



**Biomedical
Engineering**

FLORIDA INTERNATIONAL UNIVERSITY

Annual Report

July 2014-June 2015

Ranu Jung, PhD

Department Overview and Accolades

Sustained Excellence, Continue Growth and New Beginnings!—This is what defined 2014-2015 for the Department of Biomedical Engineering (BME). As the only department at a public minority and Hispanic serving institution in the United States that offers a full slate of programs in biomedical engineering (BS (accredited), MS, BS/MS and PhD), we continued to flourish over the year. True to its mission of merging engineering with science and medicine the department extended collaborations in education, research, and outreach in partnership with the colleges of Medicine, Nursing & Health Science, Arts & Sciences, Public Health, and Architecture. The department has risen to the challenge of developing a Worlds Ahead program of research and education.

A \$5M endowment from the Coulter Foundation matched by \$5M from the State of Florida helped launch the department in 2003. From its inception, the Biomedical Engineering program has continued to grow and improve each year. In spring 2012, the Department faculty and Chair, Ranu Jung, merged the vision she had laid out in her paper, “Rising to New Challenges”, with those laid out in the Strategic Plans of the University and College of Engineering and Computing to develop a five-year departmental strategic plan. The BME plan establishes Vision Goals to enhance research excellence and productivity, develop educational excellence, establish medical and industrial engagement and create a sustainable model of growth. 2014-2015 saw actions to address multiple strategic issues for fulfilling the Vision Goals and a banner year of faculty and student achievement. Faculty were awarded 6 patents, AIMBE Fellow, and the Faculty Award for Excellence in Research and Creative Activities. Student achievement was highlighted by BME Undergraduate, Elizabeth Gallardo being awarded the prestigious Goldwater Scholarship.

As the department propels itself into its second decade, it has become a major provider of a diverse engineering work force. As of the end of spring 2015, the department had over 531 alumni. The department once again had an increase in undergraduate enrollment to an all-time high with a fall enrollment of 501 undergraduate students. The department also awarded six doctoral degrees and five masters.

To achieve its research excellence vision, the department established three areas of excellence in research. Enhancement of research and discovery and growth of vibrant and sustainable areas of excellence require success in securing research awards and establishing national and international collaborations in this fast growing knowledge economy. The department continues to maintain an extensive grant portfolio and has steadily increased research expenditures.

Capacity building in the department increased with the recruitment of Dr. Jacob McPherson (Assistant Professor on tenure track). We are excited to have him join us. Dr. McPherson’s research focuses on revealing neuropathophysiological changes that contribute to motor and sensory impairments following injury to the central nervous system. His work integrates engineering approaches such as robotics, neural-computer interfaces and medical imaging with neuropharmacology, biophysics, and physical therapy. Dr. McPherson’s expertise strengthens the therapeutic and reparative neurotechnology research focus area of the department. At FIU, McPherson will explore the interrelationships between motor and sensory systems following brain and spinal cord injury, using a combination of animal models and human subjects with and without injury. The ultimate goal of his work is to design technology-driven interventions that improve quality of life by directly addressing the underlying mechanisms of impairment.

In fall 2014, the department introduced two new teaching labs, the Undergraduate Teaching Lab and the BME Creativity Lab for undergraduate students. The Undergraduate Teaching Lab features a state-of-the-art 3D display system, eight work stations equipped with essential devices to accommodate BME Labs I

and II, as well as an on-site conference area to facilitate group discussions and lab meetings. The BME Creativity Lab is primarily used by the Senior Design students during the process of completing their capstone projects. The lab features two 3D printers and one 3D scanner to address the needs of students in designing prototypes.

In terms of academic advising, the department revamped the faculty mentorship program. All students admitted into the BME program in fall 2013 or later are now required to meet with a Faculty Mentor at least once a year for two years (once a year for transfer students) with the purpose of additional academic and career guidance. On average each BME faculty member met with 15-20 undergraduate freshmen and transfer students. The long-term goal is to boost retention and graduation rates for our undergraduate students by helping them engage with a faculty member outside of their academic advisor.

Following on the heels of a self-study and Carnegie style review of our doctoral program, the department made major revisions to its graduate program that now offers students directed courses and greater opportunity for early engagement with research. A two-semester course sequence emphasizing physiology and associated engineering concepts was added. New elective courses were introduced for neural engineering. All of the new additions continued to thrive and well received during the 2014-2015 academic year. FIU BME continued to strengthen its educational links to the Herbert Wertheim College of Medicine. Graduate students are now taking courses from the Department of Physical Therapy as electives and a joint DPT/ BME Ph.D. degree is officially in the planning stage, with a hope to launch in fall 2016.

Twenty-eight lectures were presented over fall and spring by international and national experts, invited as part of the scientific WH Coulter Lecture Series, supported by the Coulter endowment to the department. The speakers were required to meet with BME graduate students during in a lunch meeting setting, giving the students an opportunity to directly interact with them. The lectures included those from Dr. Babak Kateb (Neuroscientist, Chairman of the Board of SBMT and President of Brain Mapping Foundation and one of the main architects of President Obama's BRAIN initiative), Dr. Joseph Pancrazio (BME Chair and Professor at George Mason University), Dr. Dieter Manstein (Massachusetts General Hospital, Associate Professor Department of Dermatology at Harvard), amongst others.

Engagement with the Community

To engage with national, local, and international constituencies, BME embarked on several outreach programs.

FIU BME co-sponsored the 7th Annual Nanoscience Technology Symposium: NanoFlorida. The symposium creates a forum for researchers in the State of Florida for scientific exchange and to help identify emerging challenges at the frontiers of nanoscience and technology. In addition to co-sponsoring the event, FIU BME's Dr. Chenzhong Li is an active member in the nanoscience community and serves on the advisory board. The department also served as one of the co-sponsors in the Urban Affairs Association 2015 Conference on Urban Health Issues. At the conference, the department displayed research work from various BME faculty laboratories.

FIU had one of the largest exhibits at eMerge Americas Techweek where the biophotonics group was one of the main attractions. eMerge Americas Techweek brought both industry and tech people together in South Florida to explore the possibilities of what most believe is the next developing tech community. Creating a lot of interest throughout the exhibit, FIU BME displayed the research of the six faculty

members involved in biophotonics research. The group was spearheaded by Associate Professor, Jessica Ramella. The exhibits were an excellent opportunity for FIU to showcase its amazing research projects.

Ranu Jung, Professor and Chair of the Biomedical Engineering Department, and the Adaptive Neural Systems Laboratory (ANS) were invited to travel with a contingent of other preeminent research groups at FIU to represent the university at the Annual Tallahassee FIU Day. The annual trip to the state capitol provides FIU the opportunity to showcase the university's world class research, and discuss with legislature's the key issues facing by the university.

As part of BME's recruitment and marketing effort, the department exhibited a booth at the annual Biomedical Engineering Society meeting in San Antonio, Texas. The conference also marked the first time that FIU BME hosted a University Reception at the BMES conferences. The reception provided the department the opportunity of meeting with prospective students and key figures in both industry and academia. The department will host the second University Reception at this year's conference in Tampa, FL.

In celebration of the International Year of Light, FIU hosted a mini symposium titled "Photonics in Healthcare." The symposium brought together researchers from multiple universities in discussions on the impact of biophotonics research in biomedicine. Spearheaded by Dr. Jessica Ramella-Roman, FIU BME has a cluster of six faculty that are actively conducting photonics related research. The event was highlighted by an expert panel discussion that included FIU's own Dr. Herbert Wertheim.

Multiple faculty hosted students from high school during the year for short visits as well as summer research internships. This summer, Dr. Anthony McGoron is hosting seven local high school students in his research lab. This year's group of interns is spending its time investigating biodegradable microspheres and microparticles. The microparticles are injected into a person's artery that leads directly to the tumor, thus treating the tumor from the inside. There are three different techniques for making these particles and researchers are identifying the optimal conditions for making the particles needed for this application.

Faculty Highlights

2014-2015 saw a new faculty appointment and professional and community recognitions of the faculty. The faculty was active in research and establishing new national and international collaborations. Completing a banner year for the department, five faculty members received six patents. A few key highlights of individual faculty are:

Dr. Jacob McPherson joined the faculty from Northwestern University. Dr. McPherson's research focuses on revealing neuropathophysiological changes that contribute to motor and sensory impairments following injury to the central nervous system. His work integrates engineering approaches such as robotics, neural-computer interfaces and medical imaging with neuropharmacology, biophysics, and physical therapy. At FIU, McPherson will explore the interrelationships between motor and sensory systems following brain and spinal cord injury, using a combination of animal models and individuals with and without injury. The ultimate goal of his work is to design technology-driven interventions that improve quality of life by directly addressing the underlying mechanisms of impairment.

Dr. Anthony McGoron was elected as a new fellow of the American Institute for Medical and Biological Engineering (AIMBE). McGoron joins BME Chair, Ranu Jung as the second AIMBE fellow in the department

of Biomedical Engineering. The fellows are elected after going through a rigorous process with extensive peer review, followed by a vote of current fellows.

Dr. Chenzhong Li was awarded the FIU Faculty Award for Excellence in Research and Creative Activities. This award recognizes excellence in scholarly achievement and research. This marks Chenzhong's second consecutive award winning year. As one of FIU's brightest researchers, Dr. Li has made a significant impact in the areas of clinical point-of-care diagnostics, biodefense and environmental related applications of biosensor technology, specifically, sensors incorporating whole cells and those used for disease-related biomarker analysis. His research employs the interfacing of bioengineering with cell electronics, bio-nano conjugations, functional nanomaterials, and device fabrication. Dr. Li's work has earned him significant grant support from the National Institute of Health (NIH), Department of Defense (DoD) and the National Science Foundation (NSF).

Highly recognized for his innovative technologies, Dr. Shuliang Jiao was awarded a US Patent for "Spectral Contrast for Glaucoma Imaging". Dr. Jiao developed a method for imaging the earliest signs of glaucoma by applying both visible and NIR light to a retina, where early detection may allow treatment to save vision. Shuliang Jiao's lab, the Ophthalmic Imaging Research Lab, is dedicated to the development of novel optical technologies for 3D high resolution imaging of the anatomy and functions of the eye in vivo.

Associate Professor Nikolaos Tsoukias received a US patent in the 2014-2015 academic year. Tsoukias' patent, organometallic fluorescent sensors for nitric oxide detection and imaging, was issued in December 2014. This patent has significant importance for human health as nitric oxide is recognized as a key signaling molecule in the cardiovascular system. Detecting the presence and/or the concentration of nitric oxide will aid in the development of therapeutic and diagnostic products to treat conditions such as hypertension, ischemic heart disease, and stroke.

Sharan Ramaswamy, Assistant Professor of Biomedical Engineering, and his co-inventor team received a US patent for their novel bioreactor for use in mechanobiological studies of engineered tissues. Ramaswamy's bioreactor is designed for dynamically culturing engineered tissues across physiologically-relevant scales of flow, cyclic stretch and cyclic flexure, or any combination of these states. The bioreactor can replicate mechanical stresses of flow alone, or coupled with flexure and/or stretch states, that cardiovascular tissues would experience in vivo under normal or diseased states. Ramaswamy also continues to actively serve as a peer reviewer for the American Heart Association's Bioengineering Peer Review panel and works as part of the Education and Cell & Tissue committees. He also worked closely with Miami-Dade public schools, particularly, MAST-Homestead and TERRA, through the ACCESS Leadership Group/Office of Engagement at FIU.

Dr. Ranu Jung, professor and chair of FIU's Department of Biomedical Engineering received a department high two patents in 2014-2015. Her first patent of the year was awarded for a portable system and device that can provide crutch-free walking to a person with an injured lower limb. The system automatically initiates, terminates, and adjusts based on a combination of the user's intent to walk and their walking speed. The patent was granted to Advensys LLC, a research and development company started by Jung and the work was supported by an Small Business Technology Transfer (STTR) grant to Advensys LLC from the U.S. Army. Dr. Jung's second patent was granted for the development of a communication interface system between sensors in a prosthetic arm or leg and a neural stimulator for restoring sensation to amputees. Unlike current systems, Dr. Jung's work facilitates the communicating of information from multiple hardware fabricated sensors and multiple modes of sensation. This invention was supported under a grant awarded by the National Institutes of Health (NIH).

Student Highlights

Enrollment in BME increased to an all-time high with 545 students. The student headcount has risen steadily and last year the department had another significant increase in BS enrollment from the previous record high. BME undergraduates and graduates had much to celebrate.

The Barry Goldwater Scholarship and Excellence in Education Foundation named FIU Biomedical Engineering major Elizabeth Gallardo a Goldwater Scholar for the 2015-2016 academic year. The scholarship program is designed to foster and encourage outstanding students to pursue careers in the fields of mathematics, the natural sciences and engineering; it is the premier undergraduate award of its type in these fields. Gallardo is the third FIU student to receive the scholarship, and the first since 2003.

Vinay Bhardwaj received the Young Scientist Award 2014 in Biomedical Engineering from the Photon Foundation in the global student competition for novel and original ideas, which has global significance. Vinay was also awarded the Outstanding Graduate Teaching Assistant and the Dissertation Year Fellowship. The Dissertation Year Fellowship is a prestigious scholarship award given to highly-qualified FIU doctoral students during the writing phase of their dissertation. Special consideration is given to students who are conducting outstanding research in their discipline and have established notable scholarly accomplishment during their doctoral studies.

FIU Biomedical Engineering Ph.D. student, Yinchun Song, was selected as one of the thirteen winners of the Young Investigator Awards (YIA) among nearly 200 participants in the BRAIN Grand Challenge Conference held in Washington, D.C.. This award was open to students, postdocs, assistant professors, or equivalent, and outstanding young investigators working on Brain Research through Advancing Innovative Neurotechnologies Initiative (BRAIN). YIA winners include students from Stanford, MIT, Georgia Tech, UCSF, UCLA, and Harvard Medical School. He also received the Trainee Abstract Travel Award for the 2014 Organization for Human Brain Mapping Annual Meeting in Hamburg, Germany.

For the second consecutive year, Glenda Castellanos was granted the LAC fellowship for excellence in research and academics. The LAC fellowship is a prestigious award designed to promote international education and research between FIU and the countries of Latin America and the Caribbean. Through the funding provided by the LAC fellowship, Castellanos is scheduled to fulfill one of her long time goals of obtaining a Master's degree in Biomedical Engineering in spring 2016.

Biomedical Engineering PhD student, Arash Dadkhah received the Biomedical Research Initiative (BRI) 2015 FIU Summer Research Award. The BRI award is designed to fund students in the biomedical sciences through a program development award from the National Institute of General Medical Sciences (MBRS RISE Program). Arash is currently working in the Optical Imaging Laboratory under the supervision of Dr. Godavarty.

Ph.D. student, Pratikkumar Shah won the Junior Research Investigator Award 2015 from the Society of Personalized Nano-Medicine (SPNM). The conference was held in Miami this past January and the competition was open to graduate students and postdocs working in the area of nanotechnology and its applications in personalized medicine. Nearly 30 participants from 7 different universities competed in the poster presentation event. Pratik's research is supervised by Professor Chenzhong Li.

Manuel Salinas '09, MS '11, PhD '14 BME alumnus, has joined a team of medical doctors at Harvard Medical School to study the effects of blood flow in the heart.

Student placement for higher education was excellent. Several undergraduate students got summer research internships and industry internships with rising biomedical companies such as Entopsis. Graduating undergraduates got admission into medical school, graduate schools or gained employment within the industry.