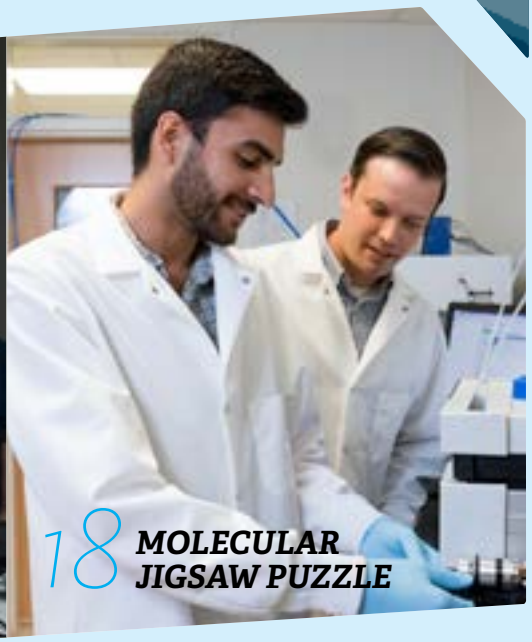
FEATURES

8 COMPUTING A HEALTHIER FUTURE



18 MOLECULAR JIGSAW PUZZLE

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CrossLink

A publication of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida

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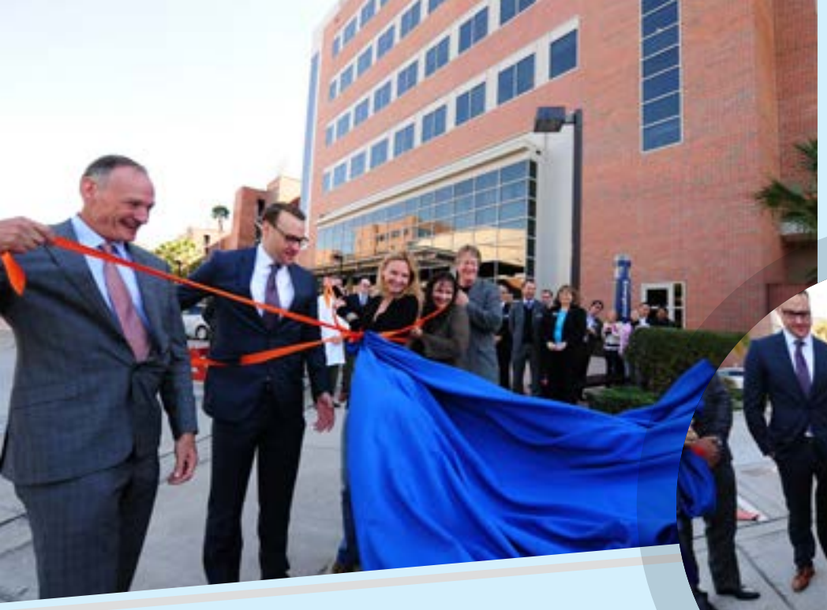


Left: Members of the Pruitt family unveiling the new historical marker
Below: Dr. Pruitt Sr.'s daughters, Natalie Judge and Helen Wallace

BME HONORS NAMESAKE WITH HISTORICAL MARKER

The J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida is made possible by the vision and generosity of Dr. J. Crayton Pruitt and his family. This fall the department honored and recognized this generosity during the third annual Pruitt Research Day, an event held in celebration of the research being conducted in the BME community.

In addition to a successful day of talks and poster presentations, the department held a special ceremony for the unveiling of the Pruitt Historical Marker. UF Provost and Senior VP for Academic Affairs Dr. Joe Glover presented the Pruitt family with the university's first-ever "Preeminence Award" to thank them for their continued support.

This marker sits near the entrance of the Biomedical Sciences Building, home to the BME department as a reminder of Dr. Pruitt and his family's influence.

The plaque's inscription reads:

J. Crayton Pruitt Sr. was a visionary leader and inspiration to all who knew him. An accomplished cardiothoracic surgeon, researcher, inventor and philanthropist, Dr. Pruitt had a lasting influence over innumerable lives in his 80 years. Born on November 23, 1931, in Jefferson, South Carolina, he built a thriving private surgical practice in St. Petersburg, Florida.

He devoted his career to the prevention of strokes. His father suffered a debilitating series of strokes beginning mid-life, which motivated Dr. Pruitt to research and create improved surgical technology. In the late 1970s, Dr. Pruitt co-invented the Pruitt-Inahara Carotid Shunt, one of the most widely used shunts of its kind for many decades. He also pioneered the surgical treatment of carotid artery arteriosclerosis for stroke prevention. At the time of his death in 2011, he had performed more of these procedures than any other surgeon in the nation.

In 1995, Dr. Pruitt received a heart transplant at UF Health Shands Hospital. The experience left Dr. Pruitt and his family with a profound appreciation for biomedical engineering. They expressed their gratitude through multiple gifts to the biomedical engineering graduate program at UF's College of Engineering, and University leaders created the first-ever named department at UF: the J. Crayton Pruitt Family Department of Biomedical Engineering. The University of Florida is grateful to the Pruitt family for its generosity and foresight.

News & Notables

MAJOR FACULTY AWARDS

- Dr. Wesley Bolch appointed to U.S. delegation to United Nations Scientific Committee on Effects of Atomic Radiation
- Dr. Jon Dobson elected AIMBE Fellow
- Dr. Aysegul Gunduz received IAMBE Early Career Award
- Dr. David Hintenlang elected Fellow of the American Association of Physicists in Medicine
- Dr. Gregory Hudalla received NSF CAREER Award
- Dr. Benjamin Keselowsky named UF Research Foundation Professor
- Dr. Hans van Oostrom selected as College of Engineering and University of Florida Faculty Adviser/Mentor of the Year
- Dr. Christine Schmidt elected Chair of AIMBE's College of Fellows
- Dr. Blanka Sharma featured on cover of ASEE's *Prism* magazine
- Dr. Bruce Wheeler elected IAMBE Fellow

KEY RESEARCH ADVANCES & INNOVATION

- Dr. Aysegul Gunduz's lab highlighted in CNN's Vital Signs with Dr. Sanjay Gupta
- Dr. Aysegul Gunduz and UF neuroengineering team awarded up to $5.4M from DARPA for neuroprosthetics research
- Dr. Gregory Hudalla's article published in *Nature Materials*
- Dr. Huabei Jiang authored book on Photoacoustic Tomography
- Dr. Benjamin Keselowsky awarded $1.5M NIH R01 grant as PI for "Biomaterial Delivery System for Type 1 Diabetes Vaccine"
- Dr. Parisa Rashidi awarded $1.9M NIH R01 grant as Co-I for "Finding Good TEMporal PostOperative pain Signatures"
- Dr. Carlos Rinaldi invited to speak at Gordon Research Conference on Cancer Nanotechnology
- Dr. Blanka Sharma received National Academies Keck Futures Initiative grant
- Dr. Cherie Stabler awarded $4.9M NIH UC4 grant as PI for "Engineering a Human Physiomimetic Islet Microsystem"
- Dr. Lin Yang awarded $1.5 M NIH R01 grant as PI for "Development and Dissemination of MuscleMiner: An Imaging Informatics Tool"

STUDENT AWARDS

- Evelyn Bracho-Sanchez voted President-Elect for the Society of Biomaterials National Student Chapter
- Aniruddh Ravindran selected as 2015 Engineering M.S. Scholar
- Izabella Lipnharski won two 1st place awards at 2015 AAPM Spring Clinical Meeting
- Four students awarded Health Physics Society Fellowships
  - Michael Hermansen
  - Emily Marshall
  - Heather Petroccia
  - Michelle Sands

RANKINGS

- University of Florida ranked 14th among public universities by U.S. News & World Report
- UF BME Graduate Program ranked 22nd among public universities by U.S. News & World Report
- UF BME ranked 10th by GraduatePrograms.com student reviews

Distinguished Leadership Seminar Series: 2014-2015

10/06/2014
Dr. Michael L. Shuler, James and Marsha McCormick Chair of the Department of Biomedical Engineering and Samuel Eckert Professor of Chemical Engineering, Cornell University
"Body-on-a-Chip": A New Approach to Drug Development

11/10/2014
Dr. Maryellen L. Giger, A.N. Pritzker Professor of Radiology, University of Chicago
Deciphering Breast Cancer with Imaging, Genomics, and Big Data

11/17/2014
Dr. W. Mark Saltzman, Goizueta Foundation Professor of Biomedical, Chemical and Environmental Engineering & Physiology, Yale School of Engineering & Applied Science
Highly penetrative nanocarriers loaded with drugs targeted to resistant cells improve treatment of brain tumors

01/12/2015
Dr. Cato T. Laurencin, University Professor, Van Dusen Distinguished Professor of Orthopaedic Surgery, Professor of Chemical and Biomolecular Engineering, Materials Science and Engineering, University of Connecticut
Regenerative Engineering: The Launch of a Next Generation Field

02/23/2015
Dr. Andrés J. Garcia, Neely Chair and Regents' Professor of Mechanical Engineering, Georgia Institute of Technology
BioArtificial Materials and Mechanobiology Technologies for Regenerative Medicine

03/30/2015
Dr. Metin Akay, Founding Chair and John S. Dunn Endowed Chair Professor, Department of Biomedical Engineering, University of Houston
Engineering High-Throughput 3D Platform for Targeting Gliablastome Multiforme Vasculature and Molecular Profiling

Upcoming Speakers

09/14/2015
Dr. Kristi S. Anseth, Distinguished Professor, Tisone Professor, Associate Professor of Surgery, and Howard Hughes Medical Institute Investigator, University of Colorado Boulder

09/21/2015
Dr. Jennifer L. West, Fitzpatrick Family University Professor of Engineering, Duke University

10/26/2015
Dr. Rashid Bashir, Abel Bliss Professor of Engineering and Bioengineering Department Head, University of Illinois at Urbana-Champaign

01/11/2016
Dr. Matthew O'Donnell, Frank and Julie Jungers Dean Emeritus, College of Engineering and Professor, Department of Bioengineering, University of Washington

02/15/2016
Dr. Dominique M. Durand, EL Lindseth Professor of Biomedical Engineering and Director, Neural Engineering Center, Case Western Reserve University

Computing a Healthier Future

Biomedical Informatics Rising at UF

A *Star Trek*-like device that can monitor and diagnose your health while you're on the go...

A prescription that truly factors in "you" (your medical records, genetics, behavior, and community) when choosing the right medicine and dosage...

A supercomputer, much like IBM's Watson of *Jeopardy!* fame, able to easily absorb the often-overwhelming inflow of new medical research while offering invaluable advice to doctors in their decision making...

These are the medical advancements Dr. Parisa Rashidi envisions for biomedical informatics in the next decade or so, and the University of Florida is making headway in its focus on the rising field, adding faculty members, including Rashidi, and planning the launch of a certificate program in the fall.

BY MICHAEL STONE

"I am feeling lucky to be involved in the biomedical informatics field at this time," she says. "This means I can use my knowledge of computer science and machine learning in practical applications and hopefully be able to make a change in people's lives."

Though the definition varies from source to source, biomedical informatics' overarching aim is to turn sometimes vast amounts of data and knowledge about medicine and personal health, from an individual's DNA sequences to whole populations, into meaningful health care solutions.

The field is indeed a complex one, the product of interdisciplinary efforts from computer scientists, doctors and engineers, says Rashidi, an assistant professor in the J. Crayton Pruitt Family Department of Biomedical Engineering.

"It's not like an individual project that we are working on in isolation," she says. "It's usually a collaborative type of project."

Rashidi graduated with her Ph.D. in computer science in 2011 from Washington State University. She taught at Northwestern University's Feinberg School of Medicine for a year before coming to UF in 2013.

The BME department has made one other recent hire with a specialization in biomedical informatics: Dr. Lin Yang, who graduated with his Ph.D. in 2009 from Rutgers University's Department of Electrical and Computer Engineering. He was an assistant professor at Rutgers for two years and at the University of Kentucky for three before coming to UF in 2014. Dr. Yang specializes in imaging informatics, which complements Dr. Rashidi's expertise in clinical and health informatics.

Another hire as part of UF's Informatics initiative, Dr. William Hogan was recruited to UF in June 2014 by the Department of Health Outcomes and Policy (HOP) in the College of Medicine.

Formerly chief of the University of Arkansas Medical Sciences' Division of Biomedical Informatics, ***Hogan serves as UF Clinical and Translational Science Institute's director of biomedical informatics,*** and he's organizing the 15-credit graduate certificate in the field that's set to launch this fall. In anticipation of the launch, Hogan has made three more biomedical informatics hires himself for the HOP department.

What to Research?

Rashidi describes biomedical informatics as a "back-and-forth process" in which doctors outline a health care problem with researchers in other fields, who later return with data collections.

"I can do all of the data analysis. I can find all these interesting patterns in data," she says. "We need to talk to doctors to say, 'OK, these are the patterns that we see, but do they have any meaning to you?'"

For an example, Rashidi points to a study she's working on with two other researchers at UF that looks at post-surgery pain in more than 250,000 patients.

By gathering data on patients' pain levels and what's causing the pain — as well as adding in factors such as the type of surgery, patient demographics and previous medical problems — the research could help in prescribing more accurate dosages of pain medication, Rashidi says.

"Taking such factors into consideration moves pain from what has been considered a static classification to a dynamic one," she adds.

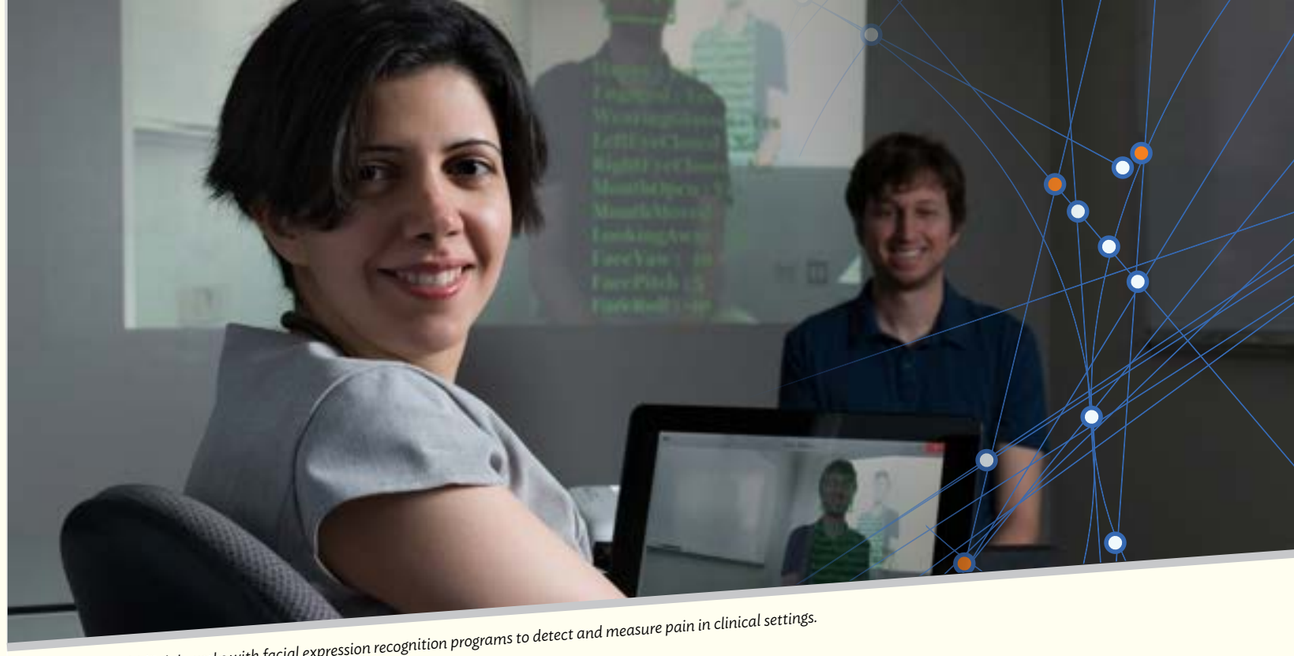
"The problem is nobody knows what the dosage is that should be prescribed," Rashidi says. "This would be more personalized medicine as opposed to blanket prescribing for the general population because what works for you might not work for me. And the whole goal is to make it more personalized."

Rashidi's first experience with biomedical informatics occurred during her time at Washington State. Smart-home-technology sensors were used to monitor the daily activities of dementia patients so their caregivers could see how they're performing and where they most need help.

Then Into Now

Some trace biomedical informatics back a half century or more, while others consider it relatively fresh.

The 2009 paper "What is biomedical informatics?" in the *Journal of Biomedical Informatics* says the discipline "has been an 'emerging field' for decades. Concern about medical information and the desire to computerize health care are hardly new."



Dr. Rashidi's lab works with facial expression recognition programs to detect and measure pain in clinical settings.

For Rashidi, the timeline comes down to title and technology — what you want to call the intersection of medical data and technology, and what inventions opened the floodgates.

"It has been around," she says, "but with very different names. It wasn't perfect. It was more like a toy compared to what we have these days."

Rashidi explains that today's version of biomedical informatics owes much to two primary developments: high-tech sensors and computers that can navigate mass quantities of data.

Like those found in smart phones, today's sensors are capable of tracking a great deal about people, such as their movements and their exposure to light.

The problem in the past, Rashidi says, was that data could be collected only for the few hours a participant was in a lab. But sensors can now stay with the participant around the clock, and computers are able to process everything the sensors detect, she adds.

Still, the technology has some room to expand. For instance, electroencephalography (EEG) machines, used to measure brain activity, are often bulky and unreliable, Rashidi says. "So not all the measures are there yet, but we've come a long way."

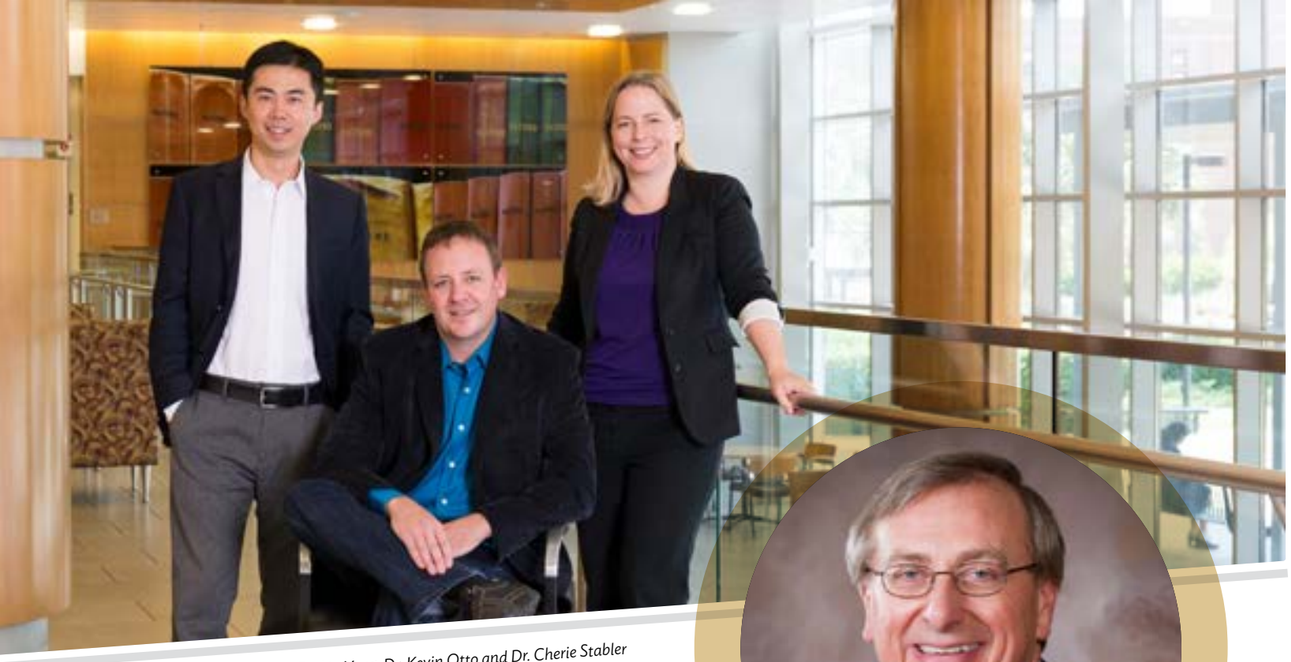
Another limitation: Much of the research has not yet translated into health care policies. "We have had research activities," Rashidi says, "but in terms of being actually implemented (in the health care system), I think it's going to take a while."

While many universities date the roots of their biomedical informatics departments back many decades, Rashidi says many of the programs have started in the past five years.

UF is set to launch its own graduate certificate this fall, and Dr. William Hogan, UF's director of biomedical informatics, says classes taught by Rashidi and Yang could count as electives for students in the certificate program.

With the already-made hires and others likely for his and other departments, Hogan's aim is to eventually turn the certificate into a full 30-credit master's program.

"Nationwide, there is a critical shortage of informatics-trained professionals. Florida is no exception," Hogan says. "The launch of the graduate certificate represents the first step in developing advanced degrees, including a master's degree, to address this shortage."



Above: UF BME's Preeminence hires, Dr. Lin Yang, Dr. Kevin Otto and Dr. Cherie Stabler
Inset: Dr. W. Kent Fuchs, UF President

UF Preeminence

INVESTING IN PEOPLE AND PROGRAMS THAT HELP US HELP THE WORLD

The University of Florida has an ambitious goal to become one of the world's best public research institutions. Already viewed as the state's premier public university, UF wants to accelerate the pace of research, teaching and service to become globally recognized as an educational leader.

Since receiving "preeminent" designation from the Florida Legislature in June 2013, UF has devised a plan for meeting this goal. The plan includes articulating more than two dozen interdisciplinary focus areas, spanning health, agriculture, computing and education that are shining a light on world challenges such as biodiversity, drug discovery and development, food security and the harnessing of "big data." Additionally, UF is well on its way to recruiting 120 nationally recognized faculty members who will join existing UF faculty in pursuing these focus areas.

As UF moves into the third year of this groundbreaking effort, it welcomes a new President, Dr. W. Kent Fuchs. Most recently the provost of Cornell University, Dr. Fuchs' experience combines academic leadership as a provost, dean and department chair; a distinguished career as an engineering professor; and graduate education in both engineering and divinity. Dr. Fuchs joined Cornell from Purdue University, where he headed the School of Electrical and Computer Engineering from 1996 to 2002. He was a professor in the Department of Electrical and Computer Engineering and the Coordinated Science Laboratory at the University of Illinois from 1985 to 1996.

He is a fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the Institute of Electrical and Electronics Engineers, and the Association for Computing Machinery, and has received numerous awards for teaching and research.

As a fellow engineer, President Fuchs continues to pursue the goal of elevating UF to one of the nation's best public universities and sees the BME department playing a large role in that success.

"UF's Department of Biomedical Engineering has the strategic advantage of being one of only a handful of biomedical engineering departments nationally that is located adjacent to a top-ranked academic health science center," Fuchs says. "The department continues to advance UF's preeminence goals while making scientific breakthroughs and shaping new technologies that improve the health of patients."

As part of the university's growth initiative, the J. Crayton Pruitt Family Department of Biomedical Engineering received five preeminent faculty positions and was fortunate to welcome three outstanding new faculty this past year.

Dr. Kevin Otto joined the department as an associate professor under the Neuroscience and the Brain initiative. His research is in the area of systems neural engineering. Specific laboratory research interests include neuroprostheses, brain-machine interfaces, neural applications of BioMEMS, and assessing and optimizing neural implant lifetime and biocompatibility. Dr. Otto received his Ph.D. in Bioengineering from Arizona State University, Tempe. He was a research assistant in the ASU Bioengineering Department, where his work was in the areas of neural engineering and sensory neuroprostheses. As a research fellow in the Department of Biomedical Engineering, University of Michigan, Ann Arbor, his work focused on brain-machine interface systems and implantable devices.

Dr. Otto was a post-doctoral fellow in the Central Systems Laboratory in the Kresge Hearing Research Institute in the Department of Otolaryngology at the University of Michigan, Ann Arbor, where his work focused on cochlear implants. Before joining UF he was associate professor in the Department of Biological Sciences and Biomedical Engineering at Purdue University.

Dr. Cherie Stabler joined the department as an associate professor under the Smart Polymer Nanomedicines initiative. Her research centers on the engineering of cell-based tissues for the treatment of Type 1 diabetes, specifically the development of novel biomaterials for cellular encapsulation, three-dimensional scaffolds, and in situ oxygen and drug release. Through the fabrication of novel biomaterials capable of actively interfacing with the host, she seeks to modulate the graft environment to favor survival and optimal function of the implanted cells. She has published her work in a broad range of journals, with recent publications in Advanced Healthcare Materials and Proceedings of the National Academy of Science. Prior to joining UF, she was an associate professor in Biomedical Engineering at the University of Miami. She also served as the Director of the Tissue Engineering Program at the Diabetes Research Institute at the UM College of Medicine. Dr. Stabler received her Ph.D. from the joint Georgia Institute of Technology/Emory University Biomedical Engineering Program. She receives funding support from a variety of sources, including the NIH and the Juvenile Diabetes Research Foundation. She was also awarded the 2008 NIH NIDDK Type 1 Diabetes Pathfinder DP2 Award.

Dr. Lin Yang joined the department as an associate professor under the Biomedical Informatics/Big Data initiative. His research is in the area of biomedical image analysis, imaging informatics, machine learning, and robust computer vision. He received his Ph.D. from the Department of Electrical and Computer Engineering from Rutgers University. He conducted part of his Ph.D. research at Siemens Corporate Research and IBM T. J. Watson Research Lab. Before joining UF, Dr. Yang was an assistant professor in the Department of Radiology at Rutgers University and an assistant professor in the Division of Biomedical Informatics, Department of Biostatistics and Department of Computer Science at the University of Kentucky. He has more than 15 years of research experience and has published more than 60 peer-reviewed journal and conference articles. Dr. Yang's biomedical image computing and imaging informatics lab (BICI2) is sponsored by multiple active extramural grants, including NIH R01.

UF Preeminence is an opportunity for Gators to come together to help UF focus on addressing the world's biggest challenges, including hunger, poverty and infectious disease. In the process, the university will expand in impact, influence and prestige. Such a leap will strengthen UF's role as an economic engine and trusted resource for people around the globe.

Having an Impact on Patient Care

Researchers in the UF College of Engineering's J. Crayton Pruitt Family Department of Biomedical Engineering are poised to forge new paths in the landscape of patient care, both on campus and off. Here are two department faculty members who are turning heads with their innovative work.

DEEP BRAIN STIMULATION, MODIFIED

For example, take Aysegul Gunduz, Ph.D., an assistant professor in the department. She runs UF's Brain Mapping Laboratory and has teamed up with UF neurologist Michael Okun, M.D., and UF neurosurgeon Kelly Foote, M.D., both professors and co-directors of the Center for Movement Disorders and Neurorestoration, in their groundbreaking work to help people with Tourette's syndrome, Parkinson's disease and other illnesses.

Together, Gunduz, Foote and Okun are taking the practice of deep brain stimulation to new levels. This treatment involves implanting special stimulators deep inside the brain, at carefully selected spots. The stimulators are wired to a battery-powered pulse generator implanted in the chest, which receives signals from a computer. The stimulators deliver a constant, mild electrical current to the brain, to help control disease symptoms.

Deep brain stimulation is FDA-approved for use in people suffering from Parkinson's disease and essential tremor, but Gunduz and her collaborators are exploring its potential for patients with Tourette's syndrome. One key difference is that people with Tourette's syndrome are wracked by their diseases at intervals, not continuously.

That's where Gunduz's background in electrical engineering comes in handy. Intermittent symptoms require stimulation signals that stop and start as needed.

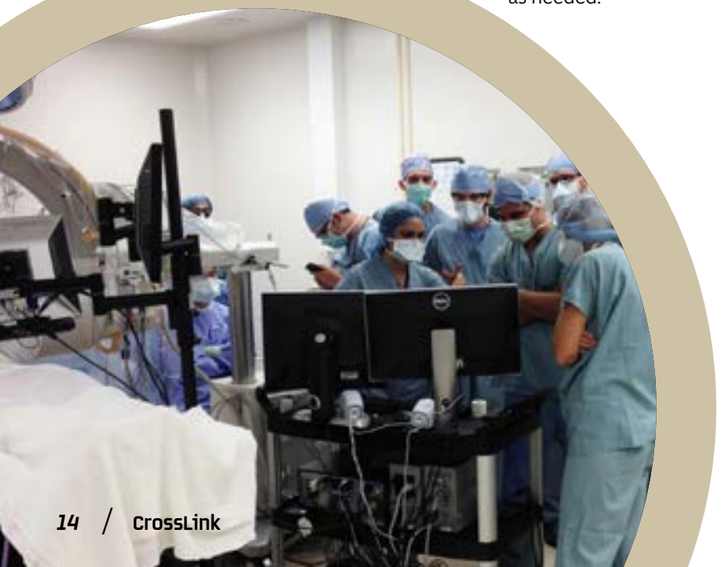
Gunduz uses an air conditioner as an example. "You know how the ACs are now, they're not blowing air continuously," she explains. "They are actually detecting the temperature of the room and if they say 'Oh, it's now hot, that's when the AC actually starts working. That saves us a lot of power.'"

Saving power is important when it comes to deep brain stimulators, as well. When the control pack's batteries run out, surgery is required to replace them.

To help solve this problem, Gunduz is using new devices from manufacturer Medtronic that can listen to and record signals in the brain to detect when stimulation is needed to stave off a tic in a Tourette's syndrome patient.

Less frequent stimulation also should reduce side effects in patients. Adaptive devices will allow clinicians to tweak stimulation signals for each individual patient as needed, Gunduz added.

"It's really, really exciting research," she says, "and having access to chronic devices that can record from the human brain whenever we want is just fascinating."



Left: Dr. Gunduz works with a team of neurologists and neurosurgeons to detect a patient's pathological brain signals.

A POTENTIAL GAME CHANGER FOR CANCER CARE

Like Gunduz's work with deep brain stimulation, ***the work of Huabei Jiang, Ph.D., J. Crayton Pruitt Family Professor,*** is directly targeting patient care and treatment with photoacoustic tomography.

Jiang has created detectors that allow for the development of a new type of optical imaging, called functional photoacoustic tomography (fPAT).

Jiang and the founders of Advanced fPAT Imaging Inc. see great promise in the method, although more testing is required. The company, which formed last year, has licensed fPAT technology from UF and developed designs for a breast imaging device utilizing Jiang's detectors and unique image reconstruction algorithms.

In March the UF Office of Technology Licensing recognized Jiang with an Innovator award for his development of the breast imaging technology, which was licensed in 2014.

Jiang and Michael Addley, a medical device executive and one of the company's founders, say fPAT provides resolution equal to or better than that provided by MRI, and can be used to evaluate water content, blood flow, oxygen saturation and overall health of tumors, without the use of radiation.

And it isn't just meant for breast disease. Jiang said the interface could be adapted for use with many types of cancer.

Such a tool could prove invaluable for oncologists and cancer patients. fPAT offers another advantage over mammography, in that its effectiveness is not compromised when scanning dense breast tissue.

Jiang has built a prototype fPAT device and tested it on about 10 patients in a small clinical trial. Now, he, Addley and the rest of the Advanced fPAT Imaging Inc. team are working to raise money to continue clinical trials.

Jiang and Addley see fPAT as an advance that could significantly change cancer care and may even be applied to screening, with additional clinical evaluation.

While the two men initially focused on breast cancer, Jiang sees fPAT's potential as even greater. "Basically, I would say there is no limitation [to the types of cancer for which this could be useful]," Jiang says.

BY LAURA MIZE

"The idea here is we wanted to use photoacoustic tomography as the tool to monitor tumor response to therapy, so that physicians can really make a timely decision [about] whether they need to change their treatment strategy," Jiang explains.

Above top: Hybrid fPAT/diffused optical tomography of breast cancer
Above bottom: Artist's rendering of fPAT breast imaging system

Above: SHMPS members at the 2015 Relay for Life event

Student Endeavors: Organizations & Outreach

SHMPS RAISES AWARENESS, HONORS STAFF MEMBER

Honoring the lives of loved ones, including a valued BME staff member, the Society of Health and Medical Physics Students (SHMPS) became the top fundraising team at April 17's Relay for Life, an annual event sponsored by the American Cancer Society to raise money and awareness of the fight against cancer.

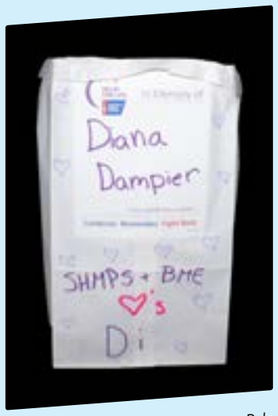
Consisting of an 18-hour walk around the track and a series of competitions, this year's event embraced an overall "storybook" theme. SHMPS, in another example of the involvement of BME students in community activities, chose the specific theme of "Relay in Wonderland."

Despite an attendance of more than 300 participants, SHMPS took the lead in raising funds, with three of the top 10 fundraisers coming from the SHMPS team.

In addition to this great achievement, SHMPS members recognized friends and family members who have or had cancer. With paper lanterns, purple ribbons, and T-shirts emblazoned with the names of these loved ones, the SHMPS team dedicated their walk to them and, most especially, BME colleague Diana "Di" Dampier, who passed away in February from lung cancer.

Di joined BME as office assistant in 2011, taking on myriad responsibilities throughout the department. She was well regarded for her commitment, passion, and humor (and her occasionally purple-colored hair!). A devoted and caring staff member, Di supported many SHMPS members throughout their undergraduate and graduate careers. She is greatly missed.

BME congratulates all of the members of SHMPS on their successful fundraising at the Relay for Life, and appreciates the team's recognition of Diana Dampier, beloved BME staff member and friend.



Above top: SHMPS table at the 2015 Relay for Life event
Above bottom: Paper lantern in honor of BME staff member, Diana "Di" Dampier (right)

Student Endeavors: UF Biodesign

BME SENIORS PARTNER WITH TAMPA BIOTECH COMPANY TO EVALUATE CANCER-CELL-SEPARATION TECHNOLOGY

Above: Cellparation team working in the lab on their prototype
Left: Julian Rey presenting at the IPPD's annual event

Julian Rey admits that he was a tad intimidated last fall when he started the College of Engineering's Integrated Product and Process Design (IPPD) program.

The J. Crayton Pruitt Family Department of Biomedical Engineering senior considers it the closest to a real-world scenario he's experienced in his undergraduate career. Classes are usually based on absorbing information for an eventual test, he says, but IPPD requires students to work with actual companies to develop applicable technologies.

Another "real-world" challenge: being on a team of six seniors from four different engineering departments at the University of Florida. Such an interdisciplinary effort was new after studying alongside just BME students, Rey says.

"What I learned most throughout the process was how to interact with my team to get the deliverables finished, how to communicate effectively with our sponsors so that we could really clarify what their needs were, what their expectations of us were," says Rey, the team's leader.

The six-student team — which included another BME senior, Sophia Bou-Ghannam — partnered with Tampa-based biotech firm Morphogenesis Inc. to further its Polymer Antibody Cell Separator technology.

The company uses polymer microspheres (basically tiny plastic beads) that have their surfaces molded so they attach to specific types of cells, such as circulating tumor cells that could spread cancer to other locations in the body. The cells can then be filtered from complex mixtures — bone marrow and blood, for example — containing a variety of cells.

The technology is meant for use in cancer diagnostics and therapy.

The specific goal for the team, called Cellparation, was to perform research on a device that filters out the beads and their attached undesirable cells.

The students' intention wasn't to fully develop the device themselves but rather help Morphogenesis researchers with the design and evaluating how well it separates the cells.

Cellparation was one of 25 teams in this year's IPPD program, a two-semester College of Engineering course that starts with defining a problem at the beginning of the fall semester and goes all the way to having a prototype built by the end of spring.

Headed by Dr. Keith Stanfill, IPPD celebrated its 20th anniversary this year. The program groups students into teams, each of which is mentored by a faculty member and is partnered with a private-sector company to develop technology.

Cellparation was mentored by Dr. Carlos Rinaldi, a joint professor in BME and chemical engineering.

"The IPPD program provides engineering students with an opportunity to participate in a project that has real, practical elements," Rinaldi says.

"In real life, as an engineer, you work in a diverse group, and you're suppose to learn to bring in your expertise and also listen to the expertise of others," he adds.

He describes how he pushed his team hard over the past two semesters.

"Did they meet all the objectives I set out? No," Rinaldi says. "But I set objectives that were harder than what was needed. They met everything that Morphogenesis was expecting and then some."

"This was the students coming up with the ideas because … I don't tell you a solution. You have to come up with it because when you're an engineer, you have to figure it out."

Cellparation's project received funding from the J. Crayton Pruitt Foundation Inc. in St. Petersburg, another namesake of BME's founder and his family.

"It's great to see after a lot of time making calculations and talking about what materials to purchase that, in the end, something does come together that you can show your sponsor company and your classmates," Rey says.

BY MICHAEL STONE

THE Molecular JIGSAW PUZZLE

BY REBECCA BURTON

Greg Hudalla, assistant professor in the J. Crayton Pruitt Family Department of Biomedical Engineering, always knew he wanted to make a positive impact on human health. Suffering damage to cartilage in his knee while playing soccer during his freshman year, and experiencing first-hand the potential of biomedical engineering technologies to improve quality of life, led him to where he is today.

"An initial surgery was performed to repair the cartilage, but that surgery didn't take. At that time, the only real clinical option was a total knee replacement, which was not ideal for a 19- to 20- year-old," Hudalla says.

Luckily for Hudalla, a new technology soon became available, which involved taking some of his cartilage, sending it to a lab to grow, and implanting it back into his knee.

"I was wholly unfamiliar with these sorts of efforts to improve medical interventions until my orthopedic surgeon suggested this new technology as a promising alternative to total knee replacement," Hudalla says. "It was at that moment that my eyes were opened to biomedical engineering."

Today, Hudalla's lab is focused on solving human health challenges by building new therapeutic and diagnostic biomaterials with a process called "self-assembly."

Hudalla explains that self-assembly is kind of like molecular Velcro. Different molecules can be designed to have complementarity, or a sense of attraction, that allows them to organize together in a precise way.

"We're interested in self-assembly because this is how functional materials are built in nature. The simplest cell is a number of different pieces that have self-assembled together, and in doing so can work together to enable the cell to perform complex functions, like moving or dividing," Hudalla says. "Although we haven't reached the complexity of a cell yet, we often look to nature to find examples of how to build new functional biomaterials."

Right now, his team is working to engineer common biological molecules – proteins, peptides, and carbohydrates – to self-assemble into functional biomaterials with easily interchangeable components.

Dr. Hudalla works with students to produce a new self-assembling peptide

"Self-assembly can allow you to take different components and bring them together in a precise way to perform a specific function," Hudalla says. "So let's say we build a therapeutic intended for the general population, but it doesn't work for a subset of patients. Instead of rebuilding the whole therapeutic, we can go back and precisely change one or more parts to improve its efficacy. Ideally, we can systematically interchange the different components to achieve optimal effectiveness throughout diverse patient populations."

In a 2014 publication in the journal *Nature Materials*, Hudalla and colleagues developed an approach to create multifunctional biomaterials by co-integrating different proteins into "self-assembled peptide nanofibers" - elongated assemblies having a diameter less than 100 nanometers. Self-assembly allowed the amount of each protein within the nanofibers to be precisely and independently varied. This provided unprecedented means to create biomaterials with tailored functional properties, including finely tuned fluorescent hues and optimized efficacy as multi-antigen vaccines.

Through a recent CAREER award from the National Science Foundation, Hudalla and his UF team are now investigating self-assembly as a means to construct materials that manipulate the activity of "galectins," a family of proteins that instruct cell behavior in various biological processes, including development, cancer and viral infection.

"Self-assembly allows us to precisely vary material formulations to find those that can modulate the activity of a particular galectin for a given application," Hudalla says. "For example, galectin-1 and galectin-3 have differing roles during immune responses and autoimmunity, and we're working to identify materials that can selectively inhibit galectin-1, or galectin-3, while having no effect on the other galectins. Viruses, such as HIV, show such galectin-binding specificity, and we try to use insights into these natural interactions to design galectin-binding biomaterials."

A team of graduate, undergraduate, and high school students in Hudalla's lab spend most of their time conducting experiments to piece together molecular puzzles.

One of those team members, Antonietta Restuccia, a second-year Ph.D. student, is learning what works and doesn't work when designing new

Antonietta Restuccia, Ph.D. student in Hudalla's lab

molecules. She considers the team problem solvers of the human body.

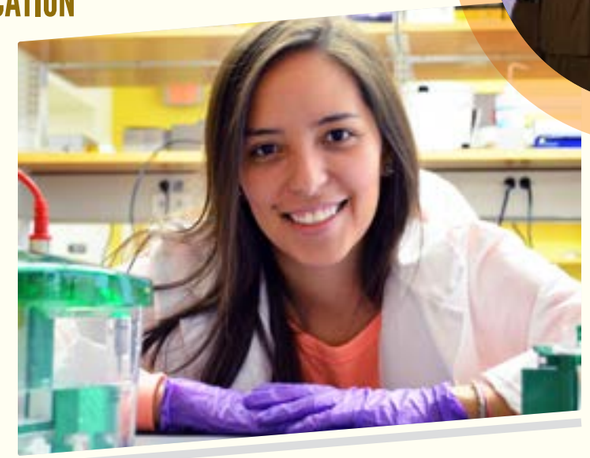
She hopes her contributions will lay the foundation for future students in the Hudalla lab.

"These materials can be applied as therapeutics and diagnostics for a wide range of human health concerns," she says. "The beauty of this research is that the future applications are limitless."

Graduate Student Feature

NEW SFB STUDENT PRESIDENT LOOKS TO FOSTER BIOMEDICAL COMMUNICATION

Above: Evelyn Bracho-Sanchez receiving the Thomas O. Hunter Leadership Scholarship



Evelyn Bracho-Sanchez, a Ph.D. candidate under the supervision of Dr. Benjamin Keselowsky, was recently elected President of the National Student Chapter of the Society for Biomaterials (SFB), helping to push the University of Florida's J. Crayton Pruitt Family Department of Biomedical Engineering to national recognition.

Bracho-Sanchez, who became interested in engineering when she was a senior in high school, began her journey with SFB as an undergraduate. Quickly she rose to the position of vice-president and, now, as president-elect, she has clear goals for the society, and for herself.

Chief among these, Bracho-Sanchez says, is an increase in communication among all of the student chapters. "We can learn a lot from each other's way of doing things," she says.

In addition, Bracho-Sanchez has an active role in the organization of UF Biomaterials Day, a symposium entirely organized by students, with the intention of fostering communication among members of the biomaterials field. Bracho-Sanchez and her team have secured funds for the event for the past four years, and have been able to bring to UF a distinguished list of speakers, including Dr. Cato Laurencin, a member of both the Institutes of Medicine and the National Academy of Engineering.

Bracho-Sanchez credits the students for these luminary visits. "Particularly within SFB there's a strong sense of commitment to be better, to push further and to reach out to the best," she says.

Over the years her leadership efforts have been recognized by many. Among the prizes she has received are "Best Professional Event," awarded by the UF Benton Engineering Council, and the "Thomas O. Hunter Leadership Scholarship," awarded by the College of Engineering.

Bracho-Sanchez's current research focuses on the development of drug delivery systems for therapeutic applications in autoimmune diseases mainly in the field of Type 1 Diabetes. She has shared her findings in presentations at numerous national conferences.

A key point of Bracho-Sanchez's message is that, when it comes to biomedical engineering, it is important to focus on the big picture.

> ***"We do a lot of experiments that don't work, but when you realize this could be the new Type 1 Diabetes treatment, you understand why it is important to fail. That's how we learn the most and the only way we're going to eventually find a solution."***

Bracho-Sanchez is passionate about the Biomedical and Biomaterials Engineering community. As the active vice president of the UF Biomedical Engineering Graduate Student Council, she has participated in every recruitment and orientation event, and has interacted with seminar speakers and External Advisory Board members. She recently was given the honor of delivering a speech on behalf of the student population during the annual Pruitt Research Day, and was nominated to the Student Leadership Advisory Board for the College of Engineering.

During the summer semesters, Bracho-Sanchez participates in the Board of Education Summer Fellowship program, serving as a peer mentor to new underrepresented minority graduate students.

"A lot of them come from historically black colleges and universities or smaller schools, and transitioning to something as big as UF can be difficult," she says. "I try to provide a place for them to feel welcomed. It can be hard to find someone like you in such a big school. This program allows all of us to shrink it a bit."

Bracho-Sanchez says that while the challenges of biomedical engineering are many, the potential benefits of scientific discovery are more than enough motivation.

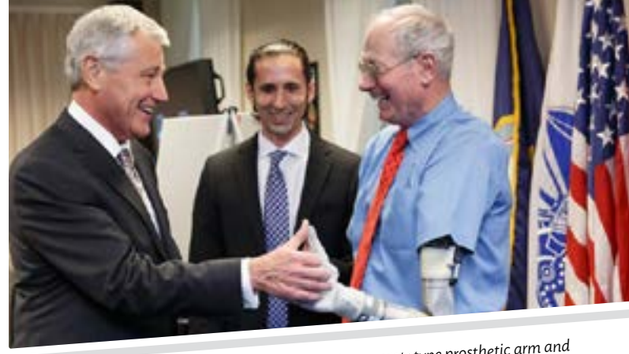
"Out-of-this-world ideas move the field forward," she says. "Finding the balance between ingenuity and applicability can be hard. There's yet so much we don't know about the human body. How will the immune system react to our new designs? How will we vascularize such designs to be integrated properly? There isn't a one-size-fits-all answer to these questions, and each experiment or idea has its own set of challenges."

Despite her many accomplishments as a student, representative and leader in the field of biomedical engineering, Bracho-Sanchez says she is no different than her peers.

"I come in to work, make a list of things to do for the day, fail often and celebrate the science victories."

Alumni Highlight

ALL IN YOUR HEAD: BME ALUM CARRIES BRAIN WORK TO PRESIDENTIAL LEVEL



Above: Defense Secretary Chuck Hagel, left, examines a prototype prosthetic arm and hand developed by DARPA, fitted to Fred Downs, right, and explained by Justin Sanchez, center, a program manager with DARPA

When Justin Sanchez completed his doctoral work in 2004 from the J. Crayton Pruitt Family Department of Biomedical Engineering, he was only the second Ph.D. student to graduate from the young department, formalized just two years before.

Carrying the Tampa native into the field were two goals he'd had since childhood: to work in science and technology, and to help people. These were perhaps lofty, cliché goals for a youngster, but Dr. Sanchez, now 37, has fulfilled them in many ways in his work in neuroprosthetics, the discipline that uses electronic machinery to help in functions that might have been lost from brain injury or illness.

In fact, he sees his present position in the Defense Advanced Research Projects Agency (DARPA) in Arlington, Virginia — part of the Department of Defense — as "a unique opportunity" that goes as far as to ask, "How do we change the world?"

"The best you can do right now is go talk to your therapist on the couch or take medications, and we want to do much better than that," he says of those with brain injuries, neuropsychiatric issues, and who have trouble with memories and moving.

"We want to develop technologies that are based on knowledge of how the brain functions and use that knowledge to deliver precise therapy back to the brain."

Sanchez was hired by DARPA in June 2013 following biomedical engineering professorships at the University of Florida and the University of Miami. Traditionally, DARPA's focus is developing technology for military use.

> ***Sanchez's work would help current and former soldiers who may have neuropsychiatric illnesses, such as depression, PTSD and anxiety. But it also stands to assist anyone with brain disorders by being tied to President Obama's BRAIN Initiative, launched in April 2013.***

The $300 million effort brings together DARPA, the National Institutes of Health, the National Science Foundation and other organizations to improve the understanding of how the brain works, the disorders that affect it, and technologies that can unlock mysteries within.

As a DARPA project manager, Sanchez is meant to find out what research aspects the U.S. needs to invest in to stay ahead of the rest of the world, or to at least not be bewildered when another country makes a discovery.

"We have this slogan here that says, 'DARPA: Create, or prevent technological surprise,'" Sanchez says.

This objective dates back to the founding of DARPA in 1958 as a response to Russia's launch of the first human-made satellite, Sputnik, the year before.

With his neuroprosthetic focus, Sanchez oversees multiple programs that have different aims but fall in line with the BRAIN Initiative's goals. The programs include Enabling Stress Resistance; Neuro Function, Activity, Structure, and Technology; Restoring Active Memory; and Revolutionizing Prosthetics.

Working on these projects are multidisciplinary teams of several hundred researchers with specialties in software, hardware, the brain and other related fields. The follow up, Sanchez says, could be going to a medical-device manufacturer in the private industry to bring any technologies developed to the commercial market.

Sanchez's curriculum vitae is an expansive one, going far beyond DARPA. Among his accolades: being credited to 75-plus academic papers, co-authoring the 2007 book *Brain-Machine Interface Engineering*, and holding seven patents in neuroprosthetic design.

His advice to current BME students: "Define your own future." When he started graduate courses related to biomedical engineering at UF, the department was not yet official, but he knew he wanted to work in neuroprosthetics. So he sought out faculty and mentorship that would further his goal.

One such mentor was Dr. Michael Okun, now interim chair of UF's Department of Neurology and co-director of the Center for Movement Disorders and Neurorestoration. Okun says that when he began working at UF in the early 2000s, Sanchez was one of his first students.

In the lab, they explored the physiology of human brain cells and how different regions of the brain talk with one another.

Okun says it's "very gratifying to see someone like that go all the way up to one of the top positions at DARPA."

"Justin was always a cut above," he adds. "He was running with the cream of the crop. He was thinking like a scientist, even as an undergraduate."

Continuing with his advice for future students, Sanchez says being a "go-getter kind of a student is the best thing you can do."

"I would always tell any person who is in the BME program that there are bound to be new fields in biomedical engineering that are going to be emerging, that are not well established," Sanchez says.

"I know a lot of students now look to the program to tell them what they should be doing. And I guess the message that I'm saying is the reverse of that: The students should have the desire to seek out new knowledge and new technologies."

BY MICHAEL STONE

Left: Jerry Chang, VP of Business Development; Tim Brahm, Founder and Chairman; and Russ Olsen, President and CEO

BME Gifts

LEADING BIOTECH FIRM INVESTS $1M INTO BME AT UF

The biotechnology company BioD has committed $1 million to the University of Florida J. Crayton Pruitt Family Department of Biomedical Engineering. The funding will be used to establish the Tim Brahm Endowed Term Professorship in Biomedical Engineering, and to bolster a collaborative research partnership between the university and the company. The professorship will be awarded to a faculty member who specializes in regenerative medicine, a revolutionary research area that involves engineering tissues and cells to establish and restore normal functioning. Regenerative medicine will be the central focus of this new research collaboration.

"Regenerative medicine is a key focus area for our department, and one that is tremendously important for advancing patient outcomes," says Christine Schmidt, Ph.D., professor and chair of the Biomedical Engineering department.

"We already collaborate with faculty across campus in our research efforts, but this new industry partnership will expedite our ability to create new products and technologies that will affect and save lives."

BioD is a leading regenerative medicine company engaged in the development and commercialization of novel biologic products derived from placental tissues. The endowed professorship is named in honor of BioD's founder, chairman of the board, and chief development officer, Tim Brahm, who has over 21 years of experience working in tissue banking.

"UF's state-of-the-art BME facilities, which are run and staffed by some of the top minds in human tissue engineering, have created a perfect storm to help BioD accomplish its goals in regenerative medicine," says Brahm. "I've had the great professional reward of working with Christine Schmidt and one of her lead scientists, Peter McFetridge. Their department's combined tissue engineering experience will help BioD to elevate its offerings."

BioD
Enhancing Life Through Birth®

The faculty resources, used in conjunction with the Institute for Cell Engineering and Regenerative Medicine (ICERM), will ensure that biomedical engineering researchers at UF have the cutting-edge instruments and technologies they need to facilitate significant advancement in biomaterials innovation.

"BioD is committed to advancing the frontiers of regenerative medicine, just as much as we are," says Cammy Abernathy, dean of the UF College of Engineering. "This partnership will help speed up our translational research, closing the gap from bench to bedside by stimulating our own campus-wide interdisciplinary collaborations with a proven vision for bringing solutions to a global market.

A reception celebrating the gift and research collaboration took place on Thursday, April 9, in the Biomedical Sciences Building atrium. The BME community enjoyed talks from senior leadership at BioD including Jerry Chang, VP of Business Development; Tim Brahm, Founder and Chairman; and Russ Olsen, President and CEO.