



SCHOOL OF BIOMEDICAL ENGINEERING COLORADO STATE UNIVERSITY



Virtual E-Days provides students an opportunity to showcase their capstone projects.

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First-generation students provided an opportunity to connect with faculty & alumni.

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SBME faculty receive awards and are recognized for their leadership and research.

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MESSAGE FROM DIRECTOR

Celebrating our strength: Imaging & Diagnostics

My original intention for the spring message this year was to shout out our strengths in imaging and diagnostics, and I will come back to this later. Needless to say, however, COVID19 interrupted virtually everything in the world in March. An emergency switch to all remote function was not in anyone's crystal ball when the semester started on January 21, 2020! Fortunately, this went reasonably smoothly for CSU and the SBME. We continued the delivery of our online classes as we normally do and all resident didactic classes were moved to remote delivery.

Lab classes either had to cease or move to a demo mode. The graduate practicum was taking its inaugural design voyage and leveraged the undergraduate senior design lecture class. All teams produced outstanding materials for evaluation by outside experts in a first of its kind remote judging experience as noted on page 2 of this newsletter. This effort was led by Senior Design Instructor Ellen Brennan-Pierce and the interim Director of Undergraduate Programs Dr. Ketul Popat. They led the only public display and judging forum for senior design projects in the College, viewable here: <https://www.engr.colostate.edu/sbme/virtual-e-days-presentations/>.

We are still in discussions with schools throughout the region (UC Denver Biomedical Engineering, University of Wyoming, UC Boulder, CO School of Mines, and Denver University) to establish a regional meeting and perhaps consortium for joint activities more broadly. We have had biomedical engineering leaders from four of these schools give seminars at CSU, with one more to come in the fall. The goal is to see how we can harvest regional synergies in research, with industry, and with students (existing and to be recruited). We are on the lookout for remote meeting software that truly engages an audience. Many national meetings are evaluating remote

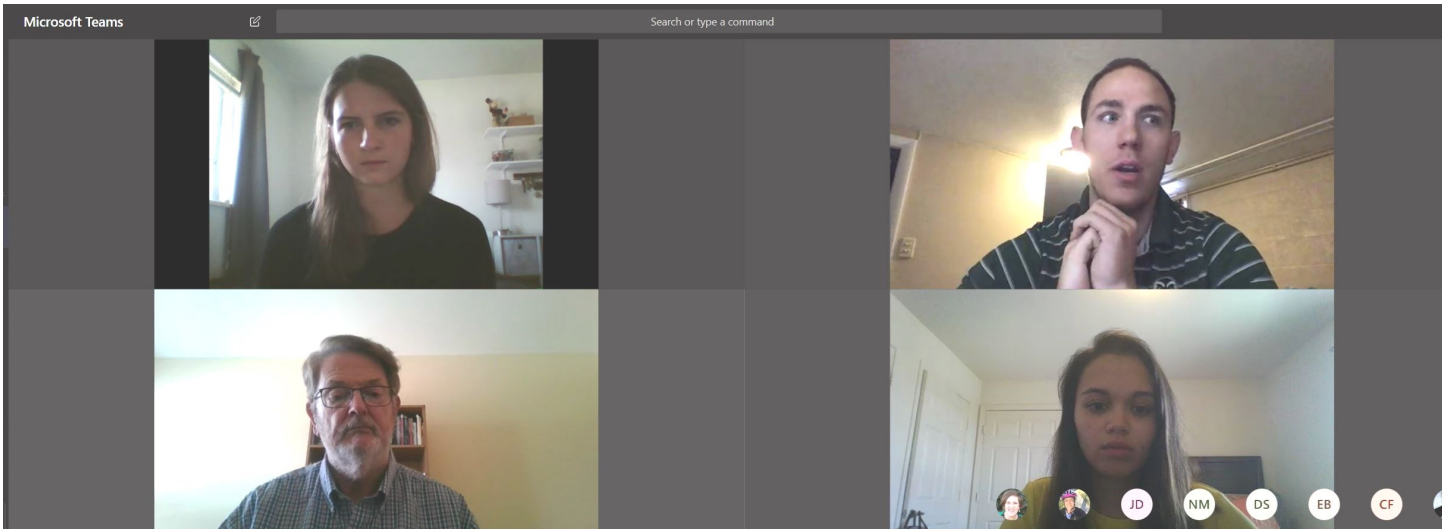
options in the near future and we hope to learn from their experiences.

Of all the times in history to have a Master of Engineering Online (MEO) program successfully in place, this is a most interesting time. We took the additional step this year of utilizing several courses from the MEO program to create a biomedical engineering certificate. This will allow people to dive in with a 12-credit commitment instead of 30 and then perhaps join the MEO program once they have a better feel for the instruction and materials.

Finally, I will sing the praises of the SBME faculty (and students) that have jumped into helping with COVID-related research across campus. This was not a focused SBME effort as much as a reflection of the fact that the faculty that join the SBME are already highly engaged in relevant translational research and were either tapped by upper administration directly or jumped in on their own. Going back to my first sentence about imaging and diagnostics, I want to particularly call out a SARS CoV2 related diagnostics project by SBME faculty Charles Henry, David Dandy and Brian Geiss (home departments Chemistry, Chemical & Biological Engineering, and Microbiology, Immunology & Pathology, respectively). They are not alone among the faculty doing COVID-related work, but at a time when "testing" is on many people's minds, they fit the theme I started with and are doing truly essential work.

Stu Tobet, Ph.D.
Director, School of Biomedical Engineering

Virtual Engineering Days (E-Days)



Clockwise: Chandler Birrell (BME+MECH), Claire Fenton (BME+MECH), Reginald Stilwell (AlloSource), and Lyndsey Nold (BME+MECH)

Engineering Days (E-Days) is an annual event that provides undergraduate engineering students an opportunity to showcase their completed senior design projects to faculty, family, industry representatives, and peers. The capstone senior design project teaches students how to succeed in a well-integrated, interdisciplinary engineering design environment and allows students to develop practical, hands-on skills.

This year, however, the judging of biomedical engineering senior design projects took place online due to the COVID-19 pandemic. In advance of virtual E-Days on April 24, judges received the project description, poster, and video of each team project to familiarize themselves with the projects they were being asked to judge. On E-Days, judges and students met virtually via Microsoft Teams for 10-15 minutes and engaged in a Q&A session.

The SBME Advisory Board judges, along with industry guests, including Reginald Stilwell (AlloSource), Michael Floren (AlloSource), and Kendra Meggett-Carr (Naval Research), decided on the following student senior design project winners for BME-themed projects. Judging criteria included presentation, appearance, technical content, creativity, and overall impression.

First Place: Optical Neurolink for a High Data Rate Brain-Computer Interface

Team members: Sarah Maclean (BME+EE), Mauri Richards (BME+MECH), Kieran Simske (BME+MECH), Justin Southerland (BME+CBE)

In 2012, a consortium demonstrated a brain-machine interface that allowed a paralyzed woman to control a robotic arm using her mind. To make neural prosthesis practical, engineers need to design communications devices to get Mb/s of data from an electrocorticogram (ECoG) array implanted in the brain out of the user's head without large cables (as can be seen in the video) and without overheating the neighboring tissue with communications circuitry or computational power. One approach being considered is using light to beam the information through the scalp. This approach is being explored by the Wyss Center. The purpose of this project is to determine the requirements for such an optical brain-computer interface, design and prototype an optical transmitter suitable for subcutaneous implantation as well as a compatible receiver, and develop and apply testing methodology to explore the capabilities and limitations of this technology.

Second Place: Smart Well Plate

Team members: Jacob Akfieri (BME+EE), Sam Ritter (BME+MECH), Alden Tennison (BME+EE)

This project involves development of hardware, software, and mechanical parts needed for a complete smart well-plate system. The smart well-plate system consists of an array of wells, an array of sensors in each well, a built-in electronic circuit board supporting all sensors in each well, a smart-phone based user interface, and all the mechanical parts supporting the operation of the system. The number of wells and the arrangement of the wells are fully compatible with existing commercial well-plate format. Therefore, all existing infrastructure that support experiments using well-plates can be used for the smart well-plate systems. The development the senior design team to be engaged in includes sensor design and manufacturing for wells, design, manufacturing, and testing of the built-in electronic circuit board, design and testing of the user interface. Technical skills in wet experiments, electronic circuit design, mechanical design, fluid dynamics simulations, and system integration are needed for the project.

Third Place: Brain Train

Team members: Zachary J. Haigh (BME+CBE), Corey Lauck (BME+MECH), Jeremy Tabke (BME+MECH), Juliette Talarico (BME+MECH)

The Brain Train is a closed loop, noninvasive brain stimulation (NIBS) device that utilizes live electroencephalography (EEG) feedback about ongoing neural activity to adjust transcranial alternating current stimulation (tACS) therapy. This project will primarily focus on improving working memory to maintain a realizable scope and impactful outcome. This proposed direct-to-consumer medical device alters neural oscillations by either amplifying or stifling various brain waves. This is done by delivering weak sinusoidal currents to the scalp to modulate the excitability of the cerebral cortex in a frequency-specific manner. The ability to perform simultaneous EEG monitoring during therapy allows for the immediate effects to be recorded and for the therapy parameters to be adjusted as a result. This creates therapy that is fine-tuned to each individual. The development of this system will involve designing and manufacturing the headset, developing a method to remove the tACS artifact from the EEG readings, creating a closed loop system to adjust the therapy parameters, and designing and performing experiments to gather data on working memory changes due to therapy.

Honorable Mention

Anti-Cancer Photochemical Cell Inactivation Device (PhotoPharma)

Team members: Katherine Conger (BME+CBE), Isaac Griess (BME+EE), Andy Hegemann (BME+MECH), Jacob Stockebrand (BME+MECH), Cameron Taylor (BME+BME)

Process to Manufacture Periosteum Fibers (AlloSource)

Team members: Sarah DeBoer (BME+MECH), Will McCormick (BME+MECH), Analia Quirk (BME+CBE), Erin Solis (BME+MECH)

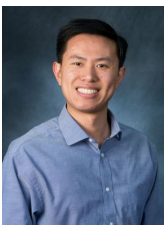
Magnetic Tweezer for Active Microrheology

Team members: Chandler Birrell (BME+MECH), Claire Fenton (BME+MECH), Nicholas Mitchell (BME+MECH), Lyndsey Nold (BME+MECH), Stephanie Pascua (BME+CBE)

Please visit www.engr.colostate.edu/sbme/virtual-e-days-presentations/ to view the senior design project descriptions, posters, and videos.

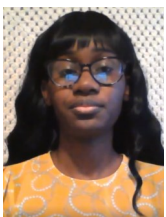
SBME Scholarship for Leadership and Innovation Winners

Michael Truong and Faith Otieno received the 2020/21 SBME Scholarship for Leadership and Innovation. This scholarship was created to support biomedical engineering students who excel as creative problem solvers and show a commitment to leadership.



Truong

Michael Truong is a third-year Ph.D. student who, under advisor Dr. Zhijie Wang, is conducting research on right heart failure. He examines the biomechanical mechanisms of, and instructs stem cell therapies for, right heart failure. Truong has a long history of leadership, including founding and actively promoting the mission of Team HBV, a student organization dedicated to hepatitis B virus education at UC Davis. He has also served as the inaugural Graduate Liaison Officer of BMES, actively connecting graduate students with professional development resources and industry members. As part of his research, he has also mentored six undergraduate BME students.



Otieno

Faith Otieno (BME+EE) is a 4th year Honors undergraduate student who has consistently contributed in service, innovation, and leadership. One of Faith's goals is to give back, especially to low-income communities. After high school, she took a gap year to work with her mother on various medical research and fieldwork projects in her home country of Kenya. At CSU, she has helped found the Engineering Entrepreneurship Club and has been involved with the Fall Cleanup service event in which CSU students help local residents clean their yards. To help fund her studies, Faith works 20 hours a week. She is the first international student to become a manager, where she currently supervises 150 people, providing training, support and inspiration to those serving in the campus dining halls.

7th Annual SBME First-Generation Student Dinner

By Brett Beal

On January 30, 2020, the 7th Annual SBME First-Generation Student Dinner took place bringing together 45 students, faculty, staff, and alumni. Participants shared stories, successes, failures, advice, and humor, connecting with each other and enhancing the CSU BME community.

Four graduating students were honored: Teryn Degenhart (BME+MECH), Elias Espin (BME+CBE), Marina Larson (BME+CBE), and Cameron Taylor (BME+CBE). As co-chair for this event for the past three years, president of BMES for two years, and generally being one of the 'go-to' people for the SBME, Teryn was given a special award "For Exceptional Contributions to SBME 1st Generation Students."

Four alumni also attended and shared their stories, lessons learned, and advice. Valerie Cochrane ('18) found a special satisfaction this year, seeing students she'd met last year and helped get connected to lab positions. "This year I saw the same students again, and it's a great feeling to know that I was able to help a student out. I really enjoy connecting with students at the dinner." Tyler Parker ('19) shared career advice, "Don't be afraid to put yourself out there in the CSU engineering community. You get out of it what you put into it. Sometimes you need to make an opportunity happen...look for companies doing what you are interested in and try and solve a problem for them." Tyler Heighes ('17) echoed this, encouraging students to "get to know their professors and not be afraid to ask for help." Michael May ('17; BME PhD student) emphasized getting campus lab experience, as it helps develop critical thinking skills and improve academics. "I found that my grades improved dramatically after I became better at problem solving due to my efforts in lab. I got into a good routine that really pulled me into academics and further improved my grades and opened doors for graduate school."



BME+CBE faculty, staff and students: (clockwise from bottom left): Claire Lavelle (adviser), Dr. Ashok Prasad, Skyler Hochmuth ('20), Elias Espin ('20), Cameron Taylor ('20), Michael May ('17), Jacob DeRoo ('18), Markos DeMarco ('22), Dr. Brian Munsky.

2019 Graduate Student Showcase

The Graduate Student Showcase of research, entrepreneurship and creativity is a one-day conference providing graduate students involved in research or creativity an opportunity to present their work and talents, connect with other graduate students, and gain conference experience. Each participant's work is entered into a contest for multiple scholarships totaling more than \$15,000.

Congratulations to biomedical engineering students Tara Wigmosta and Sid Jain (pictured) for having each received a \$250 award for Excellence in Research Award from the Walter Scott, Jr. College of Engineering.

Tara was recognized for her research on Advanced Surfaces for Orthopedic Implants, and Sid was recognized for his work on Paper-based Nuclease Protection Assays for Pathogen Detection.



High School Students Introduced to BME

By Michael Benedict



This past fall, SBME offered a unique course for the second time: BIOM 180, a 1-credit online course that covers the same content as BIOM 100, but with a twist – instead of CSU students, the course is taken by high school students in the St. Vrain Valley School District. The course grew by about 15% this year, and Mark Allen, a teacher at Frederick High School who facilitates the experience, believes enrollment will nearly double this coming fall. He anticipates further growth in the years to follow.

The program has been a very successful collaboration, and several of the students who participated will matriculate at CSU next year. Dr. Ketul Popat, the Director of Undergraduate Programs for SBME, said that options for expanding the course are being investigated, with hopes to move into additional school districts in the future. SBME is always hard at work training the next generation of biomedical engineers – and with this program, the training starts before they even arrive at CSU.

Graduate Program Update

By Sara Neys Mattern

Program Recognition

The Walter Scott, Jr. College of Engineering online graduate programs ranked 37th in the nation and 21st for veterans in the most recent survey by *U.S. News and World Report*. Ranking methodology includes factors such as student engagement, faculty credentials and training, and student services and technologies. The Master of Engineering with a specialization in biomedical engineering degree is a growing program that continues to produce highly qualified professionals ready to step into roles in this fast-growing and essential industry.

Skill Swap Event

October 7, 2019 was the second annual Skill Swap. This year we partnered with the Graduate Degree Program in Ecology (GDPE). Graduate students from both programs with expertise in a specific area were on-hand to share their skills with students looking to gain new knowledge. We had 15 tables of shared skills which included 3D Printing, CAD, Experimental Design, Microfluidic Devices, ELISA, Illustrator, R Coding, ArcGIS, and Cell Culture (to name a few). A representative from the Library also participated. We look forward to collaborating with GDPE and hosting the same event again in the fall.



Graduate Interview Days

The SBME hosted its annual poster session and social, part of the activities on Graduate Interview Days on February 24 and 25. Fifteen Ph.D. candidates seeking admission to the biomedical engineering program had an opportunity to interview with faculty, tour labs and campus, and interact with current graduate students at several events. At the poster session, current students showcased their research, giving prospective students an opportunity to learn more about the research on campus. We look forward to welcoming a new class of graduate students in August 2020.

Recruiting Update

“On the road again; I just can’t wait to get on the road again...” Lyrics from “On the Road Again” by Willie Nelson was a familiar tune to me as I ventured south to visit University of Colorado, Colorado Springs, CSU Pueblo, and Fort Lewis College in Durango in mid-October (along with a graduate advisor from another program). I gave a presentation to prospective students at each institution, discussing each biomedical engineering graduate program, showcasing the research our faculty are doing, and highlighting admission and curriculum requirements. I’m looking forward to returning again in the fall of 2020.

SBME Faculty in the Spotlight



Carmen Menoni Named President of IEEE Photonics Society

By Andrea Leland

The University Distinguished Professor of Electrical and Computer Engineering Carmen Menoni has been selected to serve as president of the Institute of Electrical and Electronics Engineers (IEEE) Photonics Society in 2020. Menoni plans to launch new initiatives aimed at bolstering memberships, publications, and conferences, with special emphasis on increasing diversity and enhancing professional development programs.

<https://engr.source.colostate.edu/carmen-menoni-named-president-of-ieee-photonics-society>



CSU Veterinary Team Performs First-Ever Heart Valve Procedure on Schnauzer

By Mary Guiden

Chris Orton, veterinary cardiothoracic surgeon and associate faculty member of the SBME, worked with leaders from the Shanghai Hanyu Medical Technology Company to perform a successful beating-heart mitral valve repair in a dog with severe mitral regurgitation, the most common heart disease in older dogs. This procedure is more affordable than the alternative of open heart surgery.

<https://cvmbbs.source.colostate.edu/csu-veterinary-team-performs-first-ever-heart-valve-procedure-on-schnauzer>



Wilson Wins NSF CAREER Award, NIH Grant to Advance Noninvasive Imaging Technologies

By Andrea Leland

Jesse Wilson received the Faculty Early Career Development award from the NSF for his work to improve the diagnosis and treatment of devastating mitochondrial diseases. He also received a grant from the NIH to develop advanced imaging tools for general medicine and surgery.

<https://engr.source.colostate.edu/jesse-wilson-wins-career-award-nih-grant-to-advance-noninvasive-imaging-technologies/>



CSU Researchers Part of National Search for Coronavirus Vaccine

By Mike Hooker

Ray Goodrich, executive director of CSU's Infectious Disease Research Center and member of SBME's Industry Advisory Board, met with U.S. Senator Michael Bennett in March to discuss the vaccine-creating capabilities of CSU's Mirasol PRT System. Goodrich explained CSU's unique capability to create and mass-produce a vaccine through BioMARC, a nonprofit biopharmaceutical manufacturing operation that is part of the IDRC.

<https://source.colostate.edu/csu-researchers-part-of-national-search-for-coronavirus-vaccine/>



Antiviral Compounds Against COVID-19 Tested in Secure Labs at CSU

By Mary Guiden

Since the start of the pandemic, CSU has been inundated with requests for testing from companies and organizations in the United States and internationally. Brian Geiss, associate professor in the Department of Microbiology, Immunology, and Pathology and associate faculty in SBME, is helping CSU handle logistics, fielding inquiries from companies, and establishing contracts for testing a variety of antiviral compounds.

<https://cvmbbs.source.colostate.edu/antiviral-compounds-against-covid-19-tested-in-secure-labs-at-csu/>



Engineering Lab at CSU Transformed into Testing Site for COVID-19 Medical Protective Gear

By Anne Manning

John Volckens' lab has suspended most of its usual activities, transforming into the official state testing site for respirators and surgical masks. Colorado healthcare workers may soon need 60,000-100,000 protective items per day, and the lab is making sure that everything is safe and effective.

<https://engr.source.colostate.edu/engineering-lab-at-csu-transformed-into-testing-site-for-covid-19-medical-protective-gear/>



WALTER SCOTT, JR. COLLEGE OF ENGINEERING AWARDS

Award winners are recognized for outstanding achievements and overall excellence throughout the college. Several faculty and staff of the School of Biomedical Engineering received awards:

Art Corey Award for Outstanding International Contributions: **Matthew Kipper**, Professor, Chemical & Biological Engineering

George T. Abell Outstanding Early-Career Faculty Award: **Brian Munsky**, Assistant Professor, Chemical & Biological Engineering

George T. Abell Outstanding Mid-Career Faculty Award: **Ketul Popat**, Associate Professor, Mechanical Engineering

Outstanding Staff Award: **Michael Benedict**, SBME Office Coordinator

Outstanding Service to Students: **Ellen Brennan-Pierce**, Lab Manager, Instructor, Research Scientist

Outstanding Service to Students: **Deb Misuraca**, Undergraduate Advisor

Pictured from left to right: Michael Benedict, Ellen Brennan-Pierce, Deb Misuraca, and Ketul Popat

THE COMPANY WE KEEP

Distinguished guests invited to speak at the SBME's weekly seminar series in Fall 2019 and Spring 2020 include:

Colorado School of Mines - Dr. Kevin Cash

Continuous, Real-time, Physiological Monitoring with Nanosensors

Binghamton University - Dr. Kaiming Ye

Human Tissue Biofabrication from iPSCs

Yale University School of Medicine - Dr. Joerg Bewersdorf

3D, Multicolor and Live-cell Super-resolution Microscopy for Cell Biological Research

University of Wyoming - Dr. John Oakey

Microfabricated Intracellular and Extracellular Niches

University of Oklahoma - Dr. Michael Detamore

Gradients and Chondroinductive Biomaterials in Regenerative Medicine

University of Colorado, Anschutz - Dr. Jeffrey Jacot

Tissue Engineering for the Correction of Congenital Heart Defects

Colorado School of Mines - Dr. Judith Klein-Seetharaman

The Synthetic Coral: An Opportunity for Collaboration between Computer Science, Biology and Materials Science and Engineering

University of Colorado Boulder - Dr. Wei Tan

Precision Design for Vascular Disease Treatment



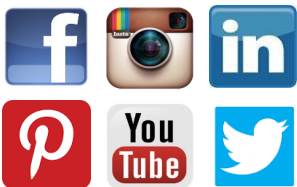
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FIND US ON:



New BME Alumni Leadership Council

By Hannah Mikelson

With an established and flourishing biomedical engineering program and an ever-growing alumni community, there is a need to strengthen our alumni connections. In November 2019, an inaugural group of BME alumni gathered together online to discuss the creation of a new BME Alumni Leadership Council.

The CSU BME ALC is a collective of alumni who strive to positively impact the CSU SBME program by supporting SBME students, providing feedback to the SBME program, creating and fostering an inclusive alumni community, and increasing the prominence of the SBME programs. Our focus on these objectives will direct the council in all activities.

ALC membership is open to CSU BME alumni who have one year of work experience post-graduation. The ALC membership term is two years, during which members will have the opportunity to participate in ALC events, provide support to the BME program and students, and connect with other BME alumni.

Being a part of the biomedical engineering program at CSU, we all share a unique collegiate experience. That experience has been a springboard to adventures much greater. However, our roots at CSU are important to remember and foster. We have the opportunity to learn from one another and further improve the biomedical program for students and alumni to come through the ALC.

CSU BME alumni are connected by our passion for improving the human experience, our ability to solve real-world problems, and our love for the colors green and gold.
