilot training and improvements to signs and pavement markings around the airport.

Another study was led by Florida Tech College of Aeronautics professor and graduate program chair Debbie Carstens, who worked with a team from Florida Tech, The Ohio State Center for Aviation Studies and Iowa State University's Program for Sustainable Pavement Engineering. The objective of the research was to analyze accidents and incidents that occurred at or near airports and to identify actual or potential airport safety risks related to those accidents and incidents. The secondary goal was to provide input on the development of metrics for future analysis reports to identify the top risks for airport safety.

The benefit of the research is increased insight into eliminating or mitigating the risk factors that result in incidents and accidents by thorough aggregation of all available airport safety-related data into one database developed by CSRA Inc. (now General Dynamics Information Technology). The data was categorized using Commercial Aviation Safety Team and International Civil Aviation Organization (CICTT) taxonomies for occurrence categories and phases of flight. The database, which is not available to the public, can also allow users to see the top 10 airports with the most runway incursions.

"The research helps to identify where future airport safety initiatives should focus by having data be more meaningful by categorizing it into the database," Carstens said. "What we did as part of that research effort is make sure from these data sources we were able to fill in the CICTT taxonomy so the FAA can compare apples to apples."

The third study was led by Florida Tech College of Aeronautics professor and human factors program director of research and chair John Deaton, who worked with a team from Florida Tech investigating the human factors involved in runway safety. That led to a focus on improving airfield features such as airport signage, markings and lighting.

Steve Cusick, PEGASAS site director at Florida Tech, said the three areas studied offer critical data and insight on an important aviation issue.

"When you bring these three research projects all together you have a bigger picture of the runway safety situation on this high-priority FAA program," he said. ◆

RESEARCH IN BRIEF

> "We rely on DNA to tell us how long a species has been on its own, evolutionarily, and how different it is."
>
> —Toby Daly-Engel, Ph.D.

NEW SHARK SPECIES HONORS FEMALE PIONEER

Eugenie Clark was a pioneer in shark biology, known around the world for her illuminating research on shark behavior. But she was a pioneer in another critical way, as one of the first women of prominence in the male-dominated field of marine biology.

Fondly labeled the "Shark Lady," Clark, who founded Mote Marine Laboratory and continued studying fishes until she passed away in 2015 at age 92, will now be recognized with another distinction: namesake of a discovered species of dogfish shark.

The species, named *Squalus clarkae*, also known as Genie's Dogfish, was identified from the Gulf of Mexico and western Atlantic Ocean. The confirmation of this new species was reported in the July edition of the journal *Zootaxa*.

Florida Tech assistant professor and shark biologist Toby Daly-Engel was among the paper's four authors, along with marine scientists Mariah Pfleger of Oceana, the lead author and Daly-Engel's former graduate student, and Florida State University's Dean Grubbs and Chip Cotton.

Before their findings, researchers labeled this species of dogfish shark *Squalus mitsukurii*. However, using new genetic testing and morphology, the study of an organism through physical appearance, they discovered and classified Genie's Dogfish as a new species.

"Deep-sea sharks are all shaped by similar evolutionary pressure, so they end up looking a lot alike," Daly-Engel said. "So we rely on DNA to tell us how long a species has been on its own, evolutionarily, and how different it is."

"This type of research is essential to the conservation and management of sharks, which currently face a multitude of threats—from overfishing and bycatch to the global shark fin trade," added Pfleger, marine scientist for the responsible fishing and sharks campaigns at Oceana. "Many fisheries around the world are starting to fish in deeper and deeper waters and unfortunately, much less is known about many of the creatures that live in the deep. The first step to successfully conserving these species that live in deeper waters, like Genie's Dogfish, is finding out what is down there in the first place."

President's Research Briefings

A SNAPSHOT OF FACULTY WHO HAVE BEEN ASKED TO OFFER RESEARCH BRIEFINGS TO FLORIDA TECH PRESIDENT DWAYNE MCCAY THROUGH OCTOBER 2018.

NAME	Steven Shaw	Meredith Carroll	Daniel Batcheldor
POSITION	Harris Professor, mechanical and civil engineering	Associate professor, aviation human factors	Professor and head, aerospace, physics and space sciences
RESEARCH INTERESTS	The development of physics-based, predictive models for vibrational systems and the use of these models for design. Special emphases are on models that account for nonlinear behavior and noise, with applications to microscale resonators and automotive vibration absorbers.	Decision-making in complex systems, cognition and learning, performance assessment and adaptive training, including utilizing physiological sensor technology to gain access to previously unobservable aspects of performance and learning.	Supermassive black holes, space telescopes, exoplanet imaging and Mars surface simulations.
DID YOU KNOW?	Shaw will be the recipient of the 2019 ASME Thomas Caughey Award "for groundbreaking contributions to the theory and practice of nonlinear mechanical vibrations."	Carroll worked as a human design specialist for The Boeing Company from 2003 to 2005.	Batcheldor's research has been successfully demonstrated on board the International Space Station.

FLORIDA TECH'S SPACE SIMULATION INNOVATION

Florida Tech, working with Sanford-based Servos & Simulation Inc., has developed a 500-pound simulator that allows human subjects to experience the entire suborbital spaceflight profile—from takeoff through landing—using 360-degree motion and the hyperbaric environment of a spacesuit.

Their findings could lead to changes in the way cockpits, flight decks and even rescue pods are designed and used. They may also provide data to help develop Federal Aviation Administration guidelines for commercial spaceflight.

CARVALHO LANDS $1.6M FEDERAL RESEARCH AWARD

Marco Carvalho, dean of Florida Tech's College of Engineering and Science, is leading a cutting-edge cybersecurity research effort that could revolutionize how multiple organizations collectively defend themselves from cyberattacks.

Carvalho is the principal investigator on a project at the Harris Institute for Assured Information that recently received a $1.6 million, three-year award from the Department of Homeland Security's Science and Technology Directorate.

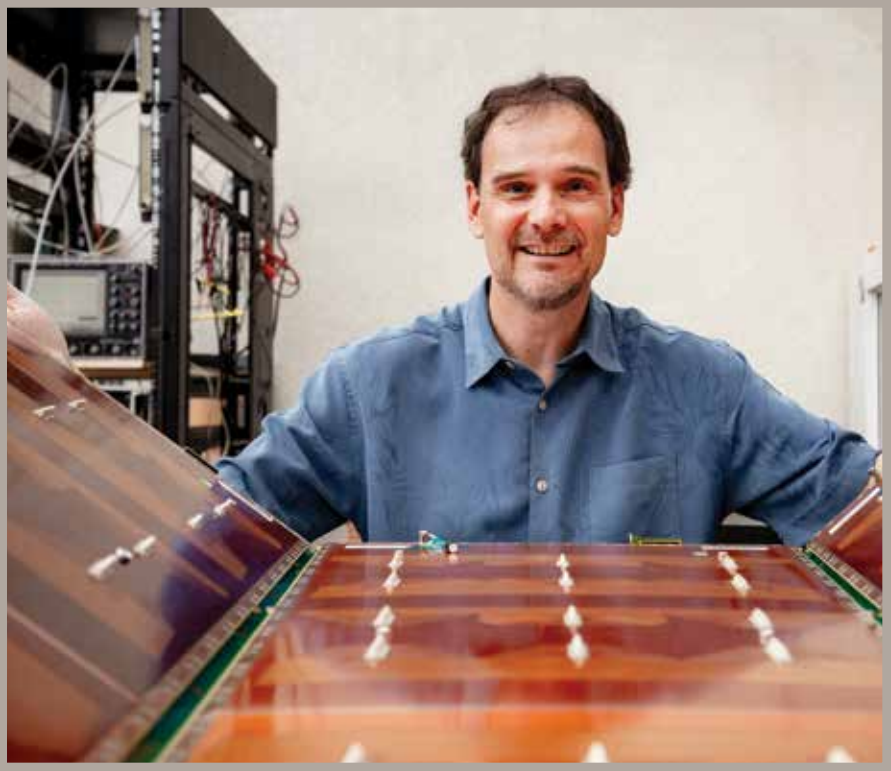
The federated command and control infrastructure Carvalho has developed under prior DHS funding enables coordinated detection and response to cyber events across different organizations, and the new DHS contract will have Florida Tech developing a federated defense ecosystem to further test and refine this powerful and important capability.

Syed Murshid

Professor, computer engineering and sciences

Major research interests involve fiber optic communications and sensors. Other general interests include photonics, instrumentation, LIDAR systems and power electronics.

There are five ways to multiplex data on an optical fiber. Murshid has invented two of them: spatial multiplexing and orbital angular momentum of photon-based multiplexing in optical fibers.



TOP RESEARCHER SPOTLIGHT

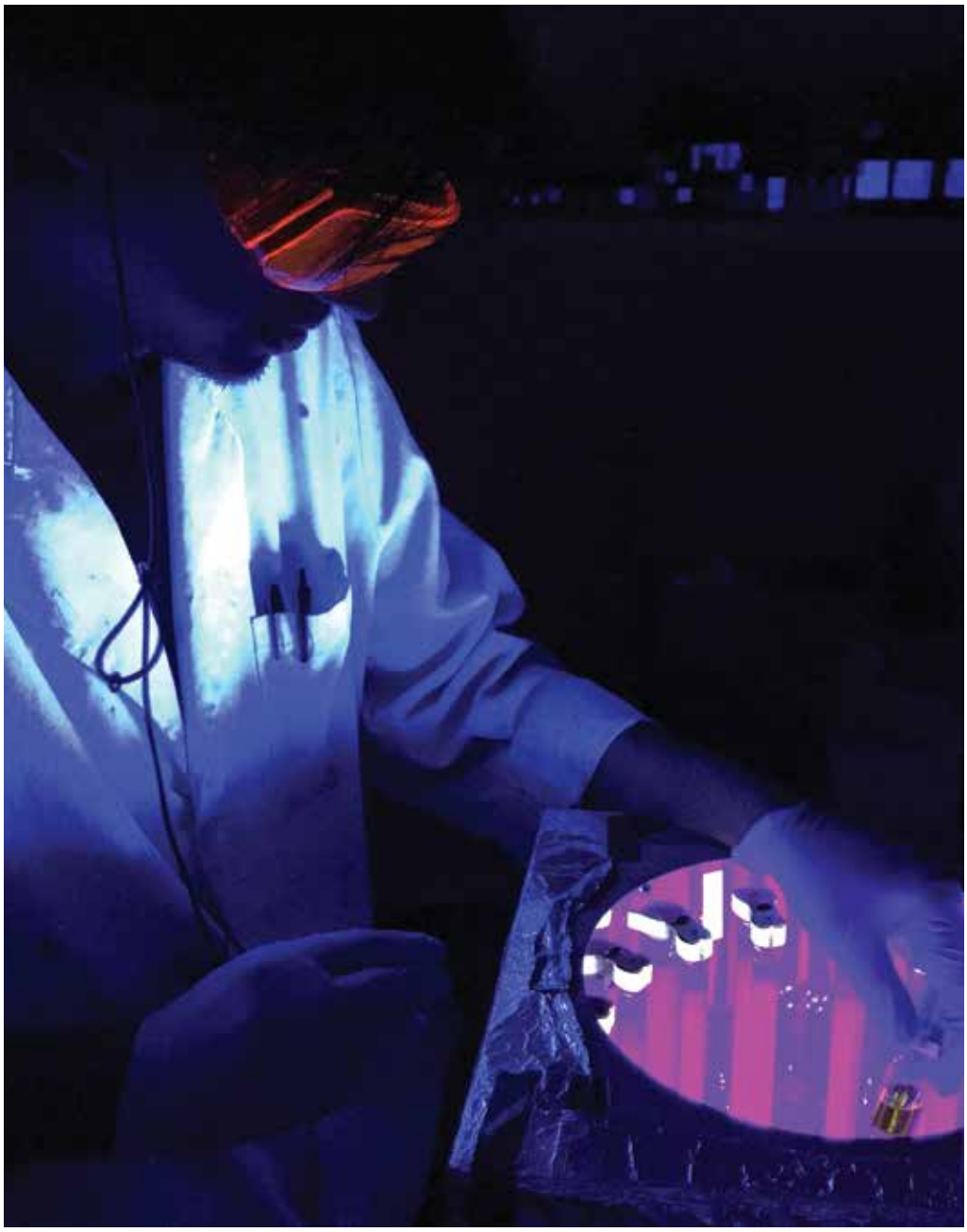
NAME	**Marcus Hohlmann**
TITLE	Professor
DEPARTMENT/COLLEGE	Aerospace, Physics and Space Sciences
GENERAL RESEARCH FOCUS	Experimental high-energy particle physics, particle detector development
CURRENT RESEARCH FUNDING	$1,110,720

What has you EXCITED about your current research?

I'm excited about dark matter, Florida Tech hardware at CERN (the European Organization for Nuclear Research) and a new big accelerator in the United States! We have just delivered a set of particle detectors to CERN that will be installed in the Compact Muon Solenoid detector in 2019. We will use them to hunt for dark matter particles that might get created in the proton-proton collisions of the Large Hadron Collider, which is operated by CERN. We are also developing new detectors for experiments at an electron-ion collider that the U.S. is planning to build.

Why is it IMPORTANT to conduct research?

It's important because research is humanity's best shot at saving it from itself and other threats. The better we understand the cosmos and its workings at all possible scales, from the largest to the smallest, and our world and all its creatures (humans included), the better our chances at surviving as a civilization in the long run. Even better, it is also a total thrill for a curious species such as humans to make discoveries and learn new things about our world and our place in it.



FLORIDA TECH TEAM HELPING LIGHTING UP BRAINS

Researchers at Florida Tech have developed the fastest method to date for creating a key molecule used by neuroscientists at Columbia University in mapping brain activity. They also discovered ways to create two new versions of that molecule—a neurotransmitter called glutamate—that can further advance this critical field of study.

This work, funded by the National Institutes of Health, was published in the American Chemical Society journal, *ACS Chemical Neuroscience* 2018.

Glu is the most common neurotransmitter. To aid neuroscientists in mapping the enormously complex brain circuitry, researchers have used light to activate inactive, or "caged," neurotransmitters in live brain tissue, including glutamate.

The work reported in *ACS Chemical Neuroscience* will make the process of making caged glu more effective, Nesnas said, by cutting the number of steps in half and overall time by 80 percent, while doubling the yields of previous methods.

President's Research Briefings

A SNAPSHOT OF FACULTY WHO HAVE BEEN ASKED TO OFFER RESEARCH BRIEFINGS TO FLORIDA TECH PRESIDENT DWAYNE MCCAY THROUGH OCTOBER 2018.

NAME	**Shermineh Rostami Fairchild**	**Paul J. Cosentino**
POSITION	Assistant professor, aerospace, physics and space sciences	Professor, mechanical and civil engineering
RESEARCH INTERESTS	Fairchild centers her research on fundamental areas such as the ultrafast interaction of high-power femtosecond lasers with gases, aerosols and solid targets and applications extending to stand-off sensing, beam engineering and free-space optical communication.	Within the geotechnical engineering area, Cosentino has performed 30 years of research in the areas of geotechnical instrumentation, reuse of recycled materials in pavements and evaluation of piles that rebound upwards as much as 3 inches when driven into Florida's silty, fine sands.
DID YOU KNOW?	Fairchild's proposal, "Free-space optical communication in plasma waveguides," was selected for funding by the U.S. Army Research Office as part of the competitive Young Investigator Program. Her proposal with John Palastro, "Efficient Simulation of High Power, Ultra-Short Laser Pulse Propagation through Atmosphere" was also recently funded through the Air Force Research Lab.	Cosentino's research with the instrumentation of the soil testing pressuremeter device has quietly changed the geotechnical engineering industry and produced savings to developers estimated at over $100 million. His research on piles has saved Florida millions of dollars by avoiding rebound.

MARINE PROTECTED AREAS MAY FAIL AS OCEAN TEMPERATURES RISE

Research from Florida Tech and the University of North Carolina, "Climate change threatens the world's marine protected areas," was published in May's *Nature Climate Change* journal.

It reports that most marine life in Marine Protected Areas (MPAs) will not be able to tolerate warming ocean temperatures caused by greenhouse gas emissions. The greatest risk is to MPAs in the Antarctic and Arctic, in the northwest Atlantic, and newly designated reserves in the Galápagos Islands.

Rich Griffith

Professor, psychology; executive director, Institute for Cross Cultural Management

Griffith's interests include cross-cultural competence, global leadership, international industrial/organizational psychology curriculum design, non-cognitive assessment and advanced measurement issues.

The author of over 100 publications, presentations and book chapters, Griffith's work has been featured in *Time* magazine and *The Wall Street Journal*.

TOP RESEARCHER SPOTLIGHT

NAME	**Georgios C. Anagnostopoulos**
TITLE	Associate Professor
DEPARTMENT/COLLEGE	Computer Engineering and Sciences
GENERAL RESEARCH FOCUS	Machine learning
CURRENT RESEARCH FUNDING	$ 997,074

What has you EXCITED about your current research?

I am relatively new to the study of phenomena in social networks and, therefore, very excited for being immersed into it as of late. Such networks are hosts to complex relationships and interactions between multitudes of actors. Our latest, DARPA-funded project has me and my students investigating how information is spread over vast social structures. Effective modeling of how information diffuses among users of such networks is key to understanding (and, potentially, combating) phenomena such as misinformation campaigns, as well as to better defining the circumstances behind specific content being promoted to so-called viral status. The former phenomenon lies at the center of current political discourse, and the latter one is of significant importance to corporate marketing efforts.

Why is it IMPORTANT to conduct research?

Leveraging creativity and imagination to build new knowledge and achieve deeper understanding satisfies one's strong, innate curiosity at a personal level. At a much broader level, research may inform public decision-making and, many times, leads to immense societal benefits, whether in the short- or long-term. Hence, in the microcosm of academia, it is important even for undergraduate students to engage in research experiences during their scholarly tenure.

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