PITT | SWANSON ENGINEERING

BIOENGINEERING

MESSAGE FROM THE CHAIR | SANJEEV G. SHROFF, PHD

We are living in unprecedented times. With the evolving coronavirus pandemic, devastating natural disasters, and ever-present racial tensions, this year has been difficult for many. In this newsletter, we will highlight some of the ways our department has persevered, and made a positive impact on society, despite these challenges. I would like to acknowledge the new decade and reflect on some of our accomplishments, especially over the past ten years.

Pitt Bioengineering in the Beginning

The Department of Bioengineering was founded in 1998, with 38 undergraduate students (sophomore + junior), 41 graduate students (28 PhD, 13 MS), and four primary T/TS faculty members (Harvey Borovetz, Daniel Farkas, Mark Redfern, and Jerome Schultz). The significant number of graduate students was a result of interdisciplinary, degree-granting bioengineering graduate programs (MS and PhD) established around 1990 with active participation of the Schools of Health Sciences faculty – a partnership that has remained strong. Under the leadership of Dr. Jerome Schultz (founding Chair) and Dr. Harvey Borovetz (2002-2013) and with significant financial support from the Whitaker Foundation, the Department rapidly grew, reaching 153 undergraduate students (sophomore + junior + senior), 146 graduate students (131 PhD, 13 MS), and 20 T/TS and 5 NTS faculty by 2010. This growth has continued over the past decade, reaching 268 undergraduate students (sophomore + junior + senior), 179 graduate students (144 PhD, 35 MS), and 27 T/TS and 14 NTS faculty. Both the undergraduate and graduate programs have matured as well. To ensure both breadth and depth, the undergraduate program is currently organized in four tracks: Bioimaging and Signals; Biomechanics; Cellular Engineering; and Medical Product Engineering. Similarly, the graduate program is organized in six research focus areas: Bioimaging and Signals; Biomechanics; Medical Product Engineering; Molecular, Cellular, and Systems Engineering; Neural Engineering; and Tissue Engineering and Regenerative Medicine.

The Growth of Translational Research

As the department grew, so did our efforts in biomedical innovation and translational research. In 2012, the Center for Medical Innovation (CMI) awarded its first seed grants of $25K each to three teams. This past year, CMI awarded $60K to three collaborative translational research projects in its Round-1 2020 Early Stage Seed Grant. This brings the total to 73 early-stage projects having received seed funds for a total investment of $1.3MM, out of 309 proposals received since the program's inception. The CMI effort has resulted in six new start-up companies and two licenses as of FY20. The Coulter Translational Research Partners II Program selected four projects to receive a total of $340K in direct funding in 2012, the first year of the program. Over the course of eight funding cycles, Pitt's Coulter Program has attracted over 260 applications covering healthcare IT, medical devices, drug delivery systems, therapeutics, and diagnostics. In total, the program has funded 39 projects, at approximately $100K each in direct funding, and has also provided significant programmatic support. Fifteen of these projects have gone on to experience a commercialization event (9 licensed startups, 5 licenses to a company/accelerator, 1 option). Today, we have witnessed technologies, such as E3 Therapeutics, PneuScooter, PerioMag GBR (AmpliMag), Renerva, Skinject and SoliDrop, advance to commercialization.

Throughout the past decade, we have seen many other bioengineering projects progress from concept to clinical use. One of these is the Hemolung Respiratory Assist System, a device designed by Dr. William Federspiel that does the work of the lungs by removing carbon dioxide directly from the blood. In 2017, the FDA approved ALung's device for clinical trials. During the coronavirus pandemic, the device and its founders truly showcased how engineers can pivot at a moment's notice to improve the human condition. On April 24, 2020, the Hemolung RAS received Emergency Use Authorization from the FDA for the treatment of COVID-19. Pitt Bioengineering has further supported Dr. Federspiel's technology through the Coulter Program's funding of the second-generation device, ModELAS, which has been licensed in AY20 to ALung Technologies Inc.

The PediaFlow Ventricular Assist Device for infants and young children is another noteworthy effort. This project began in 2002 at Pitt and builds upon blood pump technology developed by several Swanson School and McGowan Institute faculty and students over the past decade. This year, the multi-institutional research team received a $4.7MM grant from the U.S. Department of Defense to complete preclinical development of their device. The PediaFlow VAD has the potential to save the lives of countless children with congenital and/or acquired heart disease. These are just a couple examples of the many impactful contributions our department has made over the past decade in the biomedical innovation and translation arena.

Developing a Vibrant Educational Environment

Our graduate program continues to thrive. In 2003, we received our first NIH training grant (Cellular Approached to Tissue Engineering and Regeneration, CATER) in collaboration with the McGowan Institute for Regenerative Medicine and the School of Medicine. We received two more training grants in 2005 (Cardiovascular Bioengineering Training Program, CBTP and Biomechanics in Regenerative Medicine, BiRM) and have continuously renewed funding for these three programs. In 2019, we added a fourth NIH training grant that enabled us to launch the Bioengineering in Psychiatry Program. This first-of-its-kind, multidisciplinary program is aimed at preparing students with a background in engineering and other quantitative sciences for careers in mental health research. These training grants not only serve as critical funding sources for our graduate students but also provide opportunities for professional development, networking, and shared learnings.

To complement our biomedical innovation and translation efforts, we established the department's first graduate-level professional educational program in 2012: Master of Science in Bioengineering – Medical Product Engineering (MS-MPE). This program has been highly successful in providing hands-on, practical experience in medical product design and development that prepares students for an industrial or academic career in this sector, which is projected to have a 23% growth over the next ten years according to the Bureau of Labor Statistics. Annual enrollment for the MS-MPE has grown from 3 (AY13) to 22 (AY21) with a total of 110 graduates so far.

Research in the neural engineering arena at the University of Pittsburgh has seen tremendous growth over the past decade. Research focus areas within this domain include systems and computational neuroscience, neurotechnologies and intelligent neuroprosthetics, neuroimaging, neurostimulation, and neural tissue engineering. In October 2016, the White House Frontiers Conference in Pittsburgh, co-hosted by President Barack Obama, showcased a robotic arm controlled by the brain of a paralyzed patient. This technology was developed at the University of Pittsburgh by Dr. Andrew Schwartz, Dr. Robert Gaunt, Dr. Jennifer Collinger, and colleagues. Given our strength and growth in translational neural engineering research, we have recently established a new graduate-level professional educational program: Master of Science in Bioengineering – Neural Engineering (MS-NE). The first cohort of students will join this program in January 2021.

It is exciting to note that our students are very engaged in their own learning, participating in a variety of student-led organizations and national conferences and competitions, and interacting with their peers from other universities and industry leaders. Several graduate and undergraduate student projects, such as Heart I/O, Posture Protect, and Blodot, have been showcased in local and national competitions; I am very impressed with the entrepreneurial spirit of our students. Our undergraduate BMES chapter received the organization's 2020 Outstanding Chapter Industry Program Award, which recognizes "chapters who demonstrate outstanding partnership with industries in their community." The undergraduate student participation in the Annual BMES Conference has steadily increased over the past decade, with a record number of 59 undergraduate students presenting their independent research work at the 2018 BMES Conference. Student participation in external fellowship competitions has also steadily grown over the past decade, with 30% of our PhD students having external pre-doctoral fellowships during AY20 (NSF-GRFP, NIH, AHA, NDSEG, etc.).

Creating Community and Staying Connected

Community engagement, especially in the context of STEM outreach, has been a priority for the department. Our CampBioE effort, initiated in 2007 under the direction of Dr. Steven Abramowitch, is a noteworthy example in this arena. The goal of this program is to engage young minds (middle and high school students) in the wonders of science and bioengineering and their potential to benefit the human condition, while also showing them that STEM can be a fun and exciting field of learning with promising career opportunities. More than 1,000 middle and high school students have participated in CampBioE to-date. CampBioE launched a diversity initiative in 2015 with the support of several local sponsors to increase the participation by students from underrepresented minority and/or underserved groups. This initiative continues today, and we have seen a significant increase in participants from these demographics. The participation rate for underrepresented/underserved students, which was 3%-5% percent prior to 2015, has now increased to 45% (average of last three years). I am very proud of what CampBioE has accomplished so far, and we look forward to seeing continued growth and success of this program in the future.

Alumni engagement has been and continues to be strong. For example, we have alumni serving as guest lectures in graduate courses, continuing their careers at Pitt, providing mentoring/career connections for our graduates, attending department/school events, and providing financial support. I'd like to recognize alumnae Stephanie Coquia (BS BioE, 2002) and Angela Fu (BS BioE, 2003) who recently established a scholarship for bioengineering students in need. Additionally, they have worked to create a crowdfunding campaign in honor of Dr. Harvey Borovetz, who served as the department chair during their tenure here at Pitt. This sort of alumni engagement is a testament to the bioengineering community we have created at Pitt.

In summary, I am proud of what this department has achieved in the past decade, and I look forward to its future. On behalf of the Department of Bioengineering, I thank you for your continued interest and support.

Sincerely,

Sanjeev G. Shroff, PhD
Distinguished Professor of and McGinnis Chair in Bioengineering