Volume 2, Issue 2 Summer 2014

Colorado State University
School of Biomedical Engineering

Special points of interest:

- BME Awards presented at annual CSU Engineering Days (E-Days)
- SBME focuses on underrepresented populations of students
- First SBME Scholarship awarded
- SBME debuts internship and employment data

Inside this issue:

Message from the Director

Dr. Stuart Tobet, director

Signs of summer are all around us on the Colorado State University campus. Just as summer gives birth to nature's wonders, so does the School of Biomedical Engineering as we continue to grow the number of staff, faculty, and students; partake in national conferences and share our research; utilize crowdfunding to engage a new community of donors; provide underrepresented populations of students with unique opportunities; and watch our students share their talent and enthusiasm through internships and employment.

As we enroll an increasing number of students for fall 2014, we brought on two new faculty members and a part-time staff member. We continue to grow our SBME Scholarship for Leadership and Innovation through crowdfunding efforts. Our goal is to endow this fund so that we may provide a $1,000 annual scholarship in perpetuity to students pursuing careers in biomedical engineering. Because we offer a five-year dual-degree program, it is especially important that we provide scholarships to help with the increasing costs of higher education.

As active supporters of the Alliance Partnership at CSU, the SBME forged new ground in providing underrepresented students an opportunity to mingle one-on-one with faculty at the inaugural SBME First Generation Dinner in February. First generation university students are the first in their family to obtain a bachelor's degree. Our faculty and staff are aware of the obstacles first generation students face and continue to look for new opportunities to support these pioneering scholars.

The SBME Advisory Board once again presented a number of senior engineering students with a cash award for their outstanding accomplishments in biomedical engineering-themed senior design projects at the annual Engineering Days (E-Days) in April. The Board applauded the strong technical competency and articulate presentations of four engineering teams. Next year, BME dual degree students will participate in E-Days for the first time.

Yes, it is a thrilling time for all of us as we continue to roll with positive momentum, remaining totally invested in our students. Please know that we continue to value your thoughts and ideas. Let us hear from you via email at Stuart.Tobet@colostate.edu or by phone at (970) 491-7157.

Crowdfunding Beta Test Update

The School of Biomedical Engineering engaged in a beta test on behalf of the University on September 30, 2013. During the 90-day test, we learned a great deal of information, including how best to present crowdfunding projects, what is needed to make crowdfunding projects successful, and challenges that need to be overcome to launch future projects. The good news is that our initial projects significantly increased traffic to our website. We had a 44 percent increase in new visitors during the three month test. Actual page views totaled 5,671. We are pleased with knowing that our projects were seen by a new audience.

Biomedical Engineering Awards Presented at E-Days

Engineering Days (E-Days) provides undergraduate engineering students an opportunity to showcase the completion of their senior design projects to faculty, family, industry representatives, and peers. Several SBME Advisory Board members spent the morning of April 25 judging twelve projects that had a biomedical engineering focus. Judging criteria included presentation, appearance, technical expertise, creativity, and overall impression.

The SBME Advisory Board provided four teams with cash awards for their outstanding achievements in biomedical engineering.

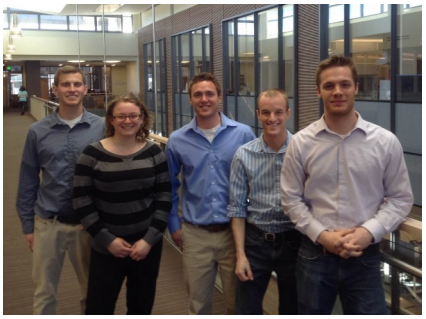
First place honors went to the chemical and biological engineering team of Andrew Baker, Kimberly Ballinger, Marlee Chase, and Taylor Keating (Ashok Prasad, faculty advisor) for their "CBE Heart Stent" which focused on optimizing the helical stent design to allow near physiologic conditions of blood flow through the stent, reducing the risk of further complications. Both computational and experimental fluid dynamic models were used and compared to determine an optimal stent design.

Chemical and biological engineering students were awarded the first place prize for the best BME project, "CBE Heart Stent." **From left**: Andrew Baker, Kim Ballinger, Taylor Keating, and Marlee Chase.

Mechanical engineering students tied for second place for their "Temporary Transcatheter Aortic Valve" project. **From left**: Zach Treadwell, Wade Schutte, Joslyne Lovelace, and Ashish Jha.

Two mechanical engineering teams tied for second place: "Aortic Valve Remover" with group members Zane Covey, Zach Dickerhoff, Alexa Garfinkel, James Tillotson, and Kevin Wilson (Lakshmi P. Dasi, faculty advisor); and "Temporary Transcatheter Aortic Valve" with group members Ashish Jha, Joslyne Lovelace, Wade Schutte, and Zach Treadwell (Lakshmi P. Dasi, faculty advisor).

Third place was awarded to the chemical and biological engineering team of Steven Floyd, Kendall Gurule, J.J. Moritz (ME Collaborator), Matt Swigart, and Luke Van (Chuck Henry, faculty advisory) for "ChemSense" which explored sensory substitution technology for people with hearing loss through stimulation of taste buds with small, localized concentrations of ions in an array. The goal of the project was to explore methods for creating such an array and analyze its resulting effectiveness.



Mechanical engineering students tied for second place for their "Aortic Valve Remover" project. **From left**: Kevin Wilson, Alexa Garfinkel, Zane Covey, James Tillotson, and Zach Dickerhoff.

The capstone senior design project teaches students how to succeed in a well-integrated, interdisciplinary engineering design environment. Students from all concentrations within the College of Engineering are challenged to think creatively and empowered to take responsibility for all phases of their projects which are publicly debuted at E-Days.

SBME Advisory Board members served as judges for awarding the best Biomedical Engineering Award. **From left:** Steve Simske, Clay Anselmo, Rick Jory, and Dennis Schlaht.

Chemical and biological engineering students were awarded the third place prize for their "ChemSense" project. **From left**: Luke Van, Matthew Swigart, Steven Floyd, and Kendall Gurule.

SBME Focuses on Underrepresented Populations of Students

In 2007, Colorado State University launched the Alliance High School Partnership to increase access for those who, due to economic or social conditions, had not previously been offered full participation in the academic enterprise.

As the first University in the country to create a "First Generation Award," Colorado State felt that the Alliance Partnership (http://accesscenter.colostate.edu/alliance-partnership) was the next step in its long history of serving underrepresented populations in gaining access to higher education.

As an active supporter of this initiative, the School of Biomedical Engineering visits a number of Colorado high schools each year, and in 2014, decided to further respond to the needs of first generation students by hosting a dinner bringing students together with faculty and staff. Here are the stories of our success in these two areas of outreach.

First Generation BME Dinner

In February, the SBME once again forged new ground with a dinner to honor, recognize, and connect first generation students with BME faculty and staff. CSU defines 'first generation' as students who are the first in their families to receive bachelor's degrees. As such, they may face additional challenges of navigating the university system, as there is not always someone at home they can ask, and there also can be additional familial challenges and stressors that come with being the first to venture into higher academic ground.

Krystal Tamayo meeting one-on-one with Professor Anura Jayasumana.

Stu Tobet, SBME director and a first generation student himself, describes the event's importance as "letting students know that they are not alone and that their success is valued by many people in many ways." Sixteen students, ten faculty and four staff members attended this inaugural event, co-sponsored by The Institute for Learning and Teaching (TILT) and Housing and Dining Services.

SBME Undergraduate Director Kevin Lear talking with BME students.

As a result of the evening, at least four students secured positions in prominent biomedical engineering laboratories across campus, and will conduct important biomedical engineering research in addition to strengthening their academic experience. Krystal Tamayo attended the event and shared that "It was at this dinner that I was fortunate enough to be offered a position for which I am so grateful. Because I was invited to the SBME First Generation Dinner, I can now say that I will be building my work experience as an engineer through the internship I have this summer. If it hadn't been for your invitation, this never would have happened."

High School Outreach

For the past few years, Kevin Lear, director of SBME undergraduate programs, and Brett Eppich Beal, student adviser, have conducted numerous high school outreach activities to raise awareness of the dual degree undergraduate program and encourage students to consider Colorado State University for their plans after high school. Targeting high ability and culturally diverse high schools in the Denver area, they have presented to students at East Denver, Denver School of Science and Technology, George Washington, Adams City and Prairie View High School.

Last year they were invited to give keynote hands-on presentations at the Institute of Science and Technology at Overland High School, and this year to counselors and teachers who are part of CSU's Alliance High School Diversity Initiative. The SBME has a strong commitment to serving historically underrepresented populations and "engaging students and teachers in hands-on activities like building a prosthetic foot or creating a snap-on circuit board allow participants to get a better feel of what it's like to be an engineer," explains Lear.

SBME has also presented to numerous K-12 groups on campus and invites high schools interested in finding out more information about the program to contact Brett Eppich Beal at Brett.Beal@colostate.edu or (970) 491-7077.

Prairie View High School students creating snap-on circuit boards.

Rizzotto Helps Build B2B Outreach for SBME Online Programs

Shantel Rizzotto, SBME's newest part-time staff member, comes to us from CSU OnlinePlus. Rizzotto is focusing her efforts on B2B outreach for the Master of Engineering Online, and the regulatory affairs certificate program. "It is an exciting time to be engaging with bioscience companies, learning about their professional development needs, and showcasing our curriculum. We look forward to offering tailored courses for individual corporate needs," Rizzotto says.

The Master of Engineering (M.E.) Online is uniquely positioned to offer educational strengths in engineering, sciences, and animal and human medicine. Some of the benefits of CSU's M.E. Online program include:

Accredited degree: Earn a highly-respected, regionally-accredited degree from a top tier university that consistently earns top rankings. The diploma and transcript are identical to those awarded to students on campus.

Cutting-edge technology: Students learn cutting-edge technology from faculty on the forefront of biomedical research.

Distinguished faculty: The courses are taught by the same faculty and cover the same content as the on-campus equivalent.

Financial assistance: Financial aid is available, and students pay the same affordable tuition regardless of where they live. Colorado State University is consistently ranked one of the top public universities in the United States in terms of affordability as well as its educational quality.

Flexibility and convenience: Students have the flexibility and convenience of taking courses at times and locations that fit their lives.

Professional development: Students can bolster their professional portfolio by taking individual classes for professional development purposes. If, in the future, the student decides to pursue a Master of Engineering degree at CSU, up to nine credits may count toward their degree-seeking credits.

If you would like more information about the online courses offered by the School of Biomedical Engineering, please contact Shantel Rizzotto at rizzotto@engr.colostate.edu.

Shantel Rizzotto

"It is an exciting time to be engaging with bioscience companies, learning about their professional development needs, and showcasing our curriculum."

First SBME Scholarship Awarded

Craig Ewell

Megan Rives

Many students put themselves through college. Many students are the first in their families to go to college. Many students are raised by a single parent. And many students have leadership roles on campus. Few students combine all these. Craig Ewell is one such student, and is one of the first recipients of the SBME Scholarship. Craig will be one of the first BME dual degree graduates to cross the stage in Spring 2015 and shares that "without generous scholarship assistance such as this, there is no way I would have been able to stay in school. Thank you to all who contributed."

Megan Rives is the other recipient of the award this year. A single mom, herself, Megan is also a first-generation college student, and is pursuing the dual degree in biomedical engineering and mechanical engineering in order to improve medical devices or health and body mechanics and to give her daughter a better life. Her strong academics, commitment to her professional field, and her ability to overcome life's obstacles demonstrate the spirit of the SBME Scholarship. "This scholarship will help me pay for classes, and have more financial flexibility to gain experience in a research lab or local company while I finish my degrees. Thank you so very much for this honor."

To make a difference in the lives of other students and contribute to the School of Biomedical Engineering Scholarship fund, please go to https://advancing.colostate.edu/SBME.

SBME Faculty and Student Updates

FIRST PLACE POSTER WINNERS AT CSU VENTURES INNOVATION SYMPOSIUM

On April 25, forty teams of Colorado State students and faculty had an opportunity to spotlight their research during the 2014 CSU Ventures Innovation Symposium which took place in the Scott Bioengineering Building. This annual event provides an opportunity for industry and the public to see the state-of-the-art research taking place in labs across the CSU campus.

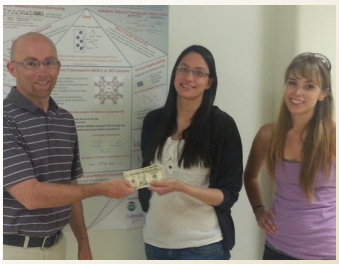


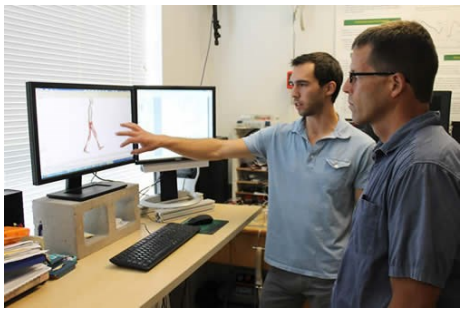
Photo by CSU Ventures

This year's first place winner of the most innovative poster was awarded to Jacqueline Harding; Jarid Metz; Megan Neufield; and Melissa Reynolds, assistant professor, Department of Chemistry and the School of Biomedical Engineering for their poster on "Next Generation Nitric Oxide Releasing Biomedical Devices." Steve Foster, director, licensing and business development at CSU Ventures presented the award money.

CSU Ventures is the commercialization arm of Colorado State, charged with helping to get student and faculty research out into the marketplace where companies can be started, products manufactured, and jobs created.

Ph.D. STUDENT IS COMPETITION FINALIST AT WORLD CONGRESS OF BIOMECHANICS

Zach Lerner, SBME Ph.D. student, was selected as one of 36 finalists out of more than 700 in the Ph.D. Student Paper Competition for the World Congress of Biomechanics (WCB). Lerner has also been asked to give a podium presentation on his work investigating the effects of childhood obesity on the musculoskeletal system. He will also be presenting results from two additional abstracts (prediction of medial-lateral contact forces and the creation of a sheep hindlimb musculoskeletal model).



The WCB meeting is scheduled to take place July 6-11, 2014 in Boston, Massachusetts. We are excited for Zach to take this opportunity to showcase his talents and highlight some of the biomedical engineering research taking place at CSU. Zach currently works in Ray Browning's Physical Activity Laboratory in the Department of Health and Exercise Science.

V. "CHANDRA" CHANDRASEKAR RECEIVES UNIVERSITY DISTINGUISHED PROFESSOR AWARD

The title, "University Distinguished Professor," is bestowed upon only a handful of professors at any one time on the basis of outstanding scholarship and achievement. Professors receiving this title hold the distinction for the duration of their association with the university.

This year, Colorado State University awarded this title to three professors including V. "Chandra" Chandrasekar, a professor in CSU's Department of Electrical and Computer Engineering and the School of Biomedical Engineering.

Chandra has made pioneering contributions in the area of polarimetric radar observations of the atmosphere and urban observation networks. He has extensive experience in radar system design, radar network development, digital signal processing design, as well as radio frequency communication systems.

The awards for 2013-14 were announced at the Celebrate! Colorado State Awards reception on April 29.

NEW SBME CORE FACULTY MEMBERS

The following assistant professors recently joined the School of Biomedical Engineering as core faculty members.

Hussam Mahmoud is an assistant professor in the Department of Civil and Environmental Engineering. Mahmoud's research interests include probabilistic tissue mechanics, premature labor and pregnancy maintenance, and fatigue and fracture of hard tissues. Mahmoud is a great example of bringing cross-disciplinary thinking from his research on the impact of seismic events on buildings to the impact of muscle structure and tone in labor and delivery.

Arun Kota is a new assistant professor in the Department of Mechanical Engineering. Kota's research interests include bio-inspired and bio-compatible surfaces, super-repellent surfaces, chemically patterned surfaces, and stimuli-responsive surfaces. His work will interact with investigators across the SBME spectrum with impacts ranging from biosensor function and fouling to blood diagnostics and separations.

SBME Seminar Speaker Highlights

The purpose of the SBME Seminar course (BIOM 592) is to expose SBME graduate students to the breadth and depth of the field of biomedical engineering through presentations from academia and industry and to provide a forum where synergistic projects can be presented to educate and inspire faculty and students in further collaborative efforts.

Students are required to post online summaries of the weekly presentations. We are proud to showcase the summaries provided by Jody Emch and Hannah Pauly.

DR. BETH WINKELSTEIN
By: Jody Emch

Dr. Beth Winkelstein is a professor of Bioengineering and Neurosurgery and the Associate Dean for Undergraduate Education at the University of Pennsylvania. Her research into the biomechanics of injuries that cause chronic pain has received many honors, including the Whitaker Young Investigator Award, National Science Foundation CAREER Award, and the YC Fung Young Investigator Award from the American Society of Mechanical Engineering. She discussed her research in her talk titled, "Biomechanics of Spinal Joint Injury: Considering All 'Facets' Ranging from Tissue Tolerance to Pain & Dysfunction," given at Colorado State University in the Spring of 2014. The focus of her work is defining injuries to the facet joint of the spine that cause chronic pain. She admitted that defining the causes of chronic pain has proved to be quite difficult; generally, the injury site is unknown and the clinical variability is high, i.e. the same exposure can cause different outcomes for different people. Her specific aim has been to define whiplash and determine the injuries that cause it. Her initial approach was to attach metal beads to facet joint capsules and simulate exposure, but she could not correlate her results to a physiologic pain response. However, using a rodent model enabled her to make the correlation. Her measurements showed that the animals experienced a greater sensitivity to pain after one day following the injury. She explained her next step was to evaluate spinal neuronal hypersensitivity in the animals. So, she added *in vivo* electrophysiology sensors to the animals, which showed that changes in hypersensitivity occur 6-24 hours after injury. To determine the injuries that cause whiplash, she studied the mechanics involved. She used polarization methods to visualize the collagen fiber alignment during injury. This showed that fiber realignment happens at strains lower than visible damage and that this realignment is correlated to pain. In the future, Dr. Winkelstein intends to identify key mechano-transduction events that occur during injury and define the mechanical thresholds for cellular dysfunction. After integrating all of these studies, the clinical relevance to humans can be determined. Theoretically, after the mechanisms of the injuries are understood, the chronic pain can be treated.


Photo by UPenn

CHRISTINE LIN
By: Hannah Pauly

Christine Lin, SBME Ph.D. student in the laboratory of Dr. Salman Khetani, presented, "Prediction of Drug Clearance and Drug-Drug Interactions in Micropatterned Co-cultures of Human Hepatocytes" on April 28, as part of the SBME Spring 2014 Seminar Series. The overall goal of her work was to accurately predict drug clearance rates from the liver. Drug clearance quantifies the ability of a body to eliminate a drug, a process that primarily involves the liver and kidney. Understanding drug clearance rate is important when determining clinical dosage rates and assessing potential drug interactions and side effects. Conventional human liver models used to determine drug clearance rates, including microsomes, cell lines, suspension hepatocytes, and plated hepatocytes, are limited in their accuracy due to a lack of key enzymes, abnormal function levels, low viability, and a rapid functional decline. Soft-lithography can be used to create micro-patterned co cultures which consist of hepatocyte cells seeded on "islands" and surrounded by supporting fibroblasts. This setup better mimics the microenvironment experienced by hepatocytes in vivo. Hepatocytes in micro-patterned co culture show high functionality and viability. Drug clearance in micro-patterned co-culture was determined by dosing the cells with the specified drug, collecting supernatants at specified time-points, and analysis the samples with LC-MS analysis. For low-turnover compounds as well as all compounds the clearance rates predicted in-vitro closely matched the predicted in vivo clearance rates. The micro-patterned co cultures were able to more accurately predict drug clearance rates compared to conventional plated hepatocyte cultures and suspension hepatocyte cultures. The micro-patterned co culture results also displayed a low donor-variability. Micro-patterned co cultures can also be effectively used to monitor drug-drug interactions with both inducers and inhibitors. Overall these results show that micro-patterned co cultures can be used to predict drug clearance rates more accurately than conventional models and drug clearance can be modulated using inducers and inhibitors.

SBME Debuts Internship and Employment Data

The School of Biomedical Engineering is proud to debut its first generation of career data for its undergraduate and graduate programs. Data was compiled for both students and alumni and reflects paid or unpaid internships, full- or part-time employment, and further educational opportunities. Although the career data was generated solely on known outcomes, it shows great promise for students' post-collegiate careers. Students are finding positions locally, nationally, and internationally in their fields of study.

Colorado State has a long history of strong internship participation and, typically, seventy percent of engineering seniors have had one or more internships. SBME plans to continue this tradition and the data shows that we are well underway. This year's undergraduate internship placements reflect a 3-fold increase over last year and continue to include important local industry partners such as Covidien, Medical Modeling, Spectranetics, and Terumo BCT. Many other students are sharpening their skillsets by engaging in faculty research across campus.

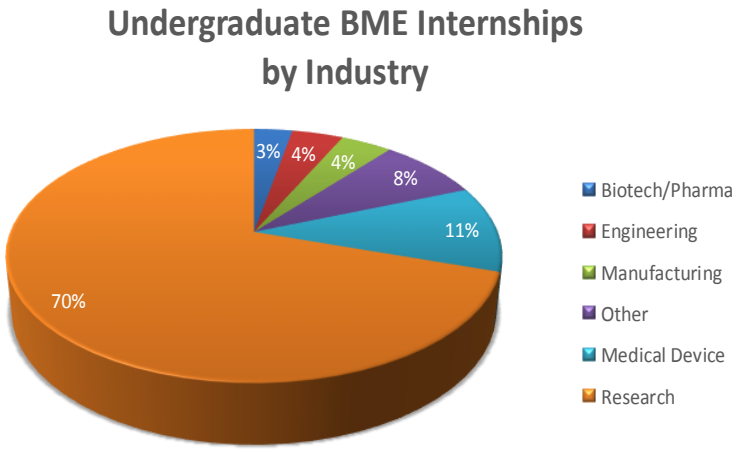
The first cohort of undergraduate dual degree BME students will graduate in May 2015. At that time, we will analyze the impact internships have on the students' post-baccalaureate employment and/or graduate school opportunities.

"The dual degree program is an excellent opportunity for students to receive a solid and broad foundational education," says Tanja Beshear, quality manager at Covidien. "Going for the dual degree helps students stand out when looking for internship opportunities and jobs, and will certainly be beneficial in a transition to the industry."

SBME graduate alumni reflect impressive accomplishments. All Ph.D. graduates were employed in biomedical engineering industrial or post-doctoral positions. The majority of master's degree graduates found employment in biomedical engineering-related industries. Our graduates are making professional contributions within such prestigious organizations as Covidien, Medtronic, Harvard, the National Cancer Institute, National Institutes of Health, Nike, Terumo BCT, and other leaders in biomedical diagnostics, therapeutics, technology, and education.

In response to increasing regulatory pressure from the Food and Drug Administration, six Colorado companies—Covidien, Medtronic Navigation, Spectranetics, Terumo BCT, Tolmar, and Zoll Medical—have launched new internship programs in regulatory affairs in an effort to expand their quality and regulatory departments. These internships bring real-world experience into the classroom, allow companies to test-drive potential job candidates, and increase the number of qualified regulatory affairs professionals.

Whether in academic, clinical, pharmaceutical, medical device, or other biomedical industries, SBME graduates are making a difference locally, nationally, and globally.



Colorado State University
School of Biomedical Engineering

1376 Campus Delivery
Fort Collins, CO 80523-1376

(970) 491-7157
FAX: (970) 491-5569
sbme-info@colostate.edu
engr.colostate.edu/sbme

FIND US ON:

SBME Events Calendar

OCTOBER 2014

CSU Homecoming Weekend

Oct. 16-19 / CSU Campus / All-day events

For more information, visit: www.homecoming.colostate.edu

APRIL 2015

Engineering Days (E-Days)

Friday, April 17, 2015

For more information, visit: http://www.engr.colostate.edu/students/future-students/undergraduate/E_Days.html

The Company We Keep

Each semester, the School of Biomedical Engineering invites distinguished professors from around the world to speak on biomedical engineering research and related disciplines for its weekly seminar series. The Spring 2014 speakers included:

Dr. Alison Marsden
University of California, San Diego
"Multiscale Modeling and Optimal Treatment Planning in Pediatric Cardiology"

Dr. Beth Winkelstein
University of Pennsylvania
"Biomechanics of Spinal Joint Injury: Considering All "Facets" Ranging from Tissue Tolerance to Pain & Dysfunction"

Dr. Kevin Healy
University of California, Berkeley
"Organs on a Chip - the Future of Personalized Medicine"

Dr. Edvani Muniz
Maringa State University, Brazil
"Developing Polymeric Materials with Potential Applications in Medical, Pharmaceutical and Tissue Engineering Areas"