



## SCHOOL OF BIOMEDICAL ENGINEERING COLORADO STATE UNIVERSITY



Sixteen advisory board members and industry guests serve as judges for virtual E-Days.

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## MESSAGE FROM DIRECTOR

### Positive lessons from hard times propel us forward

COVID-19 has provided the world with an opportunity to think anew. What has the past wrought and what will the future of SBME bring? Rarely a good idea to play the game of who had it worse! We'll do better to look at what we have learned and what we can do even better going forward. Here are two examples to consider:

The COVID-19 pandemic launched one of the largest scientific races for vaccines in human history. It currently remains a race with over 90 entrants, and to this point 3 entries have reached the level of Emergency Use Authorization in the United States (Pfizer BioNTech, Moderna, and Johnson & Johnson/Janssen), while several others are available in other parts of the world. To put the process in perspective, it is worth a brief consideration of vaccine history, which goes back many years. By anecdote, the history traces back over perhaps 2000 years for measles and smallpox. More recently, in 1796 Edward Jenner ushered in the modern vaccine era when he reported his testing of whether an inoculate from cowpox could protect humans from smallpox. In 1879 Pasteur created the first attenuated vaccine for cholera, and in 1952 the Salk team was testing a killed polio virus vaccine. In 1965 we saw use of a part of the hepatitis B virus toward a vaccine. The 'technology' evolved from live virus, to dead virus, to selected proteins to the current step into the world of providing nucleic acid templates for host cells to make viral protein components. The current templates come in 2 flavors: either DNA carried by adenoviral vectors or RNA carried by liposomal nanoparticles. Adenoviral vectors require host cell receptors to get into cells. Liposomal nanoparticles are randomly taken into cells they encounter. There is a dearth of information on the impacts of random viral protein synthesis over time from the perspective of host cell populations. CSU entered the vaccine race with technology originally developed by SBME Advisory Board member Ray Goodrich, also the executive director of the CSU Infectious Disease Research Center. The CSU entry SolaVAX™ is based on a strategy that Dr. Goodrich developed to clear pathogens from stored blood. It is based on a riboflavin enhancement of nucleic acid breakdown in the presence of ultraviolet light. This method allows inoculation or vaccination of 'virus' without its nucleic acid infection instructions. In the long run, people should be able to choose their vaccine based on understanding the underlying technology of their choice. To ignore vaccines is to repeat the follies of many years past. However, as engineers, we would do well not to ignore the technologies of choice either.

Before the pandemic, CSU was already taking educational strategies to new heights. The fastest growing population of graduate students in the School of Biomedical Engineering are those in our Master of Engineering online program! When the pandemic struck, these students did not blink an eye and were able to continue uninterrupted, already comfortable in their academic process. Before the pandemic, others around CSU were already developing [tools for virtual reality](#) (VR) approaches to education, particularly for human anatomy. In the summer of 2020, the anatomy group successfully and ambitiously moved their VR platform to remote instruction by shipping computers and headsets to the homes of about 90 students! This takes education from hybrid to Hybrid<sup>4</sup>. Four SBME undergraduate students also jumped into the future by participating in a senior [design project](#) to pair augmented reality (AR) with medical ultrasound imaging – a project led by Tod Clapp and myself. The hope is that these steps will help lead to the next educational frontier! The last year+ may have been difficult, but the experiences will be helpful for providing a brighter future.

Dr. Stuart Tobet  
Director, School of Biomedical Engineering

## 2021 Virtual Engineering Days (E-Days)



*Leigh Neumeyer (UFL-JAX), Roberta Sabino (CSU), Dennis Schlaht (Impedimed), Reginald Stilwell (AlloSource), Avri Nataf (BME+MECH), Emma MacLaughlin (BME+CBE), Jack Fleischmann (BME+MECH), Dean David McLean (CSU)*

Engineering Days (E-Days) 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.

As in 2020, E-Days took place virtually this year. In advance of E-Days on April 23, judges received the project descriptions, posters, and video of each team project to familiarize themselves with the work they were being asked to judge. On E-Days, judges and students met virtually via Microsoft Teams for 20 minutes and engaged in a Q&A session. Sixteen judges, including SBME Advisory Board members and industry guests, decided on the following biomedical engineering winners for BME-themed projects:

### **First Place: Mobile Wheelchair Control Application**

*Advisors: Sam Bechara and Noel Marshall*

*Team: Katrina Lems (BME+MECH), Chad Kennedy (BME+MECH), Christina Croal (BME+MECH), Ethan Lash (BME+EE)*

The WIT chair is a unique phone app to assist power chair users. The app displays the fluid level of the user's urine bag alongside a pressure map of their seat regardless of the orientation of the wheelchair. These two systems are used to alert the user to empty the urine bag and to shift off of pressure points to prevent pressure sores by reclining their chair. The phone app can be used by caretakers or wheelchair users for maximum convenience.

### **Second Place: Overuse Tendinopathy Device**

*Advisor: Katie Sikes*

*Team: Greta Gohring (BME+CBE), Sarah Burke (BME+MECH), Alfredo Macha (BME+EE), and Adam McAuliffe (BME+MECH)*

The Overuse Tendinopathy Device is a unique tool that will be used to induce tendon-specific injuries in mice.

As the first of its kind, this device will utilize cyclic loading to mimic Achilles tendon overuse in a realistic and time-effective manner. Once integrated into research practices, this device will provide scientists with a reliable method to create injury models for experimentation of different therapeutic techniques. Current methods to treat tendon disorders are preventative and with more testing of these therapeutic methods, there is the potential to help revert the damage in patients.

### **Third Place: SnifTek Low-Cost COVID-19 Tester**

*Advisor: Bert Vermeulen*

*Team: Katie Davis (BME+CBE), Cerine Khoo (BME+CBE), Megan Maier (BME+CBE), Sean O'Connell (BME+CBE), Faith Otieno (BME+EE)*

The need for a fast and inexpensive COVID-19 testing device is critical to reducing the high infection rates and mortality rates of COVID-19. The team is developing a proof of concept for a novel device using electronic sensing of volatile organic compounds in breath to rapidly diagnose COVID-19 at a low cost with high accuracy.

### **Honorable Mention**

#### **Training Device for Upper Right Lobectomy via Video-Assisted Thoracoscopic Surgery**

*Advisors: Michael Stanton and Greg Hofstetter*

*Team: Jacob Stewart (BME+CBE), Sandra Witta (BME+CBE), Grace VanOrman (BME+MECH), Kalley Harriss (BME+MECH)*

#### **Real-Time Augmented Reality Ultrasound Display System**

*Advisors: Tod Clapp, Chad Eitel, Jordan Nelson, Brendan Garbe, Stu Tobet*

*Diana Boll (BME+MECH), Benjamin Farkas (BME+CBE), Steven Hsu (BME+CBE), Janaye Matthews (BME+EE)*

If you are interested in learning more about these projects or the projects from all College of Engineering departments, please visit <https://www.engr.colostate.edu/current-students/engineering-days/#projects>.

The judges all enjoyed viewing the projects in advance of E-Days, as it provided a better introduction to the projects as well as the individual students. In future years, it is recommended that a hybrid approach be utilized to take advantage of judges near and far. The goal will be to have as many judges as possible face-to-face for questioning students, but also to have time for remote judges to participate. In addition, there should be a period after the initial evaluations for returning to the top contenders for more judges to see all the key top projects.

## **THE COMPANY WE KEEP**

Each semester, the School of Biomedical Engineering invites distinguished guests from around the world to speak on biomedical engineering research and related disciplines for its weekly seminar series. The Fall 2020 virtual speakers included:

### **UNIVERSITY OF VIRGINIA**

**Dr. Rebecca Pompano**

*Lighting up inflammation outside the body using chemistry and microfluidics*

### **STEADMAN CLINIC & STEADMAN PHILIPPON RESEARCH INSTITUTE**

**Dr. Chelsea S. Bahney**

*Engineering accelerated fracture healing: bench to bedside approaches*

### **UNIVERSITY OF DENVER**

**Dr. Paul Rullkoetter**

*Denver Center for Orthopaedic Biomechanics: Research Overview and Applications in Joint Replacement*

### **NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY**

**Dr. Yeoheung Yun**

*Engineering brain microphysiological system for recapitulating brain physiology and function*

## A Virtual Visit from Dr. Matthew McCullough of N.C. A&T

By Michael Benedict

Every semester, the SBME Seminar Series features a weekly speaker for the edification – and enjoyment! – of students, faculty, and friends of the program. Some are SBME graduate students sharing their work, some are SBME faculty catching us up on their research, and some are Distinguished Visiting Speakers from other institutions. In addition to the seminars themselves, these visitors also meet with CSU faculty and graduate students, exploring overlapping areas of interest, discussing their careers, and developing exciting new collaborations.

In recent years, SBME has featured several speakers from North Carolina A&T State University (N.C. A&T) – we hosted Dr. Narayan Bhattacharai in 2017 and Dr. Yeoheung Yun in 2020. N.C. A&T is “the largest historically black university in the country, the #1 producer of degrees awarded to African Americans in North Carolina, and nationally recognized for [their] excellence in science, technology, mathematics and engineering (STEM) education.”<sup>1</sup> Bonds with N.C. A&T are developing at the level of the Walter Scott, Jr. College of Engineering as well. They started with relationships nurtured by Dr. Melissa Burt (the Assistant Dean for Diversity and Inclusion) as part of her Atmospheric Science REU, continued via research and education collaborations with ATMOS faculty, and have since expanded to the level of the college – including SBME.



Dr. Matthew McCullough

On April 5, SBME hosted our latest speaker and “virtual visitor” from N.C. A&T: Dr. Matthew McCullough, who gave a seminar titled “Improving degradable orthopaedic devices using finite element analysis.” I recently had the chance to ask Dr. McCullough about his career. He explained, “I was drawn to [biomedical engineering] because of the impact I could have on people's lives. I have always been drawn to serving others.” He considered attending medical school, and was also developing a fascination with computers and electromechanical toys. With some guidance from family, Dr. McCullough came to the obvious solution: “I was blessed to later learn of biomedical engineering, which combined medicine and engineering in a way that could have a tremendous impact on people's lives.”

Dr. McCullough's relationship with N.C. A&T is long and ongoing. Years before his professorship, he was a student there, earning a B.S. in Industrial and System Engineering. After earning his Ph.D. in Biomedical Engineering at the University of Iowa, he was drawn to N.C. A&T again: “The same spirit that drew me as a student, one of community and support, still exists today.” What's a favorite part of teaching and researching at his alma mater? Dr. McCullough says it's the students: “On class projects and research, the students are a joy to be around... they bring energy, fresh insights and a strong sense of community.”

Dr. McCullough also had good advice for SBME students and others who are starting out in their careers: “Continue to refine your mentor group and your network. This could mean expanding both, as you move into a new city, technical area, or even life stage.” Of course the pandemic has created a stressful historical moment, but Dr. McCullough reminds us that even in such times, we should “take the time to celebrate, especially if you're graduating... This is a wonderful time of transition.”

Conversations between SBME and N.C. A&T are ongoing, with exciting new ideas for collaboration being explored. Remember to keep an eye on the seminar calendar, too: the next N.C. A&T speaker will be coming soon enough, as our relationship with this venerable HBCU continues to grow.

1. About N.C. A&T: <https://www.ncat.edu/about/index.php>



## Blankenship Joins SBME Advisory Board



Over his 40-year career in the medical device industry, Larry Blankenship has served as a Director, CEO, President, COO and CTO of multiple start-up companies, and served as a product development executive for divisions of Eli Lilly, Pfizer, and the Battelle Memorial Institute.

Mr. Blankenship has led business planning, staffing, funding, design, development, approval, manufacturing, launch, and exits via acquisition. He is a medical device development specialist, including conception, design, qualification, production, and FDA and EU product approvals.

He has served as a founding member of the Colorado Blackstone Entrepreneurs Network ([www.BENColorado.com](http://www.BENColorado.com)), a Director of the Colorado Bioscience Association (CBSA, [www.cobioscience.com](http://www.cobioscience.com)) and founding chair of the constituency committee for the Bioengineering program at the University of Colorado, Anschutz Medical Campus. Mr. Blankenship is constantly seeking opportunities to bring meaningful healthcare and wellness services and products to the patients and caregivers who need them.

Mr. Blankenship is a graduate of the College of Engineering at Arizona State University, holds numerous U.S. and foreign patents, and is a decorated veteran of the United States Submarine Service.

## SBME Student is Overall Winner of 2021 MURALS Symposium



This year's MURALS Symposium at Colorado State University spotlighted outstanding work among students across the university, with the top award-winning project providing an examination of the health disparities among racial groups in the United States.

More than 75 undergraduates participated in MURALS — Multicultural Undergraduate Research, Art and Leadership — in a virtual showcase March 25-26. As in previous years, the signature event highlighted student work in social sciences, humanities, STEM, creative arts, and service learning and leadership.

This year's event marked the sixth time CSU has hosted the MURALS Symposium. The event is designed to celebrate the academic success of students of color and expose them to undergraduate research opportunities and other scholarly endeavors.

Janaye Matthews, a senior biomedical engineering and electrical engineering student in the Walter Scott, Jr. College of Engineering, was the overall winner and received a \$1,000 prize.

Matthews' project spotlighted the widespread health disparities of racial groups in the U.S. amidst the COVID-19 pandemic. The project allowed for personal exploration around health inequities, while also following the resurgence of the conversation around reparations for Black Americans.

"I'm really humbled by this honor," Matthews said. "In all honesty, I was completely surprised by it. Committing to MURALS this year was a bit of a personal push, and I wasn't really focused on the competition aspect. I'm kind of just a bit of a nerd who loves learning from others and seeing the world from my peers' perspectives."

Matthews added that she appreciated the collaborative environment of MURALS, which celebrated different forms of research and brought awareness to important issues.

Full Story: <https://source.colostate.edu/murals-symposium-winners-showcase-scholarly-creative-work/>

## SBME People in the News



### SBME student is 2021 Outstanding Graduate

By Russell Dickerson

Camille Milo graduated from CSU with degrees in both biomedical engineering and chemical and biological engineering. During her third year at CSU, Milo became a student ambassador, giving tours to prospective students, taking on social media duties, and participating in many of the college's recruitment videos. "She has the biggest heart, she excels in her work as an ambassador and an engineer," said Rachael Johnson, the college's manager of strategic recruitment.

<https://enr.source.colostate.edu/outstanding-grad-camille-milo-walter-scott-jr-college-of-engineering/>



### CSU secures \$3.1 million from NIH to advance SolaVAX coronavirus vaccine research

By Mary Guiden

Principal investigator and SBME Advisory Board member, Ray Goodrich, also the executive director of CSU IDRC, said the current work builds off his expertise using the UV light and riboflavin process to improve the safety of blood transfusion products.

<https://source.colostate.edu/csus-secures-3-1-million-from-nih-to-advance-solavax-coronavirus-vaccine-research/>



### CSU team receives \$1M grant to develop noninvasive biomedical imaging technologies

By Andrea Leland

SBME faculty member Randy Bartels of the Department of Electrical and Computer Engineering has received a \$1 million deep tissue imaging grant from the Chan Zuckerberg Initiative to develop new imaging technologies that could offer new capabilities for disease pathology and early disease diagnosis.

<https://enr.source.colostate.edu/csus-team-receives-1-million-grant-to-develop-noninvasive-biomedical-imaging-technologies/>



### Research that goes boom: CSU civil engineers test structures and tissues for blast impact

By Jayme DeLoss

SBME faculty member Hussam Mahmoud of the Department of Civil and Environmental Engineering set out to prove that low-cost, easily constructed blast barriers in regions of high risk could reduce injury and loss of life and published findings in three papers.

<https://enr.source.colostate.edu/research-that-goes-boom-csu-civil-engineers-test-structures-and-tissues-for-blast-impact/>



### New SBME faculty members

#### ELLEN BRENNAN-PIERCE

Laboratory Manager, Instructor, and Research Scientist

Ellen holds a B.S. in chemical engineering from Northeastern University and a Ph.D. in bioengineering from the University of Pittsburgh. Since 2013, she has served in many roles including laboratory manager, research scientist, program director of BME Summer Clinical Immersion at Medical Center of the Rockies, and instructor of BME Senior Capstone Design and the Prosthetic Innovation in Ecuador program.



#### SAM BECHARA

Associate Professor of Practice  
Department of Mechanical Engineering

Sam Bechara holds a B.S. in bioengineering from Washington State University and a Ph.D. in biomedical engineering from Colorado State University. He enjoys working with undergraduate students and is interested in engineering education research and effective teaching methods.

# SBME Alum Finds Engineering Background a Perfect Fit for Patent Law Career

By Katharyn Peterman



Sometimes the smallest actions can have an unexpectedly big impact.

For Kelly Scharlau, this small action was noticing a flyer advertising an upcoming course. The impact? Discovering a fulfilling career path.

The flyer advertised ENGR525: Intellectual Property and Invention Systems taught by Steve Simske, SBME Advisory Board member and professor in systems engineering with over 200 patents to his name.

“I really love to learn and have always been a strong technical writer. I was worried with a traditional engineering job I would get caught up in spreadsheets and numbers,” Scharlau said.

After taking Simske’s class, she thought differently. “I felt like I could apply what I know and learned in school, in tangible ways for inventors and solve problems.”

## Applying engineering skills to patent law

Scharlau graduated in May 2019 with a bachelor’s degree in chemical and biological engineering and a second bachelor’s in biomedical engineering. She now works as a registered patent agent for Dierker and Kavanaugh P.C., an intellectual property law firm located in Troy, Michigan.

“Serendipitously, my now-bosses emailed Simske and asked him if he knew anyone who was skilled in chemistry, who would be interested in working for a small, woman-owned firm,” Scharlau said. “I told him that would be my dream job, and the rest is history.”

After a year in the position, Scharlau passed the patent bar exam, allowing her to represent clients before the United States Patent and Trademark Office as a registered patent agent.

“The patent examination bar is open to most natural science and engineering fields,” Scharlau said. “You do not need a law degree or any background in law to sit for the exam.”

## Working with new technologies

A typical workday for Scharlau consists of drafting patent applications from invention disclosures or responding to arguments of patentability made by the US Patent and Trademark Office.

She also spends time doing background research to familiarize herself with the new technology and current state of the fields in which she works. Her specialties are biochemistry, chemistry, applied biosciences, materials, and related fields.

Because many of the technologies she works with are new and not easily found on Google, Scharlau relies heavily on the problem solving and research skills she learned as an engineering student.

“In engineering, there are almost always multiple ways to work a problem, and the answer is not usually very straightforward,” Scharlau said. “Being able to work through the nuance and approach a problem from different angles has been crucial for me to find the best ways to protect an inventor’s intellectual property.”

## Advice for engineering students entering industry

For students who are graduating soon, Scharlau suggests taking time to find a job that calls out to them and is something they will really enjoy doing, even if it doesn’t have “engineer” in the title.

“Be willing to find something you love to do, or something that combines your strengths, and make it work,” Scharlau said.

Scharlau’s journey is a perfect example of combining strengths to find the right job.

“I find my work to be extremely rewarding and challenging in the best way,” Scharlau said. “Engineers are particularly well suited for patent law because we are critical thinkers, integrate knowledge well, and can think of diverse answers and arguments that may not be apparent to others.”

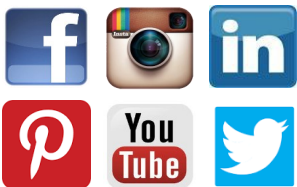


**SCHOOL OF BIOMEDICAL  
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### WHO?

We enable students and faculty of any discipline to use our lab to exercise their creative artistry and innovation spirit, and transform their ideas into things they can hold in their hand.

### WHERE?

You can find the lab in the basement of the Walter Scott Jr., College of Engineering building.

### WHEN?

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**FREE training is available!**

[www.idea2product.net](http://www.idea2product.net)

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Scholarship support at all levels provides critical aid to our students. We strive to help as many students as possible with the financial obligations of their engineering education.



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<https://advancing.colostate.edu/SBME>

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