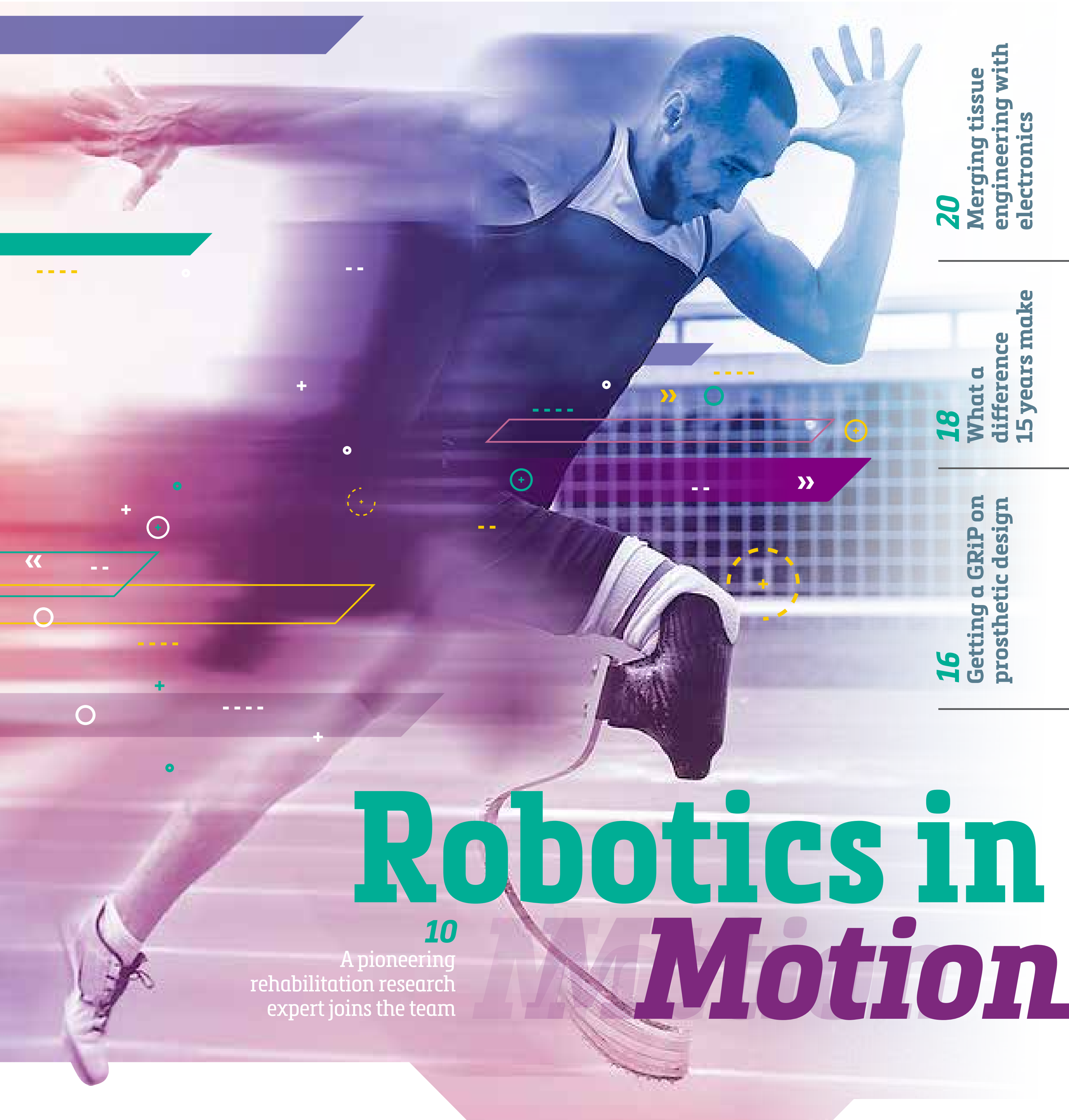
CrossLink

BIOMEDICAL ENGINEERING *at the* UNIVERSITY *of* FLORIDA // **FALL 2017** UF



Robotics in Motion

UF BME IS BUILDING TOMORROW'S LEADERS BY LEVERAGING ITS COMPREHENSIVE INNOVATION ECOSYSTEM

NEW INNOVATIVE COLLISION SPACE

Herbert Wertheim Laboratory for Engineering Excellence, Opening 2019

UF BME

SUCCESSFUL CLINICAL IMMERSION

Formal clinical immersion educational opportunities forge partnerships between students and clinicians

EXPERIENTIAL EDUCATION

Engineering Innovation and Leadership Institutes provide:

- Courses and certificates offered by leaders in industry and military
- Nationally acclaimed cross-disciplinary, industry-based senior design experience

STATEWIDE EXTENSION PROGRAMS

Innovation Stations provide workforce development, talent and tech pipelines, and K-12 initiatives.

NEW INNOVATIVE COLLISION SPACE

- Advanced bio-manufacturing & prototyping labs
- Freshman design labs and flipped classroom space
- Collision spaces to promote collaboration

UNIQUE CO-LOCALIZATION

Physical co-localization with top-ranked health sciences and hospitals

STRONG INDUSTRY PARTNERSHIPS

- Department-level formal industry engagement events
- Guest lectures by industry members
- Many local internship opportunities

ENTREPRENEURIAL COMMUNITY

Gainesville is a local hub of talent, innovation and opportunity. It is home to more tech incubators per capita than any other U.S. city.

UF | UNIVERSITY of FLORIDA

Dear UF BME Friends & Family,

Welcome to the 4th issue of ***CrossLink***, the annual magazine of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida.

I am honored to showcase the amazing accomplishments and talent of our department, college and university. This issue is particularly focused on innovation in research, education and our partnerships, including community engagement.

In this issue, we highlight novel research on neuromuscular control over prosthetic devices, ranging from exoskeletons and augmented control over walking from our new faculty member, Dr. Daniel Ferris, to an innovative merger of tissue engineering and electronics in DARPA-funded research to coax axon growth into electronic devices for improved upper limb prosthetic designs.

As we continue to strive for more experiential learning for our students, we are partnering more closely with the Herbert Wertheim College of Engineering's Leadership and Innovation Institutes. These institutes have continued to exponentially grow their unique interdisciplinary courses, modules and certificate offerings on topics such as project management, professionalism, entrepreneurship, persuasive communications, divergent thinking, innovation, leadership and risks in technology development. Our students are building a unique portfolio of skills that will enable them to be more effective leaders in their future careers. And, soon, these institutes will be housed in the new Herbert Wertheim Laboratory for Engineering Excellence – a state-of-the-art facility devoted to innovation by featuring creative collision spaces to promote collaboration, student maker/prototyping labs and a telepresence facility to build 21st century communication and networking skills.

Innovation goes beyond the walls of the university as our students and faculty continue to develop lasting partnerships with the community through outreach. Here, we highlight some amazing students who have given their time to create 3-D printed prosthetic and assistive devices for young children in need, as part of the BME-sponsored student organization, GRiP (Generational Relief in Prosthetics).

Please also read the stories about our current and former students - an alumnus who is changing patient outcomes with his work at the FDA and a student who is improving the therapeutic outcome of osteoarthritis drugs.

Thank you for being a supporter of UF BME! We hope you enjoy this issue of ***CrossLink***, and continue to keep us updated on your own endeavors. And, please stop by to visit when you are in Gainesville!

Sincerely,

CSchmidt

Christine E. Schmidt
Professor, J. Crayton Pruitt Family Endowed Chair and Department Chair

CrossLink

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

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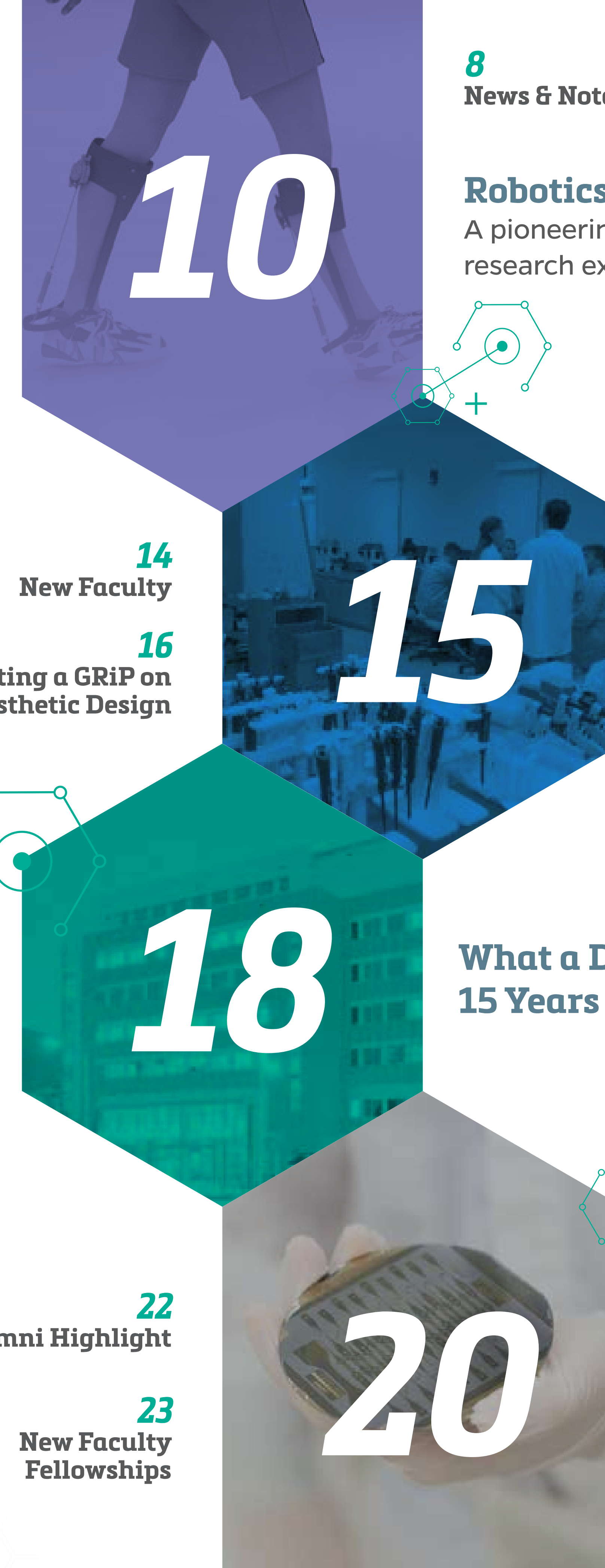


UF BME
Faculty Snapshot

ENGINEERS *for* LIFE.

Kyle D. Allen
Associate Professor, Associate Chair for Undergraduate Studies & J. Crayton Pruitt Family Term Fellow
Ph.D., Rice University
Novel strategies to diagnose and treat degenerative joint diseases

Stephen H. Arce
Lecturer
Ph.D., University of Florida
Bioinstrumentation, biodesign and BME senior design laboratories

Wesley E. Bolch
Professor
Ph.D., University of Florida
Dosimetry, computational medical physics and dose assessment

Mingzhou Ding
Distinguished Professor & J. Crayton Pruitt Family Professor
Ph.D., University of Maryland
Cognitive neuroscience, multivariate signal processing and multimodal neural imaging

Jon P. Dobson
Professor
Ph.D., Swiss Federal Institute of Technology, ETH-Zurich
Magnetic micro- and nanoparticle-based biomedical applications

Ruogu Fang
Assistant Professor
Ph.D., Cornell University
Big data analytics, brain informatics and medical image analysis

Daniel Ferris
Robert W. Adenbaum Professor & Senior Associate Chair
Ph.D., University of California, Berkeley
Biomechanics, neuromechanical control, locomotion and prosthetics

David R. Gilland
Associate Professor & Undergraduate Coordinator
Ph.D., University of North Carolina
Molecular imaging, instrumentation and algorithm development using PET and SPECT

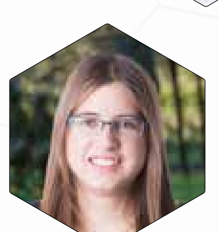
Aysegul Gunduz
Assistant Professor & J. Crayton Pruitt Family Term Fellow
Ph.D., University of Florida
Human neuroscience, neuromodulation, neuroprostheses and neurorehabilitation

Gregory Hudalla
Assistant Professor & J. Crayton Pruitt Family Term Fellow
Ph.D., University of Wisconsin
Nanomaterials engineered to direct immune responses for disease prophylaxis, implants and immunotherapies

Benjamin G. Keselowsky
Professor
Ph.D., Georgia Institute of Technology
Biomaterials and controlled release systems for vaccines, immunotherapies and implants

Peter McFetridge
Associate Professor & Tim Brahm Term Professor
Ph.D., University of Bath
Naturally inspired biomaterials for biologically functional implants and organ regeneration

Walter Lee Murfee
Associate Professor
Ph.D., University of Virginia
Cell dynamics, microcirculation, angiogenesis, lymphangiogenesis and neurogenesis



Jennifer A. Nichols
Assistant Professor (Jan. 2018)
Ph.D., Northwestern University
Biomechanics, musculoskeletal modeling, predictive simulation and medical imaging

Brandi K. Ormerod
Associate Professor & Director, BME Graduate Student Diversity and Professional Development
Ph.D., University of British Columbia
Engineered stem cell and immunomodulatory strategies for brain repair and aging studies

Kevin J. Otto
Associate Professor
Ph.D., Arizona State University
Neural engineering, device-tissue interfaces and neurostimulation

Edward Phelps
Assistant Professor
Ph.D., Georgia Institute of Technology
Cell and tissue regeneration, islet biology, diabetes and immunopathology

Parisa Rashidi
Assistant Professor
Ph.D., Washington State University
Biomedical data science, pervasive health and clinical informatics

Carlos Rinaldi
Charles A. Stokes Term Professor & Interim Chair, Department of Chemical Engineering
Ph.D., Massachusetts Institute of Technology
Nanomedicine, cancer nanotechnology, magnetic nanoparticles and transport phenomena

Sarah Rowlinson
Lecturer
Ph.D., Clemson University
Cell and tissue engineering, engineering education research and online engineering education

Christine E. Schmidt
Professor, J. Crayton Pruitt Family Endowed Chair & Department Chair
Ph.D., University of Illinois
Biomaterials for neural tissue regeneration and neural interfacing

Blanka Sharma
Assistant Professor
Ph.D., Johns Hopkins University
Nanomedicine, stem cells, biomaterials, tissue engineering and targeted drug/gene delivery

Cherie Stabler
Associate Professor & Associate Chair for Graduate Studies
Ph.D., Georgia Institute of Technology
Biomaterials, cell encapsulation, regenerative medicine, controlled release systems and diabetes

Hans van Oostrom
Associate Professor & Director, Institute for Excellence in Engineering Education
Ph.D., Eindhoven University of Technology
Human physiologic simulation to enhance noninvasive patient monitoring and education

Lin Yang
Associate Professor
Ph.D., Rutgers University
Imaging informatics, biomedical image analysis, machine learning, computer vision and computer-aided diagnosis

UF BME Collaborative Community

25 Core Faculty
40+ Affiliate Faculty
30+ Centers & Institutes
16 Colleges
5 Hospitals

News + Notables

LEADING IN THE PROFESSION

BMES Annual Meeting Co-Chair

Dr. Kevin J. Otto

UF BME Associate Professor

2017 BMES Annual Meeting

October 11-14, 2017

Phoenix, Arizona

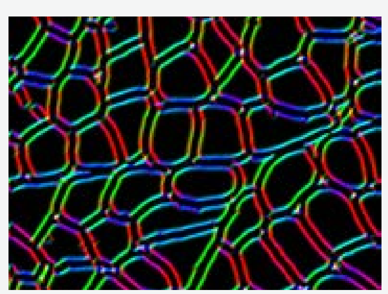
Art of Research

Science becomes art in the winning and notable photographs from the J. Crayton Pruitt Family Department of Biomedical Engineering 2016 Art of Research Photo Contest.

This annual event celebrates the art of research through the eyes of BME faculty, staff and students.

Judging was based on scientific significance, originality, and artistic and/or visual impact of the images. The winning photo, called "Nanoparticles in Synovial Fluid," by Shannon Brown, BME Ph.D. student, was chosen for its breathtaking composition and overall aesthetic quality.

1st
Nanoparticles in Synovial Fluid
by Shannon Brown, Ph.D. student, Sharma Lab



2nd
Neon Edges
by Mason McGough, Masters student, Yang Lab

3rd
Diabetes Love
by Nicholas Abuid, Ph.D. student and Kerim Gattasasfura, Research Scientist, Stabler Lab

Distinguished Leadership Seminar Series

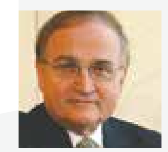
2016-2017 SPEAKERS

Dr. Rashid Bashir
Abel Bliss Professor of Engineering and Bioengineering Department Head
University of Illinois at Urbana-Champaign
Interfacing Engineering, Biology, and Medicine at the Micro and Nanoscale

Dr. Tejal Desai
Professor and Chair of Bioengineering and Therapeutic Sciences, Schools of Pharmacy and Medicine
University of California, San Francisco
Nanostructured Interfaces for Therapeutic Delivery

Dr. David Kaplan
Stern Family Professor of Engineering and Chair of Biomedical Engineering
Tufts University
Engineered Silk Proteins for Regenerative Medicine

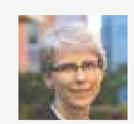
Dr. Robert F. Kirsch
Allen H. and Constance T. Ford Professor and Chair of Biomedical Engineering
Case Western Reserve University
Restoring Movement and Control of the Paralyzed Arm: BCI-commanded FES



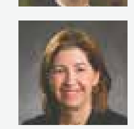
Dr. Nicholas A. Peppas
Cockrell Family Regents Chair in Engineering, Professor of McKetta Department of Chemical Engineering, Professor of Biomedical Engineering
University of Texas at Austin
Responsive and Intelligent Biopolymers for Recognitive Systems, Biosensing and Protein Delivery

Dr. Lori A. Setton
Lucy and Stanley Lopata Distinguished Professor of Biomedical Engineering, School of Engineering and Applied Science
Washington University in St. Louis
Stress Redefined–Mechanobiology and Survival of the Intervertebral Disc Cell

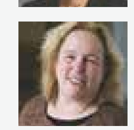
2017-2018 SPEAKERS



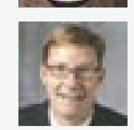
Dr. Nancy L. Allbritton
Kenan Distinguished Professor, Chair of UNC/NC State Joint Department of Biomedical Engineering, Jointly Appointed with School of Medicine and School of Pharmacy
University of North Carolina at Chapel Hill



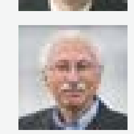
Dr. Rebecca M. Bergman
President
Gustavus Adolphus College



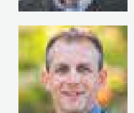
Dr. Martha L. Gray
J. W. Kieckhefer Professor of Health Sciences & Technology, Professor of Electrical Engineering and Computer Science
Massachusetts Institute of Technology



Dr. Warren M. Grill
Edmund T. Pratt, Jr. School Professor of Biomedical Engineering
Duke University



Dr. Buddy D. Ratner
Director, University of Washington Engineered Biomaterials (UWEB21), Michael L. and Myrna Darland Endowed Chair in Technology Commercialization, Professor of Bioengineering and Chemical Engineering
University of Washington



Dr. Lonnie Shea
Professor and William and Valerie Hall Chair, Department of Biomedical Engineering, Professor, Department of Chemical Engineering
University of Michigan

Major Faculty Awards + Recognitions

- Dr. Wesley Bolch named to Federal Advisory Committee for Radiopharmaceutical Regulatory Approval
- Dr. Jon Dobson honored with International Journal of Nanomedicine Distinguished Scientist Award
- Dr. Jon Dobson named UF Research Foundation Professor for 2017-2020
- Dr. Daniel Ferris elected as Fellow of AIMBE
- Dr. Aysegul Gunduz honored with UF Excellence Award for Assistant Professors
- Dr. Aysegul Gunduz honored with 2017 Denice Denton Emerging Leader Award
- Dr. Gregory Hudalla recognized as 2016 Young Innovator by Cellular and Molecular Bioengineering
- Dr. Carlos Rinaldi invited to present at the 2016 U.S. Kavli Frontiers of Science Symposium
- Dr. Christine Schmidt named president-elect of AIMBE
- Drs. Kyle Allen, Aysegul Gunduz and Gregory Hudalla honored with J. Crayton Pruitt Family Term Fellowships
- Drs. Kyle Allen, Jon Dobson, Mingzhou Ding, Aysegul Gunduz, Benjamin Keselowsky and Carlos Rinaldi honored with UF Term Professorships

Key Research Advances + Innovation

- Dr. Mingzhou Ding awarded $1.8M RO1 grant from NIH entitled "Emotional Engagement Driven by Complex Visual Stimuli: Neural Dynamics Revealed by Multimodal Imaging"
- Dr. Aysegul Gunduz and collaborators awarded $2M NIH BRAIN Initiative grant from the National Institute of Neurological Disorders and Stroke entitled "Closing the Loop on Tremor: A Responsive Deep Brain Stimulator for the Treatment of Essential Tremor"
- Dr. Benjamin Keselowsky and collaborator awarded $2.6M grant from the NIH entitled "Tolerogenic Dual Micoparticle System for Treatment of Multiple Sclerosis"
- Dr. Kevin J. Otto and collaborator awarded up to $4.2M grant from the Defense Advanced Research Projects Agency entitled "Cognitive Augmentation through Neuroplasticity (CAN)"
- Dr. Carlos Rinaldi and collaborators awarded $1.4M grant from the NSF entitled "SNM: Large-area Manufacturing of Integrated Devices with Nanocomposite Magnetic Cores"

Student Awards

- Ben Spearman (graduate) and Ella Hoogenboezem (undergraduate) awarded NSF Graduate Research Fellowships
- Adam Grippin awarded Circle of Hope Cancer Center Inc. grant
- Ella Hoogenboezem, Rafael Marin and Jake Pistiner selected for the 2017-2018 Attributes of a Gator Engineer Award
- Jackson Cagle named 2017 Outstanding Gator Engineer M.S. Scholar and awarded a NSF Young Professionals Award
- Laura Kanouse honored with UF High Honors Medallion
- Immanuel Babu Henry Samuel and Shruti Siva Kumar honored with UF Outstanding International Student Awards

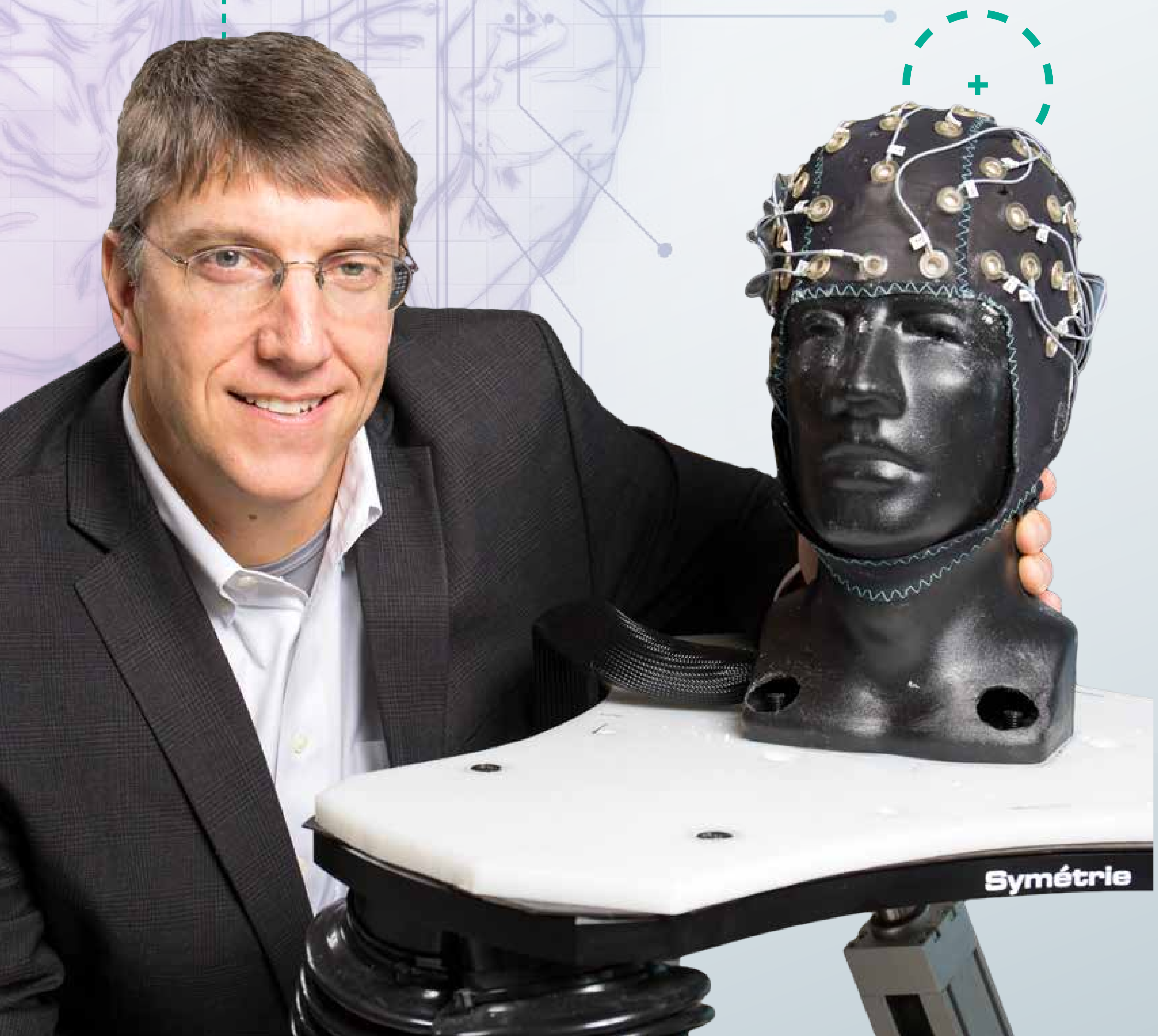
BEST GRAD SCHOOLS U.S.News & WORLD REPORT ENGINEERING 2018

UF BME Graduate Program ranked 17th among public universities by U.S. News & World Report, representing a 16 spot climb since 2013.

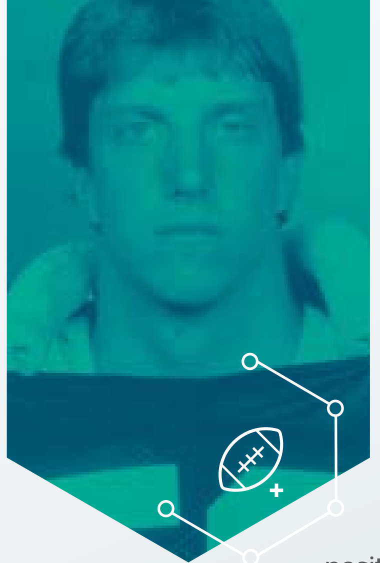
Robotics in Motion:

A pioneering rehabilitation research expert joins the team

By Laura Mize



His football talent didn't earn him a spot playing for the Gators as an undergrad. Instead, this Florida native sweated it out on the gridiron for the University of Central Florida.



"But, I'm finally getting recruited as an academic," Daniel Ferris, Ph.D., commented shortly before beginning his new role in the UF College of Engineering's J. Crayton Pruitt Family Department of Biomedical Engineering. "So, I guess it works out in the end."

These days, instead of touchdowns and tackles, Ferris is focused on work that ultimately will help others — people with motion disorders such as Parkinson's disease, or those who have suffered a stroke or traumatic injury — make some of the most important "moves" of their own lives.

After earning his bachelor's degree in mathematics education at UCF, Ferris went on to obtain a master's degree in exercise physiology at the University of Miami, followed by a doctorate in human biodynamics at the University of California, Berkeley.

He joins the Gator Nation after 16 years at the University of Michigan, where he established and ran the Human Neuromechanics Laboratory.

In June, Ferris brought the laboratory and four members of his research team to UF, where he is the first to hold the college of engineering's Robert W. Adenbaum Professorship in Engineering Innovation. The position was established with a generous $1 million gift from the Leo, Claire & Robert Adenbaum Foundation, presented in February 2015.

Ferris is a fellow of the American Institute for Medical and Biological Engineering. At the University of Michigan, he held several prominent positions, including rehabilitation robotics faculty group director, chair of the school of kinesiology's graduate program and associate dean for research in the school. In January 2018, he will become editor-in-chief of the prominent journal IEEE Transactions on Neural Systems and Rehabilitation Engineering.

UF's robust academic, research and patient care offerings, paired with the lure of living close to family again, called Ferris back to the Sunshine State. His wife, Rachael Seidler, Ph.D., has taken a position in the UF College of Health and Human Performance's Department of Applied Physiology and Kinesiology.

"The University of Florida is a fantastic school with a great college of engineering and a great medical school — a very comprehensive university that you don't find many places in the country," Ferris says. "The Biomedical Engineering Department at Florida is really rapidly increasing in quality and size."

One of Ferris' primary projects at UF might be a mobile brain imaging study conducted in conjunction with Michael Okun, M.D., a professor and chair of the UF College of Medicine's Department of Neurology, and national medical director of the Parkinson's Foundation. The two already have submitted an RO1 proposal to the National Institutes of Health.

The study would continue Ferris' previous work on the topic that is funded by the U.S. Army Research Laboratory. Ferris' funding comes as part of the ARL's Collaborative Technology Alliance for Cognition and Neuroergonomics, a consortium of academic research laboratories, industry partners and ARL scientists.

> *Mobile brain imaging involves "using electrodes on the head to do brain imaging while people are walking and running," Ferris explains. "Our lab is one of the world leaders in innovating this technology to come up with better electrode designs and signal processing methods that allow us to remove the motion artifact. We can figure out what's going on inside your head while you're moving around."*

Motion artifacts occur when the subject's movement distorts the results of the brain imaging session, producing a blurry picture instead of a crisp, clear one that accurately represents the brain activity that occurred.

How will such developments help patients?

Improving mobile brain imaging is "going to be a big boon for studying conditions like movement disorders," Ferris says, "when we know that there are individuals with Parkinson's disease or neurological injuries that have gait problems, can we actually look into the brain while they're trying to walk and figure out what's going on?"

In addition, studying what's happening inside the brain during motion may aid Ferris and others in bettering robotic exoskeletons and bionic prostheses. One current focus for improvement of such devices is to provide a smoother, less jerky walking experience.

"Being able to get as much freedom and fluidity in the motion of the exoskeleton so it moves along with the person is really important," Ferris says. "There's an increased awareness that the hardware design can get better, in terms of how they're moving smoothly and fluidly with the person. A lot of the adaptation can come from the physical device of the exoskeleton and how it interacts with and attaches to the human, being able to provide powered assistance without causing pain."

> *Progress in the function of such devices will not only benefit patients, but also moves the field of robotics closer to offering robotic exoskeletons and bionic prostheses to a wider audience.*

Currently, most exoskeletons are used in rehabilitation facilities. But the potential exists for daily use and direct-to-consumer sales.

In addition to devices meant to assist people working to overcome disease or injury, a variety of industries stand to gain from devices designed to aid generally healthy people engaged in physically demanding occupations.

"Imagine a firefighter's got a big oxygen canister and a hose that they have to climb up many, many stairs in a high-rise," Ferris says. "Can we build them an exoskeleton that lets them get up those stairs much more quickly and without being as tired, so that when they get upstairs, they can fight the fire better? Or imagine a ship builder who's working on building a new ship hull. They have to carry very heavy machinery around to work on the hull. Can we give them an exoskeleton that allows them to use less muscle activity so that they don't get as fatigued and they can continue their work?"

> Our lab is one of the world leaders in innovating this technology to come up with better electrode designs and signal processing methods that allow us to remove the motion artifact.
>
> We can figure out what's going on inside your head while you're moving around.

There are many other potential applications, including military uses and exoskeletons that help prevent falls in the elderly or that relieve impact on the tired knees of a seasoned runner.

The gait lab is situated in UF's Particle Engineering Research Center, just across from the New Engineering Building where Ferris' office and his data analysis laboratory are located.

In addition to working with Okun, Ferris anticipates collaborating with other UF researchers, including Chris Hass, Ph.D., and David Vaillancourt, Ph.D., both professors in the UF College of Health and Human Performance's Department of Applied Kinesiology and Physiology.

Hass, who has been a mentee of Ferris' for about 17 years, calls him an innovative thinker.

"He is really one of the early pioneers in the use of exoskeletons as not only an important mode of rehabilitative engineering, but also as a way to probe the neuromechanical control of walking," Hass says. "Our understanding of the way the brain controls walking is often impaired by technology limitations, but Dan and his colleagues have provided some of the first real time use of electroencephalography to provide evidence of how cortical structures regulate the walking pattern. These seminal papers have opened up a significant amount of new research and technology development in this area."

He adds that Ferris' presence will be integral in building a star-studded roster of other engineers in the field of rehabilitation robotics.

"Dan is an internationally recognized leader in the field of biomechanics, whom others in the field naturally flock to," Hass says. "His presence here at UF will help us in recruiting other preeminent scholars in the biomechanics community."

UF BME Welcomes New Faculty

Ruogu Fang, Ph.D.

Assistant Professor

Big Data and Brain Informatics

Dr. Fang's long-term goal is to develop innovative computational models to understand, diagnose and treat brain disorders. In particular, she leverages big biomedical data and brain dynamics for robust, safe and effective brain imaging and computer aided diagnosis of cerebrovascular disease, such as stroke. Fang received her Ph.D. in electrical and computer engineering from Cornell University. Before joining UF, Fang worked at Florida International University as an assistant professor in the School of Computing and Information Sciences. She was also an affiliate faculty in the Cognitive Neuroscience & Imaging Center at the School of Integrated Science and Humanity. Fang runs the Smart Medical Informatics Learning and Evaluation (SMILE) lab, which reflects her expectation for every member in the lab to smile while exploring the human brain with big data. Fang is the recipient of the Ralph E. Powe Junior Faculty Enhancement Award (2016), the Robin Sidhu Memorial Young Scientist Award, Society of Brain Mapping and Therapeutics (2016), the National Science Foundation CISE Research Initiation Initiative Award (2015), and the Best Paper Award at IEEE International Conference on Image Processing (2010), among others. She was selected as a member of the Association for Computing Machinery's inaugural Future Computing Academy.

Walter Lee Murfee, Ph.D.

Associate Professor

Microvascular Cell Dynamics

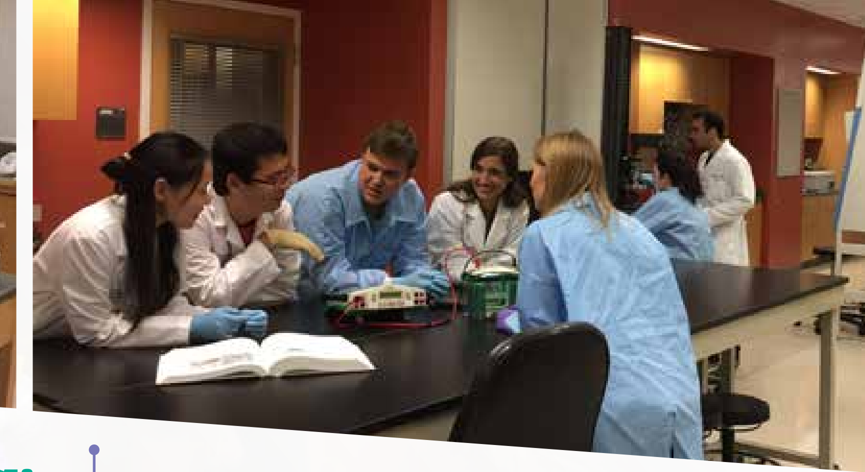
Dr. Murfee's research is focused on making scientific discoveries and developing new bioengineering approaches for connecting tissue level function to integrated cellular dynamics. Specifically, his laboratory applies in vivo, in vitro, and computational approaches to investigate the vascular patterning and the functional relationships between angiogenesis and other processes, such as lymphangiogenesis and neurogenesis. Murfee received his Ph.D. in biomedical engineering at the University of Virginia in the laboratory of Dr. Thomas Skalak. He was a postdoctoral fellow in the Microcirculatory Laboratory with Dr. Geert Schmid-Schönbein in the Department of Bioengineering at the University of California – San Diego. Before joining UF, he was an associate professor in the Department of Biomedical Engineering at Tulane University and a member of the Tulane Center for Aging, the Tulane Hypertension and Renal Center of Excellence and the Tulane Center for Stem Cell Research and Regenerative Medicine. Murfee was received an Outstanding Young Investigators Award from the Microcirculatory Society and numerous biomedical engineering awards from Tulane University.

Jennifer A. Nichols, Ph.D.

Assistant Professor (Jan. 2018)

Biomechanics & Musculoskeletal Modeling

Dr. Nichols' long-term goal is to create predictive, biomechanical simulations to improve the functional ability and quality of life for individuals suffering from musculoskeletal disorders (e.g., osteoarthritis, muscular dystrophy, fracture, joint pain). By predicting surgical outcomes or the effectiveness of physical therapy, predictive simulations will catalyze clinical advancements and inform modern, data-driven medicine. Nichols received her Ph.D. in biomedical engineering from Northwestern University in the Applied Research in Musculoskeletal Simulation (ARMS) Laboratory led by Dr. Wendy Murray. Her doctoral research elucidated how two common surgeries for wrist osteoarthritis alter wrist biomechanics, thereby leading to impairments in both wrist and hand function. Through biomechanical experiments, she identified key changes in carpal kinematics and muscle moment arms following surgery. She also developed a predictive simulation framework that provided novel insights into how the wrist influences thumb function. For her postdoctoral research, Nichols worked with Dr. Andrew E. Anderson in the Department of Orthopaedics at the University of Utah. Here, Nichols utilized dynamic medical imaging and patient-specific musculoskeletal models to study how surgeries for ankle osteoarthritis affect joint and muscle mechanics. At UF, Nichols will continue to integrate anatomical and in vivo experiments with computer simulations to examine musculoskeletal biomechanics.



Experiential Learning:

UF BME's Cell & Tissue Engineering Lab

One of the most exciting and rapidly growing areas in biomedical engineering is cell and tissue engineering, which offers vast potential for changing traditional approaches to clinical treatment. This area of research and development has the potential to revolutionize the treatment of a wide variety of disorders and injuries.

UF BME Cell and Tissue Engineering Laboratory's dedicated teaching facility offers an outstanding opportunity for undergraduate students to actively gain insight into BME regenerative medicine research and development. The lab engages students in fundamental studies and develops theoretical and analytical methods that will prepare them for exciting careers in biomedical engineering.

This fall, UF BME welcomes Dr. Sarah Rowlinson as a lecturer who will lead the Cell & Tissue Laboratory while focusing her expertise on cell and tissue engineering, engineering education research, entrepreneurship and online engineering education.

Before coming to UF, Rowlinson earned her B.S. in biomedical engineering from the University of Miami. She then completed her Ph.D. in bioengineering at Clemson University under the mentorship of the Hunter Endowed Chair and Professor Emerita in Bioengineering, Dr. Karen Burg. Rowlinson developed new cell culturing technologies for breast cancer research while concurrently conducting peer-reviewed research on engineering education and science policy. Rowlinson received the Outstanding Women Award from Clemson University (2016) and was an active member of the Clemson Bioengineering Society, having served multiple leadership positions including vice president, service chair and graduate student government representative. Rowlinson is an active participant in policy and advocacy groups in science and women's leadership.

While completing her graduate studies, Dr. Rowlinson was an instructor for Clemson University's General Engineering program. She was a lead instructor for two sections of Engineering Graphics and Machine Design, introducing students to the modeling software, SolidWorks. She delivered in-class demonstrations, assignments, and cooperative projects for the 112 students enrolled.

Rowlinson will bring her expertise to the department by expanding her engineering learning modules to undergraduate and graduate classes.

Foundational Training

Hands-on laboratory experience

First Half of Class

- Cell engineering topics: cell cycle/metabolism, adhesion, signal transduction and assessment.
- Tissue engineering topics: fabrication, biomaterials/scaffolds and cell integration, and functional assessment
- Core mammalian cell culture techniques
- Standard 2D culture techniques then move to engineering focused 3D systems
- Cell function and principles followed by hands-on cell freezing, thawing, culture, passage, microscopy and quantitative assessment measures
- The mechanics of tissue – how remodeling and wound healing alter tissues mechanical properties

Applied Projects

Design a series of experiments that modulate cell function in a meaningful way

Last Half of Class

- Cell engineering topics: cell cycle/metabolism, adhesion, proliferation and matrix deposition
- Fostering analytical and quantitative measurements to assess biological and engineering systems
- Assessment of different biomaterial properties to modulate cell function
- Comparative analysis between different biomaterials currently used in regenerative medicine

Getting a GRiP on Prosthetic Design:

How UF students are transforming lives with 3-D printing

Students at the University of Florida are following their passion for helping others by building inexpensive prosthetics for children.

Generational Relief in Prosthetics (GRiP) is a student organization that designs and and manufactures free 3-D printed assistive devices for children with upper limb differences. GRiP focuses on the empowerment of the recipients and STEM education in the community. Students come from every major, from engineering to medicine and to learn how to fabricate the prosthetics.

For Joshua Berko, UF BME senior, GRiP allows him to apply what he has learned in the classroom to a practical application that helps give back to the community in a way that no other organization can.

> *"GRiP is an enriching experience and most importantly a team effort," says Berko. "It's truly amazing to see all of the different prostheses we come up with and how they allow the children to do something that they wouldn't otherwise be able to. Nothing beats working with the children hands on. You really get a feel for what works for them and what doesn't and every child is unique."*

These devices aren't meant to replace prostheses developed in collaboration with a medical professional. They're designed to be affordable and accessible tools for children. The artificial hands are made out of plastic and don't use electrical sensors or robotics. Making them this way reduces the cost of supplying multiple prostheses when children grow out of them and can be easily replaced if they break.

Making a 3-D printed prosthetic is similar to making any other 3-D printed object. The area where the prosthetic will be worn is scanned and the measurements are saved in a computer. Solid plastic is fed in

from a reel, then melted and emitted out according to the computer's commands. The printer then prints one layer at a time, slowly building up a solid object.

In GRiP, the students are divided into teams working on specific devices personalized to the individual with an upper limb difference. They can personalize the device for both functionality, based on what type of residual limb they are designing for, as well as adding colors and themes. The students can additionally personalize devices for a more playful application such as a marshmallow shooter or a paddle holder for kayaking.

"Working with GRiP reminds me why I chose to pursue biomedical engineering and how many opportunities there are at UF to really make a difference," says Meggie Pires-Fernandes, UF BME senior. "One of the best parts of my junior year was seeing a young boy with a passion for music, who had learned to make the most of what he had by using GRiP-designed devices to make playing music easier," she says. "Seeing the excitement of a child being empowered to engage in activities that other children do, makes all the time and effort worth it."

To date, GRiP has gifted an estimated 30 devices around north central Florida. The power of innovation through collaboration and the overall impact on the children is evident by the smiles on the children's faces as they learn to use their prosthetics.

According to Berko, "To be able to provide such a functional tool for anyone with congenital hand or limb loss and to make a significant difference in their lives through engineering skills and education, is truly transformative."

What a Difference 15 Years Make

This year UF BME celebrates a history steeped in excellence, innovation and an endless pursuit of discovery.

Inspired by the possibilities offered by interdisciplinary health care research, the UF College of Engineering, which was recently named the Herbert Wertheim College of Engineering, established a graduate program in the emerging discipline of biomedical engineering in 1997 through a $1 million grant from the Whitaker Foundation. In 1997, a curriculum was produced and the first class of 13 graduate students enrolled that fall.

In 2002, UF BME became the 11th department within the college.

In 2006, the department received a donation totaling $10 million from J. Crayton Pruitt Sr. and his family foundation. As a result of the gift, University officials named the department in honor of the Pruitt family. The Pruitts' gift is among the largest cash gifts received by UF. The department had nine faculty members, dozens of researchers and more than 75 graduate students with research expenditures approaching $2 million.

Since its inception, we have grown to include 25 faculty members and have graduated more than 48 master of engineering graduates, 345 master of science graduates and mentored 159 doctoral degrees. Our newly created undergraduate program has over 106 alumni.

For over 15 years, UF BME has produced outstanding academics, industry leaders and research scientists. The department has undergone a rapid expansion over the last few years and plays a leading role in educating the biomedical engineering workforce of the future.

With more than ***$8.7 million*** in annual research expenditures, nearly ***155 patents***, and ***14 startups***, our faculty and students are at the forefront of scientific discovery and clinical translation.

As we continue on past this milestone, we look forward to the future: to the places and the possibilities our field will take us, as well as the contributions we hope to make both to the academic community and to the local and global communities we work with every day.

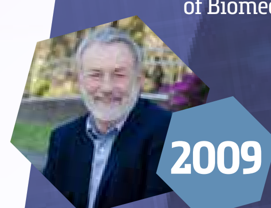
Please continue to engage with us as we look forward to the years ahead.

Key events in our history

2002 Dr. William Ditto is hired to serve as the founding chair of new biomedical engineering department

Becomes the 11th department established under the college

2006 Department receives a total of $10 million from J. Crayton Pruitt Sr. and his family foundation, and is named the J. Crayton Pruitt Family Department of Biomedical Engineering



2009 Dr. Bruce Wheeler becomes interim department chair

2010 Department is relocated to a new state-of-the-art building that is co-located with the medical school and steps from engineering. The $90.5 million, 163,000-square-foot building houses researchers from the College of Medicine, Engineering and Public Health and Health Professions

2012 Undergraduate curriculum and program is initiated

2013 Dr. Christine E. Schmidt is hired as department chair

2014 First undergraduate class graduates

2016 UF College of Engineering is named the Herbert Wertheim College of Engineering with a $50 million catalyst gift from Dr. Herbert & Nicole Wertheim

2017 Department has grown to include 25 faculty members, has graduated more than 106 undergraduates, 48 master of engineering graduates, 345 master of science graduates, and has mentored 159 doctoral degrees

Student Highlight

RUSH DELIVERY

Student Shannon Brown and the pursuit of a more efficient drug delivery system

As a young girl living in Honolulu, UF BME student Shannon Brown developed an early appreciation for life, and whatever form it may take. She spent many afternoons traveling by boats and rusty bicycles accompanying her father, a marine biologist, to the various laboratories where he worked.

> *"While my father conducted his research in Hawaii, I would hang out in the wading pools and see this spectacular life surrounding me," says Brown.*

These early experiences inspired her to complete a bachelor's of science degree in agricultural and biological engineering, and later a Ph.D. in biomedical engineering.

Today, under the supervision of Dr. Blanka Sharma, Brown's research focuses on improving the therapeutic outcome of osteoarthritis drugs through the development of advanced nanoscale delivery systems.

Osteoarthritis, a common and often devastating disease, can lead to debilitating pain and low quality of life for those suffering from it. Brown's research seeks a way to improve patients' osteoarthritis by providing a drug that can be specifically delivered at the right dose to the right place at the right time.

To do this, Brown's work investigates how the fundamental design of nanoscale vehicles impact where drugs go after injection to the joint, and how this localization changes with the severity of a disease.

For the tens of millions of Americans suffering from osteoarthritis, a more efficient drug delivery system would mean smaller doses and fewer injections. The drug's cost and its side effects would be reduced, along with risk of infection and clinical burden.

It may seem a lofty goal, but taking on challenges is an everyday thing with Brown. While research keeps her busy, she still finds time to chair the student-run UF BME Student Safety Council. Through her leadership, the SSC has successfully launched multiple programs since its induction in 2015, including safety newsletters and a new student orientation for BME safety. In addition, Brown serves as liaison between BME students and the college-level Environmental Health and Safety Committee, representing BME in meetings and directing questions and disseminating answers that researchers have regarding policies.

Brown's drive has been recognized by numerous organizations. In addition to receiving the NSF graduate fellowship, the Pittman fellowship from the Institute for Cell and Tissue Engineering and a UF graduate school fellowship, Brown has been awarded the Thomas O. Hunter Leadership Scholarship and the Linda Hudson Scholarship. Brown also is the recipient of the UF BME Graduate Student Award for Excellence and the Gator Engineering Outstanding Scholar Award.

Outside of her coursework, Brown regularly promotes STEM education. She is an active member in Tau Beta Pi, through which she teaches K-12 students what it means to be an engineer. She hopes to spark an interest in lifelong pursuits in STEM fields.

As for the future, Brown sees industry as the way for her to have the most immediate and direct impacts on patient care. "What motivates me is the idea of someone in their older age not being able to play with their grandchildren, or not being able to take a walk with their spouse," she says. "I want to make a difference in their lives."

Merging Tissue Engineering with Electronics

By April Frawley

He wiggles each finger, one by one. Despite the wires threaded under his skin, Luke Skywalker's hand looks the same as it always has, as if Darth Vader had not sliced it off moments earlier in the previous scene with a glowing red lightsaber. Luke looks on, almost unimpressed, as a robot zooms around him, using needlelike fingers to close the control panel on his good-as-new hand.

In a galaxy far, far away, technology like this exists – lifelike prosthetics that work as naturally and reliably as a person's real hand. But here on Earth, it's a concept researchers are still striving for: a smart prosthetic that not only moves and fits like a real one, but also feels like a real arm with the same type of natural, dexterous movement we typically take for granted. While smart, robotic prosthetic limbs already exist, many amputees missing upper limbs such as arms and hands often still opt for a hook. This is because even though the prosthetic limbs are advanced, there is currently no reliable way to control them.

With a $2.4 million grant from the Defense Advanced Research Projects Agency (DARPA), researchers from the UF Herbert Wertheim College of Engineering have been working for two years to develop a novel nerve interface to help solve this problem. The goal is to have the device work in a way that makes the user feel like it is part of his or her own body, says Kevin Otto, Ph.D., one of the lead researchers on the project with Christine Schmidt, Ph.D., and principal investigator Jack Judy, Ph.D.

> *"To get to that level, current technologies are not even close," says Otto, an associate professor of biomedical engineering. "We are working to improve the ability to communicate with a prosthetic orders of magnitude beyond what it is right now. It's a divergence from any existing technology."*

"The device is really meant to communicate bidirectionally with the nerve. We would like to have as specific communication as we can. We also want it to be reliable and stable for a long time."

Typically, a nerve interface — which helps connect the brain to a prosthetic limb — is inserted into a nerve at the place on the body where the limb is missing, says Schmidt, the Pruitt Family Professor and Department Chair of the J. Crayton Pruitt Department of Biomedical Engineering. This allows the body and the limb to communicate. However, it doesn't allow for a high level of precise, specific control.

Instead of inserting the interface into a nerve, the team has devised an interface that entices the nerve to regenerate into the electronics. The team is currently testing the device in animal models.

"Amputees say it is hard, they don't know how much force to use (with a prosthetic limb), and they miss the feeling of holding a hand," Schmidt says. "By doing this, hopefully we can create a more seamless connection that allows for finer control."

The project came together a few years ago after Judy, who holds the the Intel Nanotechnology Endowed chair and serves as director of the Nanoscience Institute for Medical and Engineering Technologies, joined UF. A former project manager at DARPA, Judy attended a conference shortly after he joined UF in 2013. There, he met with tissue engineers and wondered if there just might be a novel idea at the intersection of electrical engineering and tissue engineering. When he met Schmidt, a leading expert in tissue engineering and biomaterials, he approached her with the idea for the device. Judy asked Schmidt if she thought they could build a scaffold around the tiny electrodes of the interface that would lure nerve threads called axons into the device.

"Christine has done pioneering work to help people with nerve injuries," says Judy, also a professor in the UF Department of Electrical Engineering. "A scaffold of bioengineered material can be inserted into an injury to create a bridge for the nerve to grow through. Once this occurs, you start to regain function. The integration of microfabricated nerve interfaces into a scaffold allows us to make them out of highly compliant materials and designs that would be impossible to otherwise implant into nerves and could reduce adverse tissue response while increasing interface performance."

The team put together a proposal for DARPA. Judy's team would handle building the electrodes, so delicate and tiny they would be like handling slivers of plastic wrap. The electrodes could be arranged like a cloud to closely mimic how nerves really work, Judy says. Schmidt's team would build the scaffold that would surround the device like a sausage casing, with a protein hydrogel designed to lure the axons into the device. "It's like a sidewalk," she says. Otto was recruited to the project to bring it all together and lead the evaluation of the device.

"One thing that was unique about the TEENI project is that it combined two state-of-the-art technologies: the nerve guide technology from Dr. Schmidt's team, and the micro electrode array technology Dr. Judy has been developing," says Douglas Weber, Ph.D., a program manager at DARPA. "There is a unique ability to regenerate peripheral nerves. As the axons regrow they form this healthy connection with the electrode."

After receiving funding from DARPA in 2015, the team got to work. The device they built is just five millimeters long and 1 millimeter around. In addition to the tiny electrode threads embedded in the hydrogel, the device also contains another unique property: it is coated with a shark-skin like texture. Developed by Anthony Brennan, Ph.D., a professor in the Department of Materials Science and Engineering, the texture — called Sharklet — helps keep the body from rejecting the device.

"The results so far are very intriguing," Otto says. "We are currently seeing regeneration of the nerve. It is growing and interacting with our device. There are technical aspects we are working on to make it grow even closer, in a more harmonious way."

But encouraging a nerve to regenerate and implanting electronics inside the body are tricky, and the team has faced challenges along the way. "Sometimes we know what to do," Otto says. "Sometimes the basic science is not understood, and we have to work those issues out."

From left to right: Dr. Kevin Otto, Eric Atkinson (Ph.D. student) and Dr. James B. Graham

The researchers are also still trying to work out how to record the nerve's response inside the body, Judy says.

This is where the collaboration between the three scientists and their teams has proved to be most exciting, Schmidt says.

"This is cross-fertilization in so many ways," she says. "Our teams are all learning from each other."

"The results are early, but very exciting," Weber says. "The team has successfully built the device. They can implant into animals and track the growth of axons through the nerve guide. Also, Dr. Otto has developed really cool techniques for visualizing the regenerated nerve with electrodes in place. This is giving us the first-ever look at the full three dimensional structure of axons with everything intact. Normally, you have to dissect tissue so you only get a small picture."

> *The project has been a great one for UF because it has all the needed ingredients — the expertise of researchers, a strong tissue engineering lab, access to state-of-the-art technologies and hospitals situated right on campus.*

"I have always been intrigued by the interactions between disciplines. This [partnership between tissue engineering and electrical engineering] is an emerging area that is going to grow," Judy says. "This is one of the areas where UF excels."

Alumni Highlight

Driving Innovation:

How one alumnus is improving patient outcomes

Most people know about the Food and Drug Administration (FDA) in its capacity as a drug regulatory agency, but it also regulates medical devices.

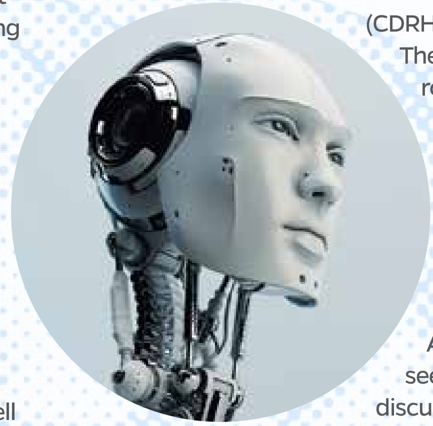
Medical devices are rapidly changing as new technologies make their way into the marketplace, but before they do, officials at the FDA must make sure these new technologies and therapies are safe and effective.

Eric Franca Ph.D., a Food and Drug Administration lead reviewer and UF BME alumnus, is one of the individuals tasked with that responsibility.

Franca is part of the FDA's Neurostimulation Devices Psychiatry Branch of the Division of Neurological and Physical Medicine Devices, in FDA's Center for Devices and Radiological Health (CDRH), which reviews medical technologies that interface with the nervous system.

At the FDA, Franca plays an integral role in a medical device's path to the US market: he helps evaluate medical devices (e.g., spinal cord stimulators, peripheral nerve stimulators, etc.) before they are distributed/marketed to patients, medical professionals and consumers in the US.

"What I enjoy most about my career at the FDA is it allows me to talk to both industry and FDA experts, engineers, scientists, and clinicians," Franca says. "I enjoy learning from and working with all of these people and building relationships so we can ultimately deliver safe and effective devices to patient populations in need."



His day-to-day responsibilities consist of reviewing medical device submissions (including clinical data, device specifications, test reports, etc.), participating in the development of international standards and FDA guidance documents, and consulting with leading experts (e.g., engineers, clinicians, etc.) within and outside of the agency. The medical device review process involves scientific reasoning as well as a regulatory understanding necessary to be able to come to a decision on the safety, effectiveness, and/or benefit of the medical device under review.

> *"Getting your message across accurately and concisely is paramount to progressing. Communication skills are vital, both oral and written. The ability to talk to people from different backgrounds and cultures not only to make yourself understood but to understand where they are coming from as well is a critical skill," he says.*

Franca received his B.S. in biomedical engineering from Tulane University in 2008 and completed his Ph.D. at the University of Florida in 2014. His research under UF BME emeritus professor Dr. Bruce Wheeler was focused on investigating neural adhesion, growth, and activity on carbon nanotubes and carbon nanofibers.

"Eric was a very strong researcher with exceptional interpersonal and organizational skills which are serving him well in his position with the FDA, where officials combine technical knowledge in a wide range of interactions aimed at bettering the nation's medical device environment. He is a true Gator biomedical engineer," says Wheeler.

Franca is co-chair for the FDA's Center for Devices and Radiological Health (CDRH) Robotics Task Group. The group discusses robotics standards that are currently being drafted and issues that may arise in the future specific to robotics and autonomous devices.

"What exactly is a robot? As strange as it might seem, after decades of discussion and debate, there isn't a consensus definition. From a regulatory perspective, the technologies of the future will likely incorporate more and more autonomous features into medical devices; this increased autonomy introduces a unique set of safety questions for each novel device. So there are many challenges in this field, even some as basic as 'Is this device a robot?'" he says.

He's also the primary liaison and U.S. expert for JWG 36 Medical Robotics for Rehabilitation. Franca and other international experts define requirements for the basic safety and performance of medical robots for rehabilitation, assessment, compensation or alleviation of disease, injury or disability (IEC/CD 80601-2-78). In working with these other experts, he is creating metrics and requirements that can inform the evaluation of device performance and to help standardize the safety of these devices.

"From my background as a biomedical engineer, the FDA seemed like an interesting way to bridge the gap between academic science to the application side of medical research and science. Many young researchers coming from academia do not understand how the FDA works, let alone how the medical device regulations work. The more you understand the FDA, the more you realize how important it is," Franca says.

New Pruitt Faculty Fellowships

The J. Crayton Pruitt Family Department of Biomedical Engineering is proud to announce the awardees of the J. Crayton Pruitt Family Endowed Faculty Fellowships which were established this year through an earlier gift from Dr. J. Crayton Pruitt Sr. and his family foundation.

Generous gifts like these are transforming our department and the college, supporting our faculty and students while accelerating and expanding our research capacities.

CONGRATULATIONS TO

Dr. Kyle D. Allen, Associate Professor and Associate Chair for Undergraduate Studies

Dr. Aysegul Gunduz, Assistant Professor

Dr. Gregory Hudalla, Assistant Professor

From left to right: Drs. Kyle D. Allen, Aysegul Gunduz and Gregory Hudalla

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Forbes, 2017

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Best School in the Country – Public or Private – at Helping Low-Income Students get a College Education
The New York Times, 2017

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State for Higher Education
U.S. News & World Report, 2017

#6
The 50 Best Public Colleges
Money, 2017

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#9
Top 10 Public Universities
U.S. News and World Report, 2018