



FIU

FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university

Biomedical Engineering Department Annual Report July 2010-June 2011

1 Departmental Overview

The Biomedical Engineering (BME) Department is leading the State in biomedical engineering education. Of the eleven universities in the State University System (SUS) of Florida, FIU is the only university with the full slate of programs (BS (accredited), MS, BS/MS and PhD) in BME. It is also the only Biomedical Engineering department in the nation offering BS degrees at a public Minority Serving Institution. The department is endowed with \$11 million from the Wallace H. Coulter Foundation, the Ware Foundation and the State of Florida. One of the strengths of the growing BME department is its enhanced alignment with the Herbert Wertheim College of Medicine and the College of Nursing and Health Sciences. With the recruitment and appointment of a new Chair in January 2011 the department expects to begin a new phase of growth and development. Described below are highlights of the academic, research and service activities and accomplishment of the department for the 2010-2011 fiscal year.

2 BME Academic Programs

The BME Department continues to lead the State in biomedical engineering education. Of the eleven universities in the State University System (SUS) of Florida, FIU is the only university with the full slate (BS, MS, PhD) of programs in BME. The enrollment as of Fall 2011 was: BS – 314 (upper and lower division); MS – 18; PhD – 34. Based on the number of faculty contributing to the undergraduate program (7 FTE tenured/tenure track faculty plus 2 FTE instructors) the undergraduate Student/Faculty ratio was $314/9 = 34.9$. This number is considerably high. Based on the number of faculty contributing to the graduate program (7 FTE tenured/tenure track faculty), the graduate Student/Faculty ratio was $52/7=7.4$.

In 2010-2011, the department graduated the largest number of PhD and undergraduate students in any year. As of Spring 2011, there have been 181 graduates from the BS program, 100 graduates of the MS program and 11 from the PhD program. The student headcount and graduation rates in the BS program have risen steadily through 2008 (Tables 1 and 2). The program boasts an active student section of the Biomedical Engineering Society (BMES) and a newly established Alpha Eta Mu Beta (AEMB) Biomedical Engineering National Honor Society chapter. Both societies provide for enrichment of undergraduate and graduate students.

Eight PhD students were admitted into the PhD program in fall 2010 and spring 2011 with an average GRE score of 1245. As of the end of spring 11 there have been 11 PhD graduates, 7 male and 6 female. Of the total number of graduate students enrolled in the program to date approximately 34% have been female and 22% Hispanic. In 2010-11, there were 32.6% female and 13.5% Hispanic. These numbers make our BME program highly responsive to the need for preparing the STEM minority population for future leadership roles.

Table 1: BME B.S., M.S., and Ph.D. Headcount Enrollment*

	Fall 2003	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009	Fall 2010
B.S.	53	131	190	227	244	267	259	314
M.S.	30	42	36	38	36	23	20	18
Ph.D.	NA	8	14	19	26	30	33	34

* M.S. program started in 1999, B.S. program started in 2002, Ph.D. program started in 2004.

Table 2: BME B.S., M.S. and Ph.D. Degrees Awarded

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Total
B.S.	NA	0	8	11	25	32	29	37	39	181
M.S.	7	11	14	11	14	11	20	7	5	100
Ph.D.	NA	NA	NA	1	0	1	2	3	4	11

3 Curriculum Improvement

The BSBME has 2 required laboratory courses, BME 4050L and BME 4051L, and a laboratory component to EEE 4202C Medical Instrumentation Design. BME 4050L and BME 4051L are both held in EC 2355. This is a typical wet laboratory with space for at most 10 workstations. EC 2350 is used to house instrumentation supporting electronic circuit projects required by EEE 4202CL. In order to provide adequate and consistent training to students in lab science and team work, in 2009 the BME chair (McGoron) and the laboratory instructor started converting the courses to the accepted model in which small groups of students are doing the same exercise at the same time and in the same room. To achieve this laboratory equipment, software and maintenance support are being purchased in a phased manner using the Tech fee mechanism. In conjunction, new laboratory exercise curriculum is being developed.

In the 2010-2011 fiscal year a new Tech fee grant (#10-024- \$24,747) was used to add 500 licenses of Solid Works Premium and 45 seats of Labview available college wide.

Solid Works software is needed for training the students in design principles. It is used in BME 4090, BME 4908, BME 4100, BME 4211, and BME 4260. Since the software is available college wide, students in EML 3301L, EML 1533, EML 3036 can also benefit from it.

Labview is a graphical development environment that allows interface measurement and control hardware as well as data analysis. It is used in laboratories in academia and industry and is as an essential tool for our students.

Labview and Solid Works software and the previously existing strain gage sensors and data acquisition hardware were installed on two workstations to develop a laboratory protocol in BME 4050L for the study of bone mechanics. In future years as more funds become available, additional sensors and hardware will be purchased to implement the exercise on multiple workstations. The grant also provides software support for each of the next two fiscal years.

The laboratory component of EEE 4202CL was also improved. One additional electronics cabinet equipped with oscilloscope, function generator, power supply and DVM, a 2' x 5' workbench, two stools and one HP Compaq computer were purchased to setup one new Medical Instrumentation laboratory station, bringing the total available to six. Solid Works as well as the Agilent Electronic Workbench software were installed on the new workstation setup for use in Senior Design Projects as well as the lab courses.

In spring 2011 a UPB 6009 DAQ with associated cables was purchased so that a group of senior design students could develop a Labview based student project to permit later EEE 4202 students to build and operate a data logging ECG system. This protocol may be incorporated in the coursework by the instructor as early as this fall.

We received Tech Fee grant #10-025 (\$11859) that will permit students in BME classes to share a license in COMSOL multiphysics software with the Applied Research Center (ARC). Multiphysics Simulation permits modeling and visualization of simultaneously acting highly complex physical phenomena. Support including telephone help for users is included through FY12-13. Optimization of designs will become more cost effective as students can rapidly visualize effects of design changes. BME 4090, 4800, 2740, and 3032 with up to 280 undergraduate students and four instructors per year and up to 210 Graduate Students in BME 5036, 5316, 5340, 5560, 6037, 6265, 6266 and seven instructors per year will benefit from this new resource. In exchange for providing ARC the funds to purchase the materials library, optimization, AC/DC, MEMS and RF modules, BME will from now on have full access to all COMSOL modules.

Summary: Grants for software for FY 10-12 \$36,606

New Equipment and lab furniture purchased for the lab courses: \$11,145

4 Student Society Activities and Achievements

Student Society Activities

AEMB (Alpha Et Mu Beta) the National Biomedical Engineering Honor Society was recognized as the “Outstanding” national chapter. Graduate student Alicia was awarded the “Outstanding Officer” award. The chapter initiated an Industry lecture series (2 per semester), held a Journal club (2 per semester), a Pre-med workshop, a mathematica workshop, and a Brainbowl event. They continued their TERRA High School mentoring program. They were also very active in giving back to the community and participated in the Susan G. Komen walk and the Heart Walk. They volunteered at the “Feeding South Florida” program and the “Emmaus medical mission food drive” and they helped the department by volunteering at the Senior Design Engineering EXPO and at the National Biomedical Engineering Society Annual meeting FIU-BME booth. The BMES society established a new program called “Wellness Wednesdays” in which the FIU health department comes to the Engineering Center to give health education and free massages. BMES also held several professional seminars and students attended national conferences including ISET and the annual BMES conference.

Student Achievements

Ana Pineau, undergraduate student was selected as a “Worlds Ahead” undergraduate student at the Spring 2011 commencement. She was also chosen as the “Outstanding” undergraduate student at the College level. She and one other student were admitted to the medical school at FIU.

Sarah Erickson (PhD student) was named a “Worlds Ahead” graduating doctoral student at FIU at the Spring 2011 commencement. She was also named the “Outstanding PhD student” by the College of Engineering, the highest such accolade at the College level. Sarah was also recipient of the Session Best Paper Award at the 14th World Multi-Conference on Systems, Cybernetics and Informatics and received a Research Excellence travel Award for SPIE Photonics. Finally Sarah competed and received a Post-Doctoral Fellowship from the American Cancer Society (ACS) in collaboration with the Canary

Foundation (that supports early detection of cancer research). Her grant proposal received an “Outstanding” score, and is one of three funded proposals by the Canary Foundation and ACS.

Zenith Acosta, BME alumna was awarded the prestigious Whitaker Foundation International Fellows Scholarship.

Shrada Prabhulkar was offered a postdoctoral position at University of Miami.

5 New Infrastructure and Industrial Outreach

We purchased equipment for one additional electronic station (for a total of six) to support the EEE 4202C Medical Instrumentation Design laboratory course including a new lab bench and two stools and one HP Compaq workstation.

Dr Ramaswamy purchased a new cell storage Dewar to enhance his ability to conduct tissue engineering research. Dr McGoron purchased a new analytical balance to improve the precision available in producing nanospheres for targeted drug delivery. These additions to capital equipment totaled \$10,427.

In May of 2011, Dr Byrne attended the Medical Device Manufacturing conference in Orlando. He made contact with fifty seven companies engaged in different aspects of medical device manufacturing including USP and FDA certified contract manufacturing. These contacts resulted in site visits by representatives of four companies. Certification of one company, Contract Manufacturing Solutions Inc. (CMSI) as an FIU vendor is now in process. CMSI currently employs FIU graduates and has offered internships to others. They are now partnering with Dr. Jung in developing manufacturable components that meet specific ISAO and FDA standards for the neural prosthetic arm she is working on. They have also expressed interest in becoming partners with BME and contributing to our mission.

Dr. Jung was invited to present at the EDC BioTech11 Conference held at Florida Atlantic University. This gave her an opportunity to meet the President of FAU, VP for academic affairs for the new medical college and several industry participants. Consequently a few industries have inquired for graduating students as potential employees. BME will have the option to host EDC BioTech 2012.

6 Events

The Department held its first Undergraduate Research Expo and Competition. This event was combined with the Senior Design Expo and Competition to give a platform for the undergraduate students to present their year-long research. The Spring Senior Design Expo was attended by several industry members who also judged the event. A reception was held. From 2012, this joint Senior Design and Undergraduate Research Expo will become an annual event, give an opportunity for industry members to meet with graduating seniors at a reception and will also be the venue for announcing the summer FIU-BME Wallace H Coulter Undergraduate Excellence Scholarships.

The BME department also held two major outreach events, partially targeted for recruitment. For the first time a booth was organized at the national Biomedical Engineering Society meeting held October 6-9, 2010 in Austin, TX. We will be holding another booth this year with a more concerned effort on recruitment.

Another booth was presented at the Health Care Heroes Award event on May 12th, 2012. New brochures were developed for presentation at the booth, including video presentation and a microscope setup. Dr Byrne delivered a presentation on opportunities for science and engineering careers during Career Day, April 27, 2011, at Charles R Hadley Elementary School.

He also conducted a tour on Dec 8, 2010 of the Biomedical Engineering Research Laboratories and ARC for Christine Caley-Sanchez, Assistant Director of the European Union Center of Excellence, and her guests (see Table below)

	Last Name	First Name	Title	Embassy	Country
Ms.	Koch	Astrid-Christina	Science Counselor, Science, Technology and Education	Delegation of the European Union in Washington D.C.	
Mr.	Deelen	Bart Hildegarde	Business Development Manager Economic Section + Science and Technology Attache	Embassy of Belgium	Belgium
Mr.	Pizinger	Martin	Political Officer (Third Secretary) Head of the Political Section	Embassy of the Czech Republic	Czech Republic
Mr.	Lubi	Viljar	Counselor Economic Affairs and Sciences	Embassy of Estonia	Estonia
Ms.	Signorini	Jacqueline	Attaché for Scientific Cooperation and Higher Education	Consulate General of France in Atlanta	France

Lecture Series

The Department has been very pro-active in running a scientific WH Coulter Lecture Series supported by the Coulter endowment. 18 lectures were presented by international and national invited experts. Starting in 2011, the speakers were required to meet with all BME graduate students during a separate meeting, giving the students an opportunity to directly interact with them. One of the lectures, that by Dr. Arthur Caplan, was highlighted with a reception.

7 Research Programs

The Department has 8 faculty members, 3 at the rank of Assistant Professor, 4 Associate Professors and 1 Professor (joined spring 2011). The department has two full time Instructors, one serving as the Undergraduate Advisor. A summary of faculty research and scholarly production is given in Tables 3 and 4. After a retreat conducted in Spring 2011, the department has decided to cluster it's research into three areas:

- Basic Research in Engineered Tissue Model Systems
- Diagnostic Bioimaging and Sensor Systems
- Therapeutic and Reparative Neurotechnology

These three areas are served by technological advancements in:

- Bio-imaging, bio-signal processing and computational modeling
- Bio-instrumentation, devices and sensors
- Biomaterials and bio-nano technology
- Cellular and tissue engineering

2010-11 saw the highest numbers of faculty publications to date in peer-reviewed journals. Besides submitting individual grant proposals to federal agencies and foundations, faculty were able to setup funded collaborations with industry. Additionally, the faculty participated in multiple Center pre-proposals including two pre-proposals for the NSF STC program; one in partnership with University of Miami and another in partnership with University of Illinois Urbana-Champaign.

Faculty Honors and Research and Service Highlights

The Faculty have been very active in research and establishing new international and national collaborations. They have received national and University honors.

Dr. Anuradha Godavarty was for the second time one of three finalists for the Greater Miami Chamber of Commerce 2011 Health Care Heroes Awards. She was also sponsor of Sarah Erickson the “Outstanding” graduate student and Worlds Ahead student for Spring 2011. She is continuing her work on a novel hand-held portable device for breast cancer imaging, funded through an NIH R21. She has also initiated the use of this device for non-invasive brain imaging in children with autism and is now in discussion with industry for a licensing agreement.

Dr. Yen-Chih Huang received funding from OPKO, Inc for the “Development and Characterization of Self-Assembly Polymer vesicles for siRNA Delivery”. This work will allow novel approaches for drug delivery in a Phase III clinical trial, highlighting the importance of his work to translational research. He was also co-I on an R-21 grant with Dr. McGoron to the National Cancer Institute (see above). His work on biodegradable polymers was considered pivotal by the reviewers.

Dr. Ranu Jung joined the faculty in January 2011 as Chairman and Professor. She was also offered the Wallace H. Coulter Eminent Scholars Chair in Biomedical Engineering. Dr. Jung was awarded the “New Florida Boost Award” by the State of Florida. She is in the process of transferring her National Institutes of Health and National Science Foundation awards. Dr. Jung as invited by Springer to be Editor-in-chief of an ambitious online and print version of the first “Encyclopedia of Computational Neuroscience”. The encyclopedia to be developed over a two year time frame will be an international effort with over 150 contributions.

Dr. Sharan Ramaswamy joined the faculty as an assistant professor in spring 2010 following postdoctoral training at the NIH and Research Assistant Professor Position at the University of Pittsburgh McGowan Institute for Regenerative Medicine. He received his PhD in Biomedical Engineering from the U of Iowa. His research interests include heart valve tissue engineering, cartilage tissue engineering, MRI-based methods for monitoring tissue engineered constructs, computational predictive modeling in engineered tissue growth studies, bioreactor design/development and cardiovascular biomechanics. He is currently the PI on a 4-yr scientist

development grant from the American Heart Association. He has actively sought funding from federal agencies and non-profit associations. He filed patent for one of his technologies previously developed at University of Pittsburgh. Since arriving at FIU he has established new collaborations with industry (BOSE Corp.) and received departmental seed grant funding through the Coulter endowment and established a clinical partnership with Baptist hospital. He has also initiated new High School mentoring programs with TERRA High School and MAST. In 2010, he was selected as a RISE mentor for graduate students and as an ARCH mentor for undergraduate students by the Honors College.

Dr. Chenzhong Li was named Kauffman Professor of 2011 for his project on “Low Cost and Easy to Use Point of Care Testing Kit: Paper Based Strips for Whole Cell Bacteria Analysis.” He was appointed as the Associate Editor of the journal of Applied Biochemistry and Biotechnology (Springer) and the Associate Editor of the Biosensors Journal. He continues to serve on editorial boards of several journals including Nanomedicine, American Journal of Biomedical Science, Chemical Sensors, Journal of Nanoscience Letters, and International Journal of Nanomedicine.

Dr. Li published 13 peer-reviewed journal articles and also edited a special issue on biomedical engineering for the journal of American Biomedical Science. FIU filed a provisional patent for his work on “Electrochemical Micro-Immunosensor for Direct Detection of Amyloid Beta”. He was invited to give 28 lectures over the year of which 8 were Keynote lectures. His research work has very broad applications and hence his invitations included those from the European Materials Research Society, France and the National Dairy Research Institute in India. Other lectures were in China, Canada and USA.

Dr. Li was honored and awarded the International Resource Person Award from National Dairy Research Institute of India for his contributions to the “National Training on Nanotechnology Workshop”, which was sponsored by the World Bank and the Indian Government.

A “nanotoxicity assay” developed by Dr. Li’s lab was highlighted in the press by nanotechweb.org (<http://nanotechweb.org/cws/article/lab/43407>)

He also organized and chaired the symposium “Paper Based Point-of-care Analytical Kits” as an “Organized Contributed Symposium” for the 2011 Pittcon Conference (March, 2011, Atlanta).

He is also Co-Investigator with Principal Investigator Joe Leigh Simpson, M.D. from the College of Medicine on a \$1.4M grant awarded in July 2010 from the U.S. Army Research Institute of Environmental Medicine. His portion of the research (\$350K) is progressing well.

Dr. Wei-Chiang Lin renewed the Miami Children's Hospital Professorship in Neuro-Engineering. Dr. Lin made considerable effort to make links with universities in Taiwan. He was invited to present his research work and has established new international collaborations at the National Health Research Institute (Taiwan), China Medicine University, and Central Taiwan University of Science and Technology and Far Eastern Memorial Hospital (Taiwan). Locally he established a new collaboration with Dr. CY Huang in the Biomedical Engineering department at University of Miami to further develop biomedical optical technologies for tissue engineering.

Dr. Anthony McGoron was elected National President of the Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society and recognized nationally as the “Outstanding” advisor of an “Outstanding” student chapter. He was also recognized at FIU as a Top Scholar 2011.

Dr. McGoron was also recipient of an R-21 grant (\$340,000) from the National Institutes of Health, National Cancer Institute on “Imaging for Y-90 Microsphere SIRT”. Drs. Yen-Chih Huang and Romila Manchanda from BME and Seza Gulec from the College of Medicine are Co-Investigators. The study is to develop PET and SPECT imaging agents that more closely resemble microspheres used in Y-90 Selective Internal Radiation Therapy (SIRT). The agents are polymer microspheres with controlled biodegradation labeled with Ga-68 or Tc-99m. This work strengthens his on-going collaborations with the College of Medicine and further enhances the “Diagnostic Bio-Imaging and Sensor Systems” theme of the department,

He is Co-Investigator with Principal Investigator Joe Leigh Simpson, M.D. from the College of Medicine on a \$1.4M grant awarded in July 2010 from the U.S. Army Research Institute of Environmental Medicine. The research is progressing well.

Dr. Nikolas Tsoukakis was on sabbatical. He continues to work on his SCOR grant. During his sabbatical he has published 3 manuscripts and is wiring several. He has also made new collaborative partners in USA and Europe.

Dr. Michael Brown was promoted to Senior Instructor and his portfolio was considered ‘exemplary’. He was also appointed to the Medical College Admissions Committee by the College of Medicine. Dr. Brown mentors several undergraduate BME students, in particular those applying to the medical school. Of note are over 100 recommendation letters he wrote for the students this past year.

Dr. Michael Christie conducts both teaching and advising of BME undergraduates. There are three items of note regarding his active contribution to improve the undergraduate curriculum in BME. First, he redesigned the "Principles of Bioengineering" course to secure Global Learning certification, which was subsequently provided. The Course format was a pioneering effort in the college and has since been benchmarked by others in other Courses the college. Second, he formalized the undergraduate research experience through establishment of a structured credit-earning format and finally he developed a “How to Guide for Solid-Works” for the BME students.

Dr. James Byrne was awarded a Grant from the FIU Technology Fee mechanism in the amount of \$36,606 for 2010-2011. These grants provided 500 licenses for Solid Works and 45 seats of Labview college-wide, and to share a license of COMSOL Multiphysics Software between the BME Department and ARC.

Tables 3a and 3b below give a history of the Research awards and expenditures.

**Table 3a: Summary of BME Research Programs in the Last Seven Years
(Including funds from the Wallace H. Coulter Foundation)**

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Research Awards	\$969,236	\$1,151,036	\$2,158,350	\$2,353,409	\$1,803,738	\$1,570,751	\$2,811,528	xxx
Research Expenditures	\$860,000	\$826,959	\$740,511	\$1,493,877	\$1,290,000	\$1,343,538	\$1,704,879	xxx
RA (C&G Supported)	7	16	16	18	14	12	18	11
FTE Faculty*	8	9	9	10	10	9	11 [†]	8**

* Includes instructor positions where applicable

[†]. @2009-2010 data include Drs. Adjouadi and Barreto at 100% each, previously included at 50% each. Ramaswamy joined in spring 2010.

** Ranu Jung joined in January 2011. Dr. Adjouadi and Barreto moved to EE. Does not include instructors and lecturers.

**Table 3b: Summary of BME Research Programs in the Last Seven Years
(Not including funds from the Wallace H. Coulter Foundation)**

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Research Awards	\$750,320	\$872,025	\$1,706,891	\$1,816,340	\$1,333,619	\$1,078,252	\$2,227,964	\$2.2M
Research Expenditures	Not available	Not available	\$1,227,411	\$1,222,220	\$1,313,346	\$1,117,978	\$1,227,774	



