The research magazine of *Florida Institute of Technology*

DISCOVERY

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Winter 2017

Industry 4.0—Innovation Powers the Evolution of Manufacturing

MESSAGE FROM THE PRESIDENT

The power and potential of advanced manufacturing. How research may help parents determine if their children are on the autism spectrum. An experiment conducted nearly 250 miles above Earth and what it could tell us about Alzheimer's disease.

These are merely a sampling of the topics you will be able to explore in this, our latest issue of the Florida Tech research magazine Discovery. *They also represent core areas of our university's academic and research efforts we will be focusing on as we strive to provide the highest quality education to our students while also producing research that benefits all humankind.*

We call them our Pillars of Excellence, and I wanted to highlight those you will read about in Discovery *and others that we will explore in editions to come.*

Hardware and Software Cybersecurity*: Research into hardware-based authentication, cyber countermeasures and related areas for clients including the Department of Defense and Department of Homeland Security.*

Aerospace and Space Systems*: Our faculty are focused on the air and space above us. International Space Station experiments, pilotless aircraft and unmanned aerial vehicles, jet engines with improved performance—all examples of areas where Florida Tech researchers are advancing knowledge.*

Autism Treatment and Research*: Anchored by Florida Tech's Scott Center for Autism Treatment, the impact we can have in this area will greatly expand as we harness technology such as telemedicine and telehealth to overcome a host of hurdles, from geographic to financial.*

Human-Centered Design and Manufacturing*: From exploring 3-D printing as a cost-effective way to generate new products to the idea of using computer simulations to model and test new engineering designs before they are manufactured, these areas are critical to the 21st-century economy, and to Florida Tech.*

Ocean, Lagoon, Climate Science and Engineering*: Florida Tech scientists and engineers are in the forefront of understanding the reasons one of the nation's natural treasures, the Indian River Lagoon, is in decline and, more importantly, the engineering and science needed to fix it. Other areas, from biofouling to coral reef health, from lightning to beach erosion, offer opportunities for our researchers to make significant, positive contributions.*

We are pleased to offer you this glimpse into the work and research we are now undertaking, and we look forward to the impact all of our Pillars will have on students and, we believe, many, many others in the future.

T. Dwayne McCay, Ph.D.,
President

DISCOVERY

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Cover: Strategically managing the product lifecycle management (PLM) process will have real-world impacts in the computing and manufacturing industries. Artist's rendering.

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WE'RE LISTENING. *Please send comments or suggestions to Adam Lowenstein at adam@fit.edu.*

Sam Durrance, professor of physics and space sciences, examines the SABOL experiment back from the International Space Station.

Proteins Grown in Space Yield Unexpected Results

Sam Durrance remembers being nervous last spring as he removed the tape from the foam crate that arrived at his Florida Institute of Technology lab via FedEx. Inside was a shoebox-sized experiment featuring nine test tubes, wires and electrodes that not long ago had been cargo inside a SpaceX Dragon capsule that arrived in a more spectacular fashion—splashing down in the Pacific Ocean, fresh off the International Space Station.

It would be a few more weeks until Durrance, a professor of physics and space sciences, could determine if the experiment worked and what he and his colleagues might learn from it about the way some proteins can self-assemble into long, thin structures called fibrils. Such knowledge could have implications on researching neurological diseases such as Alzheimer's, where strings of protein mysteriously form into tangles affecting brain function.

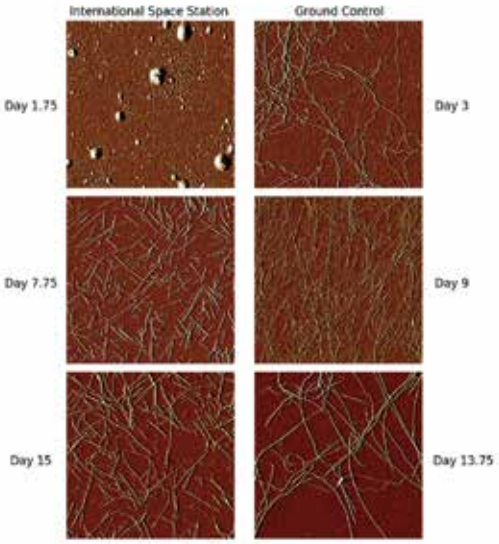
But good science often requires patience as much as it does calculations. And sometimes science throws in a surprise or two, as turned out to be the case with the metal box Durrance had unpacked.

That box was technically known as Self-Assembly in Biology and the Origin of Life, or SABOL. It was developed by Durrance and Florida Tech colleagues Daniel Kirk, professor of aerospace engineering, Hector Gutierrez, professor of mechanical engineering, and several students. The experiment utilized the microgravity environment of the space station to study how protein fibrils form and grow, a fundamental biological process.

Durrance, the lead scientist on the team (who, as a former astronaut, has spent time in space aboard space shuttles *Columbia* and *Endeavor*), said the inspiration came from growing lysozyme protein fibrils in his Florida Tech lab. In such an environment,

> "When we looked at the first images, we were blown away."
> —Sam Durrance, professor of physics and space sciences

these protein fibers make long chains in solution until gravity pulls them down to the bottom of a growth chamber, which limits how long and complex they can get for research purposes. Durrance predicted that the same growth process carried out in microgravity would allow for longer, possibly more complex self-assembly of protein structures consisting of multiple fibers wrapped in helical form around each other. Such a construct would be useful for studying propagation over a longer period and perhaps revealing more about the fibers' nature.



Mosaic of images of fibrils formed on the International Space Station in microgravity versus fibrils formed in the Ground Control lab under the effects of gravity.

During its time in space, the experiment designed and built by Florida Tech faculty and students managed to grow protein fibrils in three of the nine vials where a liquid solution and protein powder made contact via an automatic plunger and then heated to create the right growing environment. But a closer look at the fibers under a microscope was needed to see what form the fibers took.

And science smiled.

"When we looked at the first images, we were blown away," Durrance said.

The fibers looked completely different than the control group grown on Earth under the same conditions but minus the microgravity environment. Instead of long and tangled, the microgravity-grown fibrils were very short and much thicker.

"Pretty much the opposite of what we thought would happen," Durrance said.

After Durrance and his graduate student, Dylan Bell, ruled out that the surface structure inside the tube influenced the growth patterns, they had to conclude that microgravity affected the morphology in an unexpected way.

Bell is now trying to replicate how the fibril-growing process proceeded in space here on the ground, which may yield fundamental insight on how the assembly process works and could lead to further development in the science of self-organizing biological molecules. His guess is the ability of proteins to flow through the solution like they do on Earth was hindered by the lack of natural buoyant convection, which isn't present in microgravity.

Instead of the protein molecules being moved quickly to the growing end of the fibrils by buoyant forces, Bell thinks the slower process of diffusion was the only avenue to grow outward when the vials in space were heated to begin the self-assembly process.

"I think it's fair to say that the project has shown that self-assembly is much more of a mystery because the results blew away the science team," said Daniel Batcheldor, head of the department of physics and space sciences. "This is what we love as scientists, because results we don't understand means we are going to learn something."

Beyond the science SABOL yielded, Durrance is proud of the cooperation between the colleges of science and engineering that brought students and faculty together to not only construct the experiment, but to develop a research plan and then study the results.

"What we got from the experiment was not at all expected," Durrance said. "But it opens some doors to some really interesting new avenues, and our students got to experience that. I look forward to seeing where this takes us next."

Shelley Preston

Autism: Making the Case for Early Diagnosis and Action

When Henry McGill began treatment for autism spectrum disorder at The Scott Center for Autism Treatment at Florida Institute of Technology a few months shy of his second birthday, he was not speaking or turning his head when his name was called. His mother Kate said he could use the sign for "more" but that Henry threw frequent tantrums because he couldn't communicate effectively.

Transitions from one activity to another were also very difficult, often sparking long bouts of crying and throwing himself on the floor.

That was a year ago.

Now at 36 months old, Henry tells stories and sings songs and invites others to play with him. And, Kate McGill said, "he responds to his name and runs out to greet us when we pick him up, shouting 'mom' or 'dad.'"

Henry's progress provides evidence that a therapy called applied behavior analysis, or ABA, can reverse elements of autism when provided to toddlers who are under 24 months old.

"Henry is the poster child for early intervention," McGill said.

Knowing the Signs

Autism spectrum disorder, or ASD, is one of the most common neurodevelopmental ailments, affecting one in 68 children in some form, from mild to more severe. Though the causes of ASD remain largely unknown, the Scott Center and its use of applied behavior analysis has become a leader in effective early intervention even as its faculty continue to research why it seems to work so well.

ABA is based on decades of research about how humans learn. Psychologists apply its key principles in a precise way to encourage positive behaviors and new skills. One simple example: when a behavior is followed by a reward, the behavior is more likely to be repeated.

Ivy Chong, a psychologist, board-certified behavior analyst and the Scott Center's director of autism services, said that when social emotional delays or warning signs of ASD in children as young as 1-year-old are treated with ABA, the child is much more likely to be on par with his or her peers by kindergarten.

"Research shows early detection and extremely early intervention in infants and toddlers are effective, but more study needs to be done," she said. "We're working to show that screenings and access to immediate treatment for infants and younger toddlers have enduring benefits and possibly mitigate the diagnosis."

With funding from The Caplan Foundation for Early Childhood, Chong is investigating the idea of a caregiver checklist to help spot warning signs of autism in infants and toddlers that could get them to treatment at the time ABA has shown to be the most effective. To assess the checklist, she is leading a study looking at at-risk infants who were born prematurely or who have older siblings with already diagnosed autism. Infants who

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"We're working to show that screenings and access to immediate treatment for infants and younger toddlers have enduring benefits and possibly mitigate the diagnosis."

— Ivy Chong, the Scott Center's director of autism services

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have older siblings with autism are more likely to have ASD.

Chong's study focuses on these at-risk infants because parents with subsequent children may be more likely to recognize red flags in their second child and assist researchers in identifying behaviors that indicate autism at a younger age than parents raising a child for the first time.

Parents in the study are asked to watch for missed milestones at various ages and report them to Chong. The children are also brought to the Scott Center for testing, and parents receive training to provide ABA in the home if any indicators, such as lack of eye contact and response to name, are absent.

"The American Academy of Pediatrics says to screen children at 18 months, but we also know you can identify spectrum disorders earlier," Chong said. "We want to identify those early warning signs in infants and teach skills before symptoms become something full-fledged. Parents often see the signs but are dismissed and given a 'wait-and-see approach' and the diagnosis can be stigmatizing, expensive and difficult to deal with because it's crisis management by that point."

"I want this research to help provide preventative measures for families," Chong continued. "I want to know if a parent can complete a checklist without a medical professional being the source of information. Armed with that caregiver-provided evidence, we can identify skills for parents to work on before it turns into a formal diagnosis."

With Chong's guidance, Kate McGill learned ABA practices for using at home, such as not responding to Henry's requests until

he makes eye contact, announcing transitions to different activities to help reduce anxiety and consistently praising good behavior.

McGill signed up her second infant, Patrick, for Chong's sibling study after Henry had shown so much progress from the early intervention ABA treatment.

Early Screening

The current protocol for making a formal diagnosis of autism spectrum disorder is between 24 to 48 months of age. Caregivers who observe signs of delays in their infants are often told by medical and community-based providers to wait before they are referred for formal evaluation, which leads to over half of all children with autism being diagnosed at age 4 or later.

Chong believes that is too late for gaining the best results from ABA treatment.

Because research into early intervention with ABA is so promising, one of the Scott Center's missions is to promote screening for autism before the age of 2, said Michael Kelley, the center's executive director and a professor in the behavior analysis program at Florida Tech's College of Psychology and Liberal Arts.

While ABA can be used with autistic children of all ages, research from the New England Center for Children has shown that the most dramatic progress can be seen in toddlers between 18 and 24 months, the age when autism symptoms first surface.

"Many children are not getting screened at an early enough age for autism spectrum disorder and therefore may miss a crucial time for treatment," Kelley said.

To that end, the Scott Center is launching Screen Our Kids, a telehealth-based initiative that will give caregivers access to the same screening tools used by pediatricians to determine if their child could be at risk for a developmental delay before the age of 2.

When it comes to healthy development, there's a wide range of normal, Chong emphasized, but

"Early signs are tricky to spot," said Ivy Chong, psychologist and the Scott Center's director of autism services. "The earliest signs of autism involve the absence of normal behaviors—not the presence of abnormal ones."

Some early red flags include:

- Infant isn't making frequent eye contact at 2 or 3 months
- No smiling by 3 months
- Not laughing at 6 months
- Not following a caregiver's gaze at 8 months
- No babbling at 9 months
- Not turning when name is called, not waving goodbye or making hand gestures like pointing by 12 months
- Not saying a single word by 14 months
- Not playing pretend by 18 months

caregivers shouldn't take a wait-and-see approach if they feel in their gut something is wrong.

"Parents would not wait if their child was in physical pain, and this situation can be just as urgent," she said. "You risk losing valuable time at an age where your child has the best chance for improvement."

Early Intervention

Once autism spectrum disorder symptoms are recognized, ABA treatment can begin immediately, and Kelley said the payoff for early intervention can be dramatic.

"If we can get to autistic children before elementary school, 50 percent will be indistinguishable from their peers by the time they enter school, and most of the remaining 50 percent will also show significant improvement," he said. "Without early intervention, only 2 percent will show such improvements."

Suzanne Dickey got involved with the Scott Center when she reached out to get help for her firstborn son, Benjamin. A friend had a child with autism and noticed how similar Benjamin was to her child as a toddler.

By the time Benjamin was 18 months old, he had missed some of the usual developmental milestones. "His only word then was 'go,'" Dickey said, "and even then it sounded more like, 'doh.'" There were other signs, too, such as a lack of eye contact and little interest in playing with toys. By 2, Benjamin had been screened and diagnosed with moderate to severe autism.

Now 3, Benjamin's mother says ABA treatment has helped him make eye contact and has improved his communication. When Dickey had her next child, David, she said she was more aware of telltale signs of autism because of her experience with Benjamin.

And McGill, who enrolled her second and third children in Chong's infant study, was also proactive in watching for early signs of autism.

"Our son Patrick has been in the study since shortly after his birth," McGill said. "He is now nearly 18 months and is about to complete his final evaluation.

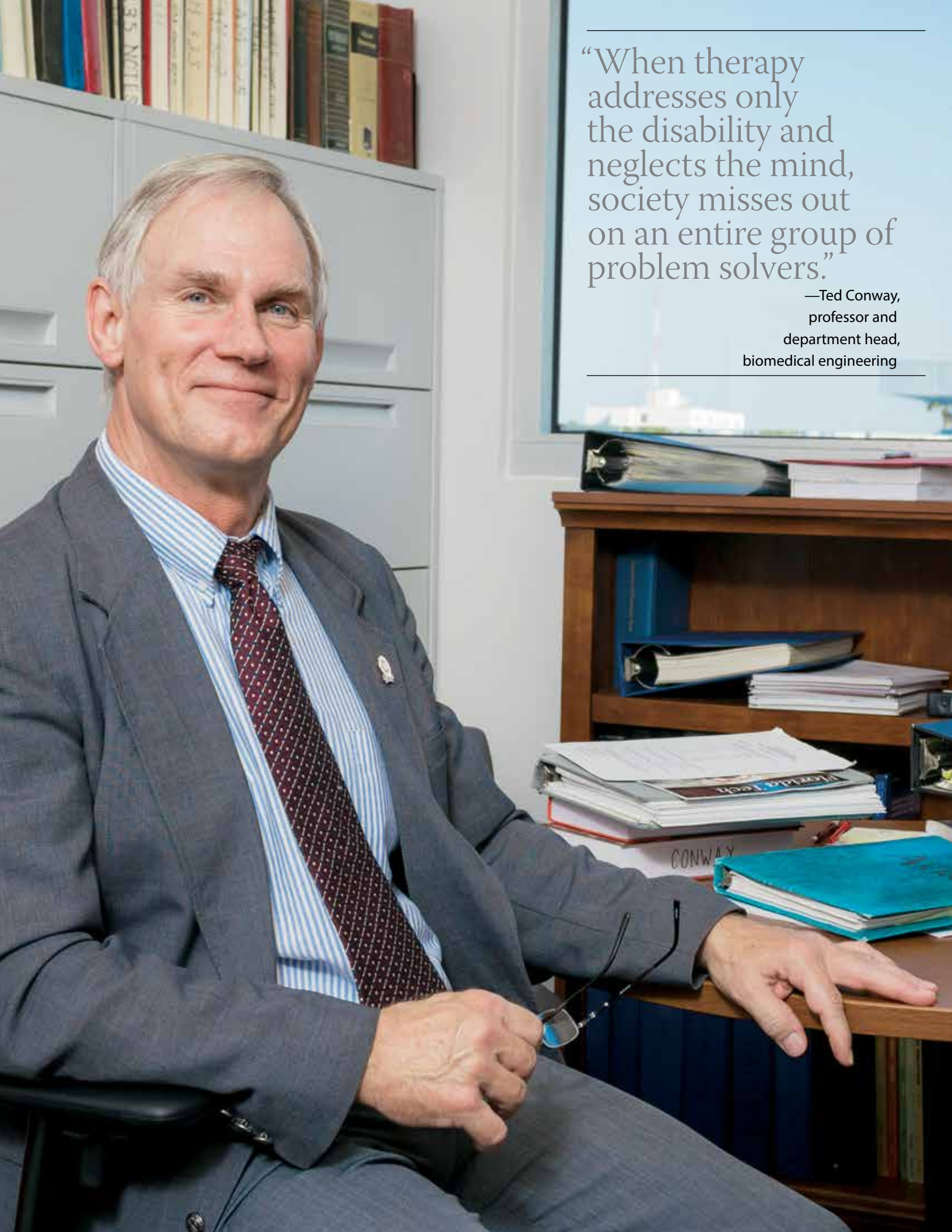
"Michael, our third son, will be joining the study as well. Our goal is to keep a watchful eye on each of our children so that any issues that arise may be dealt with swiftly and promptly."

Shelley Preston

Autism Advisor

Caregiver training to prevent and address problem behaviors at home is one of the missions of The Scott Center for Autism Treatment.

Through its telehealth initiative called Autism Advisor—a series of videos accessible at **www.thescottcenter.org/advisor**—families can learn about counseling resources and get free advice on autism-related issues on demand. Besides being a resource for caregivers, Autism Advisor can be a tool for health care providers as well.



"When therapy addresses only the disability and neglects the mind, society misses out on an entire group of problem solvers."

—Ted Conway, professor and department head, biomedical engineering

Strengthening Mind and Body

Conductive education research aims to empower the potential of the brain in children with disabilities.

Ted Conway was 10 years old when he started using crutches as a result of a neurological injury at birth.

As he became accustomed to them, he gained a specific kind of knowledge about how to move across surfaces.

"Inherently, I learned the variability of the coefficient of friction between rubber and various floor surfaces," explained Conway, head of Florida Institute of Technology's biomedical engineering department. "I couldn't articulate it until I became an engineer, but I knew it: experience showed me that my approach with the crutch would dictate either falling down or navigating the floor successfully."

Conway's family brought a thoughtful approach, as well, to their son's cerebral palsy. They understood that the hindered movement caused by the non-progressive disorder that altered his ability to maintain fine motor control of his lower extremities didn't mean sheltering him from daily life. He simply needed a different approach to mobility.

Conway grew into a distinguished scholar who spent much of his career investigating ways to connect technology and design with medicine and biology. But even as an adult, even as a former program director at the National Science Foundation, he sometimes has been viewed as a person with a disability first and an engineer second.

"The biggest challenge of dealing with a physical disability, by far, is dealing with other people's perception of what you are able or not able to do," he said. "I want to see a paradigm shift away from the tendency to exclude people with disabilities from the pool of innovative thinkers."

After years of focusing on his work as an academic, Conway wants to help open the door to the next generation of scholars who happen to have disabilities.

One of his efforts is to support schools and organizations that give children with disabilities a chance to grow their minds, which is what he had a chance to do growing up in Central Florida. After a short stay at what was then called the Harry-Anna Home for Crippled Children in Umatilla, Florida, where restraint was the standard operating procedure, Conway was enrolled in a public elementary school in Orlando catering to children with polio that integrated therapy into a traditional academic curriculum.

The move was an advantageous one for Conway, opening up the door to academic achievement and forging his future career in engineering.

Not all children with disabilities have been so lucky, Conway said, even today. When the focus is therapy that only addresses the disability and neglects the mind, society misses out on an entire group of problem solvers.

"That's one of the reasons I am passionate about conductive education," he said.

With funding from the National Science Foundation under its General & Age Related Disabilities Engineering program, Conway and his collaborators are working to find a method to scientifically quantify

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Professor Ted Conway with graduate students Jará Templet and Megan Setter.

With funding from the National Scien Disabilities Engineering program, Co to scientifically quantify the benefit of

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the benefit of conductive education for children with cerebral palsy (CP). This therapy aims to strengthen connections in the brain to allow the recipient to gain both better mobility and problem-solving skills with the ultimate goal of independence.

Research as Outreach

Still relatively unheralded in the United States, conductive education was developed by Hungarian physician and educator András Petö in 1945. His methods, which combine physiological therapy, cognitive development and social interactions, are based on the idea that the nervous system of someone with CP can still form new neural connections, and that those connections can be harnessed to stimulate movement with the help of a guided and active learning process.

A conductor, the person who guides the patient, helps link speech, thought and movement together though techniques such as "rhythmic intent"—which uses beats and lyrical cues in music—and mastery of simple equipment such as ladder chairs that promote upright alignment and support of the spine. The goal is to get the child to perform everyday activities on her own accord such as standing, walking, dressing and eating.

Currently there is only anecdotal evidence that the conductive method works.

Florida Tech is working with students at the Conductive Education Center of Orlando (CECO) who have agreed to provide biometric data to determine the validity of the collected data. Supportive findings could pave the way for more widespread use of conductive techniques.

"Conductive education has demonstrated great results for thousands of people," said Rosene Johnson, director of the CECO. "We hope this research will allow us to illustrate the correlation between the conductive method and hard science."

New Technology

Design Interactive, Inc., one of three principal investigators on the project, is designing virtual reality software that will guide subjects through a set of tests involving movement. Blue Orb, a company specializing in computer tools for people with disabilities, another PI, is developing the hardware for the system. The role of Florida Tech, the third PI, is to develop a quantitative method to measure movements such as pace, steps and joint placement to map the progress of the student over time.

The difficulty in researching progress in conductive education is that because cerebral palsy affects individuals differently, a milestone for one child may not be a milestone for another.

To work on that problem, Florida Tech research students Megan Setter and Jará Templet are developing a mathematical algorithm that can be used to track improvement for each individual tested based on his or her unique abilities and goals. Setter's job is to identify ergonomic metrics that measure things such as range of motion, while Templet will take the raw data and develop a method for systematically analyzing the information to show progress.

"What I love about this project," said Templet, "is that we will be in the classrooms with the kids and the conductors, and we can talk with the parents. We can watch and see what they are working to improve and get feedback on what they think we should be tracking.

ce Foundation under its General & Age Related
nway and his collaborators are working to find a method
conductive education for children with cerebral palsy.

We want to be able to target each of their goals specifically."

"By combining physiology with engineering, we can get some amazing biomechanics," said Setter. "And that is what this whole project really is: quantifying the biometrics."

Focused on Achievement

Though Conway and his team are excited about the engineering challenges ahead with quantifying the benefits of conductive education, the bigger picture comes back to giving more children real opportunities to succeed physically and mentally.

Conway would like to see the children at CECO—and eventually those beyond Orlando—find their own approach to the world and a path for bringing their talents to the table just as he was able to do as a boy.

"Scientifically proving the value of the conductive method could provide tools to enhance the lives of many more children with CP, allowing them to maximize their abilities," he said.

On a recent morning at CECO, Conway, Templet and Setter observed the students in their classrooms and talked with staff about their methods. In each classroom, children grouped by age and with various levels of cognitive and motor disabilities were deep into their morning routine. With conductors providing verbal cues, toddlers to teenagers practiced exercises to coax limbs into walking, pulling up to stand or reaching for an object.

Conway said he could see a lot of himself in the students. Though he didn't use the conductive method as a child, his parents intuitively used a similar approach by focusing on ability rather than disability.

"There were problems I had to solve on a day-to-day basis that most people didn't have to think about," he said. "These kids also develop creativity to solve problems. Success is not a function of brilliance; it's often a function of persistence."

Shelley Preston

"There were problems I had to solve on a day-to-day basis that most people didn't have to think about ... Success is not a function of brilliance; it's often a function of persistence."

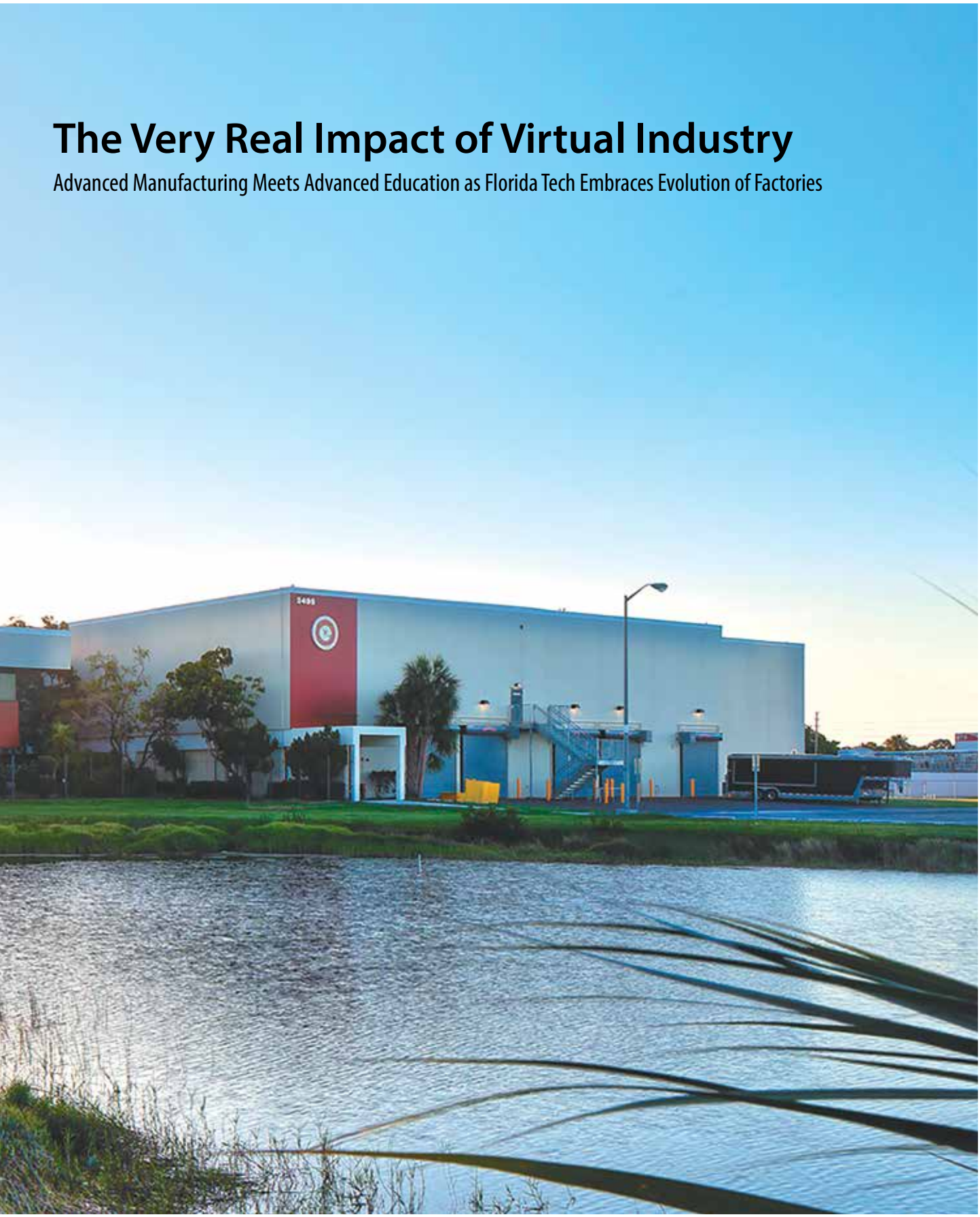
—Ted Conway, pictured in May 1959 at 4 years old

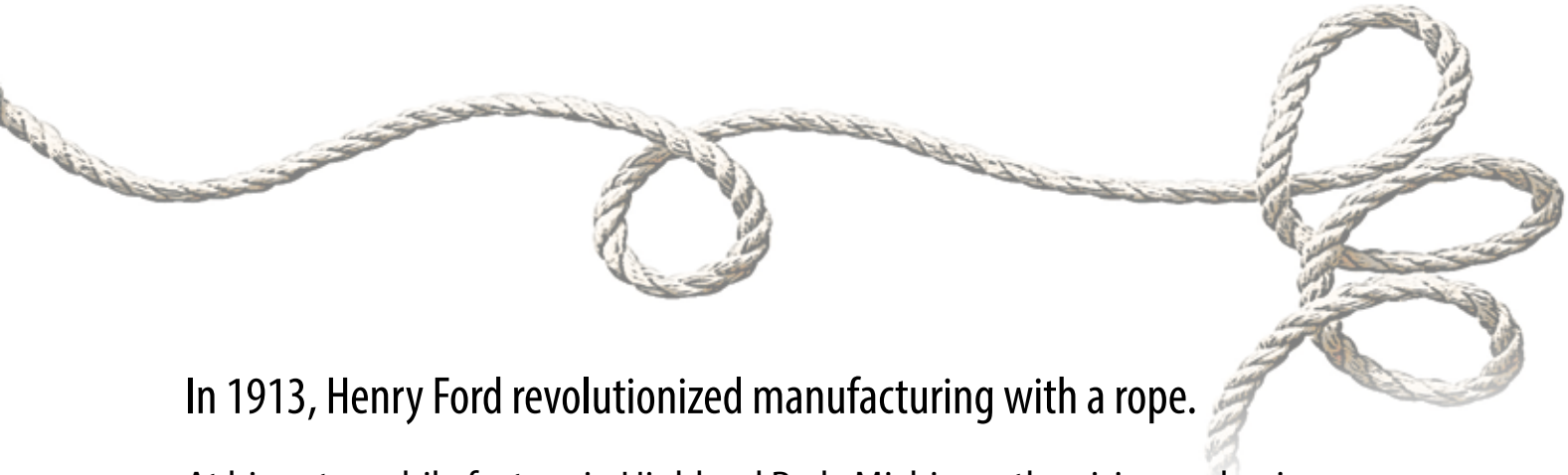
"We are creating a product research, design, engineering and manufacturing collaborative environment for students and companies with advanced, digital-driven capabilities."

—Michael Grieves, executive director of the Center for Advanced Manufacturing and Innovative Design (CAMID)

The Very Real Impact of Virtual Industry

Advanced Manufacturing Meets Advanced Education as Florida Tech Embraces Evolution of Factories





In 1913, Henry Ford revolutionized manufacturing with a rope.

At his automobile factory in Highland Park, Michigan, the visionary businessman threaded a rope through a vehicle chassis. That allowed the unit to be pulled down the line, where groups of workers performed their tasks as it got to their area. The time to assemble a vehicle went from 12 hours to 90 minutes.

As the 20th century progressed, there were other technological advances in manufacturing. Electronics and software became a part of the process, with computer-aided design taking design work into the cyberworld.

What was envisioned on the monitor was then built and tested in the real world—in a wind tunnel, a temperature chamber.

Computers and programming became more powerful, however, and they began being used to test the functionality of the product as well as help design it. Advanced programs allowed virtual prototypes to be stressed, weighted, heated and otherwise tested as if they existed. Costly physical prototypes were no longer needed.

We are in the early stages of another leap forward in manufacturing. Often referred to as Industry 4.0, this revolution takes Ford's improvements from the factory floor to the motherboards and circuitry of computers, and alters the role factory workers play.

"The next piece is modeling how something is manufactured," said Michael Grieves, a pioneer in advanced manufacturing and executive director of the Center for Advanced Manufacturing and Innovative Design (CAMID) at Florida Institute of Technology, a facility for research and training in advanced manufacturing.

"In the past, we've built a factory and tried to figure out how to make the manufacturing process work," Grieves continued. "Now, we can put the product into simulation, see it moving down the line, take measurements and learn from what doesn't work."

Though in large part virtual, this product lifecycle management (PLM) process has—and will have—real-world impacts.

Grieves, who spent decades in the computing and manufacturing industries and remains a consultant, offered an example: At one point there were 14 welding robots in use at one of the legacy automakers. By using modeling and simulation, it was determined that the same work could be done by just four robots.

"We found that fewer robots could work efficiently together," he said.

A Major Gift

Advanced manufacturing needs advanced technology, and advanced technology needs advanced software.

Enter Siemens USA.

The subsidiary of Siemens AG, a global powerhouse focusing on the areas of electrification, automation and digitalization, in October provided Florida Tech with an in-kind software grant valued at $246 million that will enable the university to offer students powerful, hands-on learning experiences to better equip them for future STEM careers in Industry 4.0.

The grant is centered on Siemens' industry-leading Product Lifecycle Management software, which is used by more than 150,000 companies around the world in the aerospace, automotive, medical device, machinery, shipbuilding and high-tech electronics sectors.

The software will allow for the creation of virtual factories, a critical step forward in both advanced manufacturing itself and preparing the workforce to succeed in that evolving industry.

"Software is at the core of an ongoing digital transformation that is changing the way our customers approach the manufacturing process, from design to production into service," Tony Hemmelgarn, president and CEO of Siemens PLM Software, told the university. "Through our partnership with Florida Tech, we are helping empower the next generation of digital talent with access to valuable hands-on training with both software and hardware tools. This real-world, project-based learning will offer students the STEM skills they need to succeed in the digital future."

Put into use at CAMID and Florida Tech's renowned College of Engineering, the Siemens products will create what Grieves called "a powerful ecosystem" where industry, software solution providers and students create knowledge and push advanced manufacturing forward.

Powered by Innovation

If the Siemens software grant is the fuel for powering into, and helping to shape, the future of manufacturing, CAMID is most certainly the engine.

Based in a building in Palm Bay, Florida, once home to the semiconductor manufacturer Intersil, the 100,000-square-foot center will offer the latest digital modeling, simulation and visualization technologies as well as computer-driven manufacturing equipment. Students and companies will undertake product research, supply chain and workforce training.

"We are creating a product research, design, engineering and manufacturing collaborative environment for students and companies with advanced, digital-driven capabilities," Grieves said.

CAMID is funded in part by a $1.4 million grant from the U.S. Economic Development Administration and a $300,000 grant from the City of Palm Bay, which will help with the launch of one of the center's first tenants, the Virtual Integrated Technologies Application Lab. And earlier in 2017, the center was awarded $1.5 million in infrastructure funding through a Department of Education appropriation in the State of Florida.

CAMID is undergoing physical improvements and upgrades even as tenants such as Larsen Motorsports utilize other space in the facility.

"We are excited about CAMID because of how it will foster innovation of all sorts," Grieves said. "Through world-class research, we will seek to improve the advanced manufacturing landscape. Working with major corporations, equipment providers and others, we will seek ways to more effectively design, secure, test and manufacture globally competitive products.

"We are, in fact and in theory, building a better future."

Adam Lowenstein

We are in the early stages of another leap forward in manufacturing. Often referred to as Industry 4.0, this revolution takes Ford's improvements from the factory floor to the mother boards and circuitry of computers, and alters the role factory workers play.

Ribbit!

There's an app for that. And a worthwhile cause.

With funding from the National Science Foundation, a trio of faculty members at Florida Tech has developed the WhatFrog app for iOS devices that identifies and catalogs common North American calling frogs and toads. The app provides ecological information and range maps in addition to identifying the calling frog or toad.

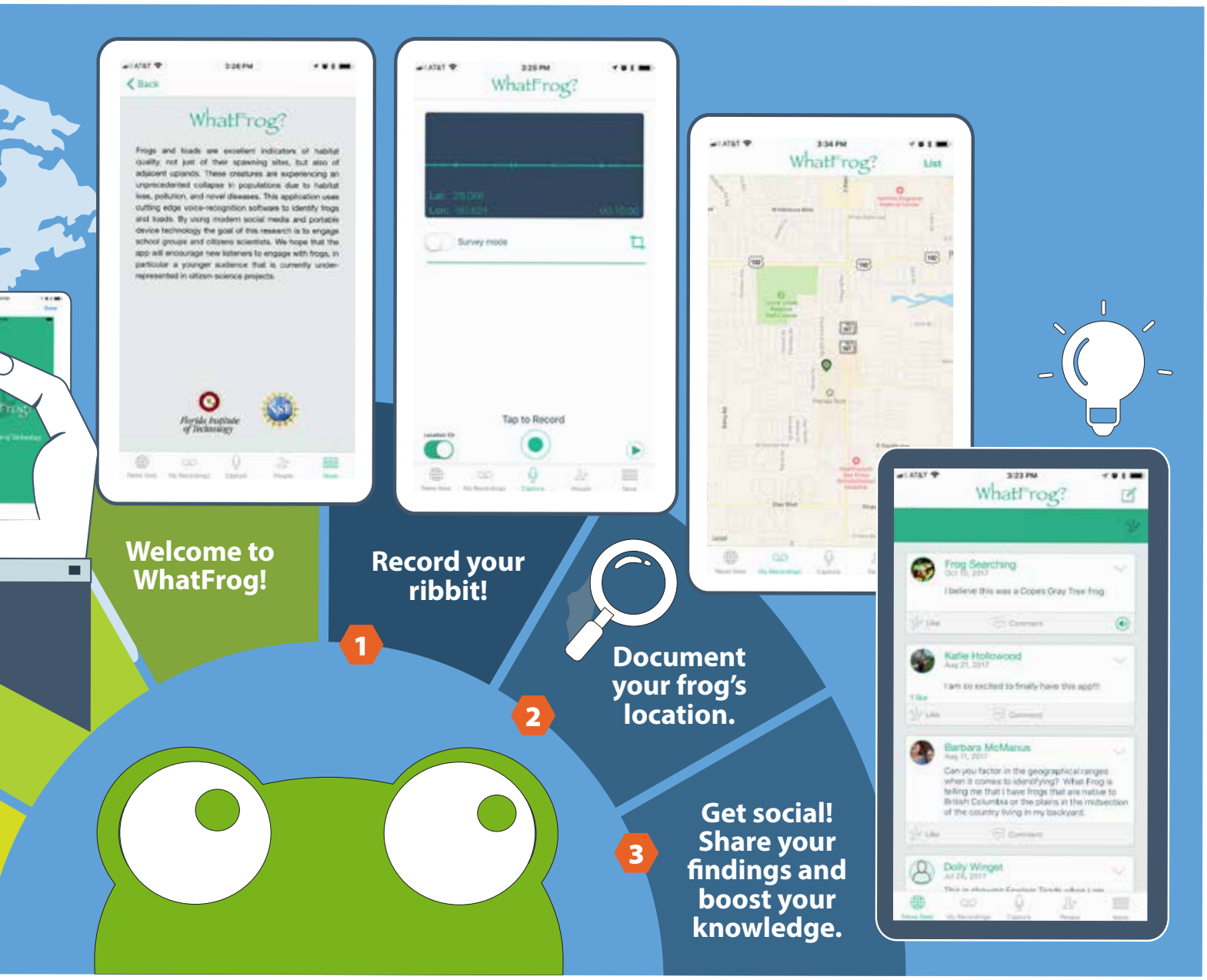
With nearly 33 percent of amphibian species on the brink of extinction, and with 200 species of frogs and toads already having disappeared since 1980—an alarmingly accelerated loss of species—WhatFrog will provide important information to scientists, said Mark Bush, a professor of biological sciences and project leader.

Anurans—the order that includes frogs and toads—are considered bioindicators. As such, they can offer information on the quality of their habitat, often wetlands and adjacent woodlands. Habitat loss, pollution, climate change and novel diseases are all threatening the survival of these species.

"Where we see a high diversity of frogs and toads that is an excellent indicator of healthy, high-quality habitats," Bush said. "We need fully functioning wetlands to reduce flooding, and to filter excess nutrients from water. Frogs and toads provide an early-warning system of when these systems are beginning to fail."

The challenging task of developing an app that can identify a frog's croak, distinguish it from the other sounds of nature, and catalog the sound and the location, fell to Florida Tech's Eraldo Ribeiro, associate professor of computer sciences, and Ronaldo Menezes, professor of computer sciences and director of the School of Computing.

The app's central component is an identification algorithm that uses methods from machine learning and computer vision to achieve a high level of accuracy, which early use had at about 86 percent on a dataset of 736 calls from 48 anuran species.



But the power of the app goes beyond its technology. It will allow a new generation of citizen-scientists to help fight the species' decline, and it will do so without the more time-consuming methods of installing sensors to detect frogs, or the cost-prohibitive approach of employing highly trained researchers to conduct surveys. Citize-scientists have stepped up and are now the eyes and ears of monitoring programs. The app is designed both to encourage new users to become interested in frogs and toads and to enhance the observations and effectiveness of experienced volunteers.

The WhatFrog team is working to have children and primary school educators use the app.

"By using modern social media and portable device technology, the goal of WhatFrog is to engage a younger audience," Ribeiro said. "The free app will make it appropriate for classroom use, and it has the potential to spur studies in ecology, physics, geography and math, as the students consider the data, sonograms and maps that the software will produce."

Researchers believe the app could quickly be adopted by thousands, perhaps tens of thousands of users, many of whom would never have paid attention to frog calls, but could now be new contributors to citizen science.

Adam Lowenstein and Jennifer Torres

Research in Brief

A LOOK AT RECENT SCIENCE AND ENGINEERING HIGHLIGHTS FROM FLORIDA TECH FACULTY

Lightning More Powerful Over Water

Amitabh Nag, assistant professor of physics and space sciences, and research professor **Kenneth L. Cummins**, recently published, "Negative First Stroke Leader Characteristics in Cloud-to-Ground Lightning Over Land and Ocean" in the American Geophysical Union's *Geophysical Research Letters*. Previous indirect observations have led scientists and others to believe that strikes over seawater tend to be more powerful, but the Nag and Cummins study represents the first time that an independent measurement has validated those beliefs. The scientists analyzed lightning over parts of Florida and its coasts using data provided by the U.S. National Lightning Detection Network.

Gene Linked to Stress Response in Cancer Cells

New research recently published in the journal *PLOS ONE* by **Eric Guisbert**, assistant professor of biological sciences, and **Karen Kim Guisbert**, a research scientist, highlights a new link between stress responses and cancer through the gene SF3B1. SF3B1 mutates in breast cancer, chronic lymphocytic leukemia and other forms of cancer. The new research shows that SF3B1 controls how cells respond to stress and could be a missing link explaining activation of stress defenses in cancer. Building on this research, Guisbert's laboratory, working in research collaboration with the Sanford Burnham Prebys Medical Discovery Institute in Orlando, is developing a method to find new drugs that disrupt cancer cells' ability to respond to stress.

RESEARCH GRANT ROUNDUP

More than 20 researchers at Florida Tech received new grants of $100,000 or more from December 2016 through September 2017. Here's a look at who got how much and for what. Grants are arranged by name of the college, the recipient, name of the project, funding amount and awarding agency.

COLLEGE OF AERONAUTICS

Professor Meredith Carroll, Professor Deborah Carstens, Professor Donna Wilt
Human Factors Considerations for Information of Varying Levels of Integrity, Reliability and Security on the Flight Deck Support
Federal Aviation Administration
$599,715

COLLEGE OF ENGINEERING AND COMPUTING

Dean Marco Carvalho, School of Computing
Shelf-shielding Dynamic Network Architecture
Intelligent Automation, Inc., Department of Homeland Security
$522,000

Computation Framework for Modeling Cyber Identity
North Carolina A & T State University, Department of Defense
$140,000

Joint Collaborative Augmentation for Sensemaking Environment Phase II
Securboration, Air Force Research Laboratory
$150,000

Professor Paul Cosentino, Civil and Construction Management; Assistant Professor Matthew Jensen, Mechanical Aerospace
Quantifying Pile Rebound with Deflection Measuring Systems Best Suited for Florida Soils
Florida Department of Transportation
$201,633

Assistant Professor Michael Fenn, Biomedical
3-D Printed Biomimetic Bioglass-gradient Matrices for ACL Reconstruction
National Institutes of Health
$203,278

Assistant Professor Austin Fox, Professor John Trefry, Ocean Engineering and Sciences
Brevard County Muck Dredging Project: Lagoon Wide Application of the Quick-flux Technique to Determine Sediment N And P Fluxes
Brevard County, Florida Department of Environmental Protection
$193,850

Study Finds Mental Health Court Curbs Recidivism

A new study from **Julie Costopoulos**, an assistant professor in the university's School of Psychology, and doctoral student **Bethany Wellman**, found that criminal defendants who graduated from mental health court demonstrated substantially reduced re-arrest rates a full three years following their release. It was the longest period of post-program behavior ever examined in a published study involving mental health courts. "Jail doesn't stop crimes by the mentally ill, treatment does, yet jails and prisons are now the largest mental health treatment facilities in the United States," Costopoulos said. "We know mental health court not only reduces jail overcrowding, it also helps participants find support to live independently and successfully while getting treatment." The study, "The Effectiveness of One Mental Health Court: Overcoming Criminal History," was published in the journal *Psychological Injury and Law*.

SPOTLIGHT ON TOP RESEARCHERS

Rich Aronson

Professor and Head
Department of Biological Sciences, College of Science

General research focus: Antarctic ecology, paleontology, deep-sea biology, coral-reef science, climate-change research

Current research funding: $1,411,799

What has you excited about your current research? We study the response of marine life to natural climate change in the geologic past and use that information to project what will happen on the sea floor over the next hundred years of climate change. In Antarctica, we are tracking biological invasions of predatory king crabs. It's been too cold for them for millions of years, but now they are returning as the Southern Ocean warms rapidly, threatening to restructure marine communities. Our coral-reef research off the Pacific coast of Panama is telling us that climate change could stop those reefs from growing for millennia.

Why is it important to conduct research? I am often asked why we should be concerned about climate change and its impacts if it has all happened already in the geologic past. First of all, we know from research that it hasn't happened this rapidly before, and as a result the planet and its ecosystems do not have time to adjust. Second, this is not about prior occurrence, but rather about desirability. Just because something happened millions of years ago, before humans evolved, does not mean it is good for us now. A large asteroid slammed into our planet 65 million years ago and destroyed the dinosaurs and legions of marine life, but you wouldn't want that to happen again. So it is with climate change. Research provides us with the facts we need to make informed policy decisions.

Brevard County Muck Dredging Project: Trends for Inputs of Muck Components From Rivers, Creeks and Outfalls to the Indian River Lagoon
Brevard County, Florida Department of Environmental Protection
$204,550

Professor Kevin Johnson, Ocean Engineering and Sciences
Brevard County Muck Dredging Project: Muck Removal Efficiency Plus Biological and Chemical Responses / Improvements After Muck Dredging
Brevard County, Florida Department of Environmental Protection
$150,000

Brevard County Muck Dredging Project: Optimizing Selection of Sites for Environmental Dredging in the Indian River Lagoon System
Brevard County, Florida Department of Environmental Protection
$100,000

Assistant Professor Vipuil Kishore, Biomedical
3-D Printed Biomimetic Bioglass-gradient Matrices For ACL Reconstruction
National Institutes of Health
$174,278

Associate Professor Razvan Rusovici, Mechanical Aerospace
Development of a Weapon Inspection and Sustainment Recording Device (STTR)
Mainstream Engineering
$299,772

Continued on page 22

SPOTLIGHT ON TOP RESEARCHERS

Kristi Van Sickle

Associate Professor
School of Psychology, College of Psychology and Liberal Arts

General research focus: Interprofessional training in integrated behavioral health care, professional competence in health service psychology

Current funding: $1,042,313

What has you excited about your current work? The most gratifying part of this project is the creation of funded opportunities for clinical psychology doctoral students to train as valued members of primary care treatment teams. In these roles, they collaborate closely with physicians and other allied health professionals to address traditional mental health concerns such as anxiety and depression, as well as behaviorally based medical issues including obesity and COPD. Not only does this experience make our students more competitive in the changing health care market, but it allows for the significant expansion and destigmatizing of behavioral health access, particularly for underserved and disadvantaged populations.

Why is it important to conduct research? There is so much that we don't know or understand about ourselves and our world. From a health care perspective specifically, we need to continue to gather evidence on the most efficient and effective ways to treat and ultimately prevent a myriad of illnesses. Research is the vehicle for continued advancement of our health care knowledge base and improvement of our population's health.

Research Explores if Algal Toxins in Prey Fish Impact Dolphins

A cyanobacteria, usually associated with fresh water bodies such as the Great Lakes, was found in the brackish Indian River Lagoon a few years ago, sparking one of the water's most massive fish kills ever. **Spencer Fire,** assistant professor of biological sciences, is working with researchers at Harbor Branch Oceanographic Institute on how toxins caused by this organism could affect dolphins and their prey in the estuary. The work is made possible with funding from the Protect Wild Dolphins Specialty License Plate Fund, which is administered by Florida Atlantic University-Harbor Branch Oceanographic Institution. Fire and the HBOI researchers are testing for harmful algal bloom (HAB) toxins in the water, sediment and in animal tissue during non-bloom times to establish a baseline and test again when an algal bloom is in effect. Ultimately, the scientists want to determine if there are correlations between toxin concentration and dolphin pathology.

RESEARCH GRANT ROUNDUP continued

Continued from page 21

Harris Professor Steven Shaw, Mechanical Aerospace
Collaborative Research: Nonlinear Coupling and Relaxation Mechanisms in New Micro-mechanics
National Science Foundation
$249,992

Associate Professor Nakin Suksawang, Civil and Construction Management
Confinement Effect of Metal Railing Narrow Baseplates on Adhesive Anchor Breakout Resistance
Florida Department of Transportation
$147,150

Assistant Professor Marcus Wilde, Assistant Professor Brian Kish, Professor and Associate Dean for Research Daniel Kirk, Mechanical Aerospace
Flight Demonstration for AoA-limiting Systems on Part 23 Aircraft
Federal Aviation Administration
$341,880

Professor Gary Zarillo, Ocean Engineering and Sciences
Evaluating Benthic Community Response to Planned Dredging Activities at Port Everglades Florida
U.S. Army Corps of Engineers, Cooperative Ecosystem Studies Units
$100,000

State of the Inlet Analysis
Sebastian Inlet Tax District Commission
$110,750

Brevard County Muck Dredging Project: Hydrologic And Water Quality Model for Management and Forecasting Within Brevard County Waters
Brevard County, Florida Department of Environmental Protection
$130,000

Brevard County Muck Dredging Project: Optimizing Selection of Sites for Environmental Dredging in the Indian River Lagoon System
Brevard County, Florida Department of Environmental Protection
$169,000

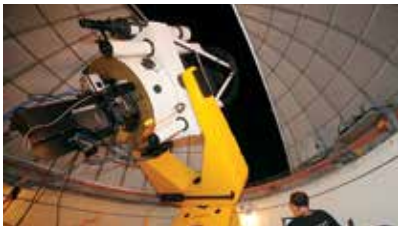
Wave, Weather and Tide Data Collection System at Sebastian Inlet
Sebastian Inlet Tax District Commission
$107,500

Researching the Affect of Rising Oceans and El Niño on Corals

Biology professor **Robert van Woesik** received a $586,000 National Science Foundation grant to find out if corals in the Pacific Ocean can thrive in the face of rising sea levels. Corals live in relatively shallow, sunlit waters, and healthy coral reefs have the ability to grow massive vertical structures fast enough to keep up with rising waters. But diseased or stressed coral reefs do not have that capacity. The new study will examine whether geographical differences in ocean temperatures influence the capacity of reefs to grow vertically as sea level rises. Other research led by van Woesik and research associate **Carly Randall** examined how three common diseases affecting Caribbean corals spike during El Niño years. The findings published in *Scientific Reports* were based on an analysis of 18 years of coral-disease data at nearly 2,100 sites collected by the Atlantic and Gulf Rapid Reef Assessment Program. That data was compared with 18 years of coinciding climate data to see if the disease cycles matched the climate cycles.

Study Shows Skepticism About Driverless Ambulances

Research from Florida Institute of Technology and Embry-Riddle Aeronautical University reported that a majority of surveyed adults were significantly less willing to be transported in a driverless ambulance compared with a conventional one. The research, based on three studies involving 1,028 U.S. adults, found that half of those surveyed had reservations about being transported in an autonomous ambulance and that women were generally less willing than men to ride in such a vehicle, even with the promise of receiving care from two paramedics rather than one. The findings may also reflect the fact that, in an emergency, predictability tends to be important to people, said **Scott Winter**, at the time an assistant professor of aviation science at Florida Tech who served as primary author of the team's paper, "Patient Perceptions on the Use of an Auto-piloted Emergency Medical Transport: An Affective Perspective." Florida Tech Ph.D. candidate **Rian Mehta** also contributed to the research.



COLLEGE OF SCIENCE

Assistant Professor Jian Du, Mathematical Sciences
Collaborative Research: Blood Clotting at the Extreme—Mathematical and Experimental Investigation of Platelet Deposition in Stenotic Arteries
National Science Foundation
$149,999

Assistant Professor Spencer Fire, Biological Sciences
Dolphins as Sentinels for Harmful Algal Bloom Toxins in the Indian River Lagoon: An Interdisciplinary Study
Florida Atlantic University's Harbor Branch Oceanographic Institute Foundation,
Florida Highway Safety and Motor Vehicles
$127,580

Professor Eric Perlman, Physics and Space Sciences
Collaborative Research: Uncovering Nature's 100 Tev Particle Accelerators in the Large-scale Jets of Quasars
National Science Foundation
$266,706

Dean Hamid Rassoul, Physics and Space Sciences
Balloon Observation of Gamma-ray Glows From Thunderstorms
National Science Foundation
$109,408

Professor Joshua Rokach, Chemistry
5- Oxo - ETE: A Novel Inflammatory Mediator
American Asthma Foundation
$150,000

Professor Robert van Woesik, Biological Sciences
Adjustment of Western Pacific Ocean Coral Reefs to Sea-level Rise and Ocean Warming
National Science Foundation
$586,229

Florida Institute of Technology

Office of Marketing and Communications
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Melbourne, Florida 32901-6975

DISCOVERY

Buzz Aldrin Space Institute Explores Human Side of Mars Missions

Florida Tech's Buzz Aldrin Space Institute and the Institute for Cross Cultural Management hosted researchers from across North America for the Mars Mission Social Sciences Workshop at Kennedy Space Center Visitor Complex. Research professor **Buzz Aldrin** (pictured) was present to share his vision for human occupation on Mars. The workshop was organized by **Jessica Wildman**, assistant professor of psychology who invited leading scholars from a variety of social science disciplines to discuss the psychological, sociological and human performance challenges associated with permanent Mars colonization and the research needed to cope with these challenges.

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