



UC San Diego
Jacobs School of Engineering

BioEngineering Newsletter



**Fall
2019**

Introduction

Dear Readers,

During Thanksgiving, I was fortunate enough to be invited to a party hosted by Dr. Yingxiao (Peter) Wang. As in all Thanksgiving gatherings, a turkey was prepared as the main dish of the event. It was an enormous creature: 15 pounds in weight and large enough to feed dozens of hungry stomachs. How could one dissect such an impressive beast? We teamed up. After a postdoctoral researcher divided the turkey into different sections, several undergraduate students transferred each cut part into a dish. Our project scientist then chopped the meat into smaller portions so that each attendee could get a share of the turkey.

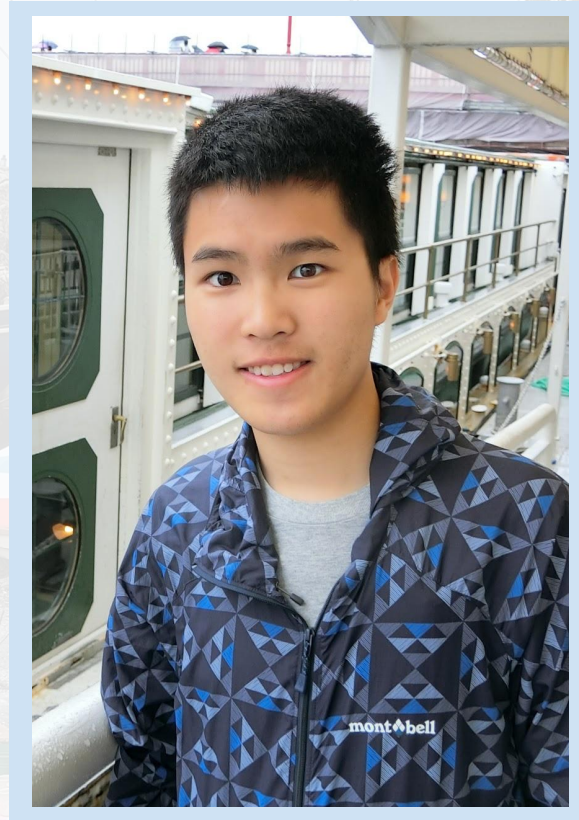
This amazing process reminds me of the collaborative nature of Bioengineering—people from different backgrounds working together to drive the continuous evolution in biomedical technologies. The fall issue of the Bioengineering Newsletter (BEN) celebrates the collaborative research community in UCSD, emphasizing the link between collaboration and research through the lenses of both students and professors.

Collaboration can come in many forms, and mentorship is one of them. This newsletter features postdoctoral researcher Dr. Ziliang (Adam) Huang and graduate student Erica Pursell, both my mentors in my undergraduate career. Through assisting them in their research, I not only learn about spectacular experimental techniques, but also develop a passion in solving biomedical problems.

Collaboration is perhaps best manifested through the prolific works of the bioengineering student organizations. As a new addition to our newsletter, the Student Organization Event section informs readers on the latest student-hosted events and expose students to academic and industrial opportunities.

As you read through this newsletter, I hope that you will gain an appreciation of the collaborative research endeavors in the bioengineering department, and be inspired to take advantage of the myriad opportunities offered by student organizations and the Bioengineering Department.

Happy New Year!
Chak Hang (Julian) Ho
Editor-in-Chief of the UCSD Bioengineering Newsletter (BEN)



The People of BEN

Every now and then, people are mesmerized by stories of novel drugs being synthesized, groundbreaking medical devices being invented, and pioneering research being published. Yet, the avant-gardes—bioengineers, scientists, students—behind the continuous revolution in medical technology are often overlooked. To most, bioengineering is a ray of white light. It certainly illuminates human society, but its very components—the assiduous engineers and the interactions across multiple academic disciplines that make innovations possible—are largely concealed from viewers. We at The UCSD Bioengineering Newsletter (BEN) strive to be a prism that refracts this singular white light into multiple colors, displaying not only the fruit of a research or the launch of a life-saving product, but also the motivations, aspirations, inspirations, hardships, and triumphs of current and future bioengineers.

By Chak Hang (Julian) Ho | Editor-in-Chief of BEN

Editor-in-Chief.....	Chak Hang (Julian) Ho
Deputy Editor-in-Chief.....	Ashwin Ganesh
Features.....	Chak Hang (Julian) Ho, Kevin Yu, Yichen (Jenny) Xiang
Interviews.....	Chak Hang (Julian) Ho, Ashwin Ganesh, Nicholas Sada
Student Spotlight	Chak Hang (Julian) Ho
BMES representative.....	Kevin Yu
ISPE representative.....	Asyria Holland, Seth Barragan
UBIC representative.....	Alexandria Tran
BEGS representative.....	Hao Mu
Editing.....	Rebecca Tsai, Allison Chen
Production.....	Chak Hang (Julian) Ho, Ashwin Ganesh, Rebecca Tsai, Allison Chen
Cover Page.....	Janet Wong
Photographer.....	Chak Hang (Julian) Ho

The UCSD Bioengineering Newsletter (BEN) is a student run publication that covers the people, the research and the events that occur within the U.C. San Diego Bioengineering Department. For Fall 2019, we decided to examine link between collaboration and research through the lenses of both students and professors.

CONTENTS

- ❖ Introduction
- ❖ Features
 - Bioengineering Day 2019.....Chak Hang (Julian) Ho, Kevin Yu
 - BENG 87 Freshman Seminar.....Yichen (Jenny) Xiang
- ❖ Interviews
 - Dr. David Gough.....Ashwin Ganesh
 - Dr. Nathan Lewis.....Nicholas Sada
 - Dr. Ziliang (Adam) Huang.....Chak Hang (Julian) Ho
- ❖ Student Spotlight
 - Erica Pursell.....Chak Hang (Julian) Ho
- ❖ Student Organization Event
 - Light the Night.....Kevin Yu
 - Illumina Industry Tour.....Asyria Holland, Seth Barragan
 - Chalk Talk by Dr. Lukas Chavez.....Alexandria Tran
 - Bioengineering Graduate InitiativeHao Mu

Features



Bioengineering Day 2019

Bridging Academia and Industry

By Chak Hang (Julian) Ho | Editor-in-Chief
Kevin Yu | Features Writer



Bioengineering Day is an annual event that celebrates students' research endeavors, highlights the faculty's contribution to the bioengineering community, and connects the academia with industry. Bioengineering Day 2019 took place in the Telemedicine Building on April 26th and was hosted by the Biomedical Engineering Society (BMES), the International Society for Pharmaceutical Engineering (ISPE), and the UCSD Bioengineering Department.

Morning Session

The extravaganza commenced with a welcoming ceremony, during which the former department chair Dr. Geert Schmid-Schoenbein enumerated students' achievements in research, community service, and national competitions. Furthermore, Dr. Schoenbein also greeted industrial members attending the event and praised the increasing bond between the research community and biotechnology companies.

After the opening ceremony, Dr. Mark Saltzman delivered the keynote speech, recounting his initial exposure to Bioengineering and outlining

his research focus. Dr. Saltzman is the current department chair of Biomedical Engineering and a professor of Cellular and Molecular Physiology and Chemical Engineering at Yale University. He specializes in the construction of polymer nanoparticles and their applications in drug delivery, gene editing, and sunblock. In addition, Dr. Saltzman is also the founder of Nanosive and Stradefy, and the Scientific Advisory Board member of TruCode. That Dr. Saltzman is involved in both academia and industry illustrates one of the key features of Bioengineering—research and commercialization do not exist as independent spheres; rather, mutual interactions between the two fields lead to evolution in biomedical technologies and propagate the translation from research to healthcare products.

The morning session of Bioengineering Day concluded with a networking lunch, creating a valuable opportunity for industrial representatives, professors, researchers, and students to engage in professional discourse.

Afternoon Session

As the event began to meet the midday sun, the event's focus shifted from academia to industry and student organizations—groups seeking to make an impact on the world and searching for prospective new talent to help them do it. A number of student organizations and companies presented their technologies to the attendees of Bioengineering Day, demonstrating what is currently on the horizon for the field and the possibilities that may be realized in the future.

Among the companies that presented, Wearable Sensing is a company focusing on dry electroencephalography (EEG) technology. They aim to apply clever design to interpret the electrical signals of the brain and integrate that design with other devices in a manner that is convenient for the user. Traditional EEG methods involve shaving an individual's head to apply wet electrodes onto the scalp beneath, or require large, expensive machines and procedures (as in the case of fMRI and PET technology) to obtain a clear picture of what is going on within the brain. Neither of these is practical for daily use by an average consumer, prompting research into dry EEG technology.

However, in the effort to read signals from the human brain in a convenient manner, dry EEG sensing encounters its own obstacles, one of which is the static electricity present in hair and the environment. This electricity interferes with dry EEG electrodes, resulting in “noise” that obfuscates an otherwise-clear signal. Wearable Sensing's solution to this issue is to use small Faraday cages to reduce the effect of this “noise”



on the electrodes, resulting in clear signals that can rival that of conventional wet EEG electrodes. With some refinement, their dry EEG devices may soon be sold for academic, government, or even commercial use. And in the future, there may even be a market for devices controlled by the human mind—just put on a helmet and think away!

Though student organizations lack the resources to rival their industry counterparts, it is a humble goal that has led Triton Prosthetics to make an impact in their own way. Through fabricating low-cost prosthetics for impoverished families, Triton Prosthetics doesn't aim to cause a revolution, but rather works to cause change on a local scale by

helping those unable to afford top-end manufactured limbs. Notably, the low cost of their prosthetics comes with the consequence of reduced complexity and features; Triton Prosthetics' arm produced for their 2019 project is entirely mechanical in nature. The closing and opening of its fingers and thumb are driven by the movement of the individual's hand, and there is no ability to rotate the wrist or move fingers individually. Still, for those in need, obtaining a surrogate arm for little or no cost is a dream come true, and Triton Prosthetics' aim is to realize these dreams. In the future, the organization aims to expand the range of prosthetics they offer, including motorized components for individual finger actuation, and improved methods for the user to control their prosthetic limb.

Finally, to top off Bioengineering Day 2019, the final round of BMES annual Quizbowl brought attendees in to watch the competition between the finalist team and a panel of graduate students who challenged them. Rounds in Quiz-bowl are run in a "steal-the-bacon" style format: a question is asked, and the team that first answers this initial question correctly proceeds to answer three more questions for additional points that the second team cannot unless the first team gets them wrong. The questions themselves are college-level in difficulty and sourced from a wide range of science and engineering subjects.

Consisting of a group of second-year undergraduates, the promising finalist team gave a good fight at the beginning of the round, obtaining a 40-point lead above the graduates. But, as the questions got more difficult, the tide turned in favor of the graduate students, culminating in a landslide victory in favor of the graduate students. While many at the event had expected this result, the spirit of friendly competition and the eager whispers of attendees as they discussed the questions alongside the competing teams hung in the air, creating a unique atmosphere of casual intellect between students aspiring to be engineers and researchers. This atmosphere is perhaps why many were drawn to Quizbowl in the first place and served as a strong sendoff to conclude Bioengineering Day 2019.



Photos courtesy of the Biomedical Engineering Society (BMES)

BENG 87 Freshman Seminar

Inspirational Introduction to Your Field of Interest

By Yichen (Jenny) Xiang | Features Writer

Students in UCSD's Bioengineering department may have heard about BENG 87, a one unit P/NP freshman seminar course offered by the Bioengineering department each quarter with a variety of topics. However, not many students, especially newly admitted students, actually understand what this course is about.

Indeed, as the department recommended, a freshman seminar course provides valuable opportunities to explore your specific field of interest, to know your professor, and to develop practical skills.

Currently Offered BENG 87 Topics

Fall 2019:
Engineering the Heart

Winter 2020:
Medical Technology and
the Public

the Public

The following is an interview with Professor Jeff Omens. Prof. Omens' research interest includes topics in cardiology, cardiac mechanics, cardiac physiology and disease, and using animal/computer models and human data to study the function of heart and heart disease.

As a well-respected professor, he has taught the bioengineering lab class BENG 172 for a long time (more than 20 years!), biomechanics, bioinstrumentation, and the Freshman Seminar BENG 87. Prof. Omens has been teaching BENG 87 for years and is eager to provide some valuable insight about this course, in a Q&A format, for interested students in the Bioengineering department.

What BENG 87(s) are you teaching? What is the purpose of your BENG 87(s)?

I am teaching two BENG 87 classes, one in the fall which I teach with professor Andrew McCulloch, and we've taught that one for a long time. It is an introduction to applications of engineering of the heart, a general introduction to the heart and its physiology, and computer models apply to the heart.

The purpose of this class is to get people interested in basic research, so it has no homework and grading is based solely on attendance. We give a couple of introductory lectures, after which students and postdocs in our group give seminar topics that are based on

their research. Topics include electrophysiology, biomechanics imaging, and tissue engineering and various things people do in our lab group. Another BENG 87 that I have taught for 3 years is in spring, which is interesting for students to learn some of the more technical engineering that are used in bioengineering, including instrumentation and computer software people use to receive data from those instruments. We build a little amplifier circuit and talk a little about the design process, adding some computer acquisition which helps one make cardiograms and play with them. It's all just an introductory class but if people like

it, they can have fun with it. There are some useful assignments that people can spend class time to work on.

What is your favorite BENG 87?

I like the instrumentation one more, because I have always had an interest in the bioinstrumentation, and we always go to the lab to explore all the instrumentation. Most students are not even in bioengineering major, but people are just genuinely interested in such topics and lack the opportunity otherwise to explore such topics.

Can sophomore students enroll in freshman seminars?

Supposedly freshman seminars are for freshmen, and this class is limited to 20 people. But when the class is not completely full, the university will open the class to sophomores and may let them take it if they submit the petition. Instructors need a minimum number in the class to obtain some financial support from the department.

Do you think BENG 87 can help prospective students to get an overview of the department?

I would think that if you went to one of my freshman seminars, you will get a limited overview of something that has to do with bioengineering. That would be okay but it wouldn't really tell you if bioengineering is for your career. If you went to my bioinstrumentation course for one quarter and you might think it is the greatest thing

ever, but you will be taking all other classes and your career may have nothing to do with this kind of stuff.

Our bioengineering department originally came from applied mechanics and the focus is less on bioinstrumentation comparing to other universities. Beng 1 is probably better than a freshman seminar for prospective students, and as a student you will be better off to talk with professors and postdoc in the department and ask them what is their career and can they do after getting their degree.

What are some of the changes you expect in the feature BENG 87 classes?

Freshman seminar starts by faculties because they believed in education and want to help young people to figure out what certain majors and disciplines are about. They are going to be something that the faculty is interested in like I am teaching bioinstrumentation because I am interested in it and am able to fix that equipment. I don't see the topics really changing unless the university policy changes because the faculties teaching them are usually the same. We have always done the same freshman seminars.

The fall one has been very similar over the years. The individual research topics can vary because they are given by people in our labs, some students graduated. Professor McCulloch and I give some lectures, I always teach the overview of the heart and physiology, and he does an overview of computer modeling. The six or seven other talks given by presenters are all very current and cutting-edge research.

Interviews



Dr. David Gough

Sensors for Anyone and Everyone

By Ashwin Ganesh | Interview Writer



Q: What kinds of research do you do in your lab?

A: I have three research projects in my lab. One is signal analysis of implantable glucose sensors. This has to do with the clinical trials that are underway with these sensors and the data that must be analyzed from these trials. It involves a lot of computing.

The second project, which has been underway for quite some time, is a polymer that has been developed for people who have been diagnosed with hepatitis C. This is a polyglutamic acid molecule with silencing RNAs attached to it that silence collagen attached to it in the liver. The purpose is to block the formation of collagen, the development of cirrhosis, and the general deterioration of the liver during hepatitis C. Both of these projects are currently in clinical trials.

The third project involves transcranial electromagnetic stimulation of the brain. It is

based on a concept where you apply electromagnetic coils to various locations in the brain and creates a high current pulse which decays and leads to a magnetic field change.

This technology is pretty widely used in depression, autism, and various other mental disorders. It is not well-understood and not highly reproducible. It is a collaboration with local clinicians who are trying to use it reliably for a variety of problems.

Q: What got you first interested in biosensors?

A: I have worked in biosensors for over 40 years now. When I finished my PhD in the mid-70s, I went to the Joslin Clinic at Harvard for my postdoctoral position. My mentor there was named George Cahill and is a famous diabetologist. He suggested this implantable biosensor idea for diabetics.

Q: In the implantable biosensor project, what kinds of things do you look for?

The main thing we look for in this sensor is glucose concentration. Diabetics need to monitor their glucose concentration to administer insulin. Specifically, this is for type 1 diabetes. Insulin is an essential injectable molecule. Their pancreas is not making insulin so they need to replace this through injection. The amount and timing of the injection depend on the amount of glucose they have onboard. It needs to be managed all day long by people with diabetes. Most people with type 1 diabetes do something called finger sticking.

They lance their fingers and get a droplet of blood. They put this in a machine and get a concentration. There is a big need for continuous monitoring and it has been there since the 70s. This would allow people to automatically know when to adjust when it is too low and too high. This is a problem as the target population can be a four-year-old child. You would like a device that would allow them to adjust their insulin. We have tried various methods over the years and we have one that works pretty well and is being tested in humans as we speak.

Q: For your research in transcranial electromagnetic stimulation, what kinds of things do you look for in someone who has a mental disorder like autism? How does their signal differ from a normal human?

The theory is that this whole process involves redirecting electric activity in parts of the brain that are not functioning properly. For example, people with PTSD who were in a war zone may have cracks in their brains. If you do this correctly, you can pattern the electrical activity around this region. For autistic children, there are not too many ways to treat them. We don't fully understand the mechanism behind this. We need to do this reliably as for some children, we can do this reliably, but for some, we cannot do this at all. It is being tested now in opioid use disorder. Opioid users are in the withdrawal process and we are looking into how this can be applied in the withdrawal process. It works for people who want to leave but not for people who do not. That is being tested here in San Diego as a collaboration with the psychology department.

Q: What advice would you have for an undergraduate who is interested in biosensors?

A: Undergraduates in my lab mainly work in signal analysis. They look at the data from clinical trial patients and analyze that. A lot of computing is required. We used to do a lot of wet chemistry in the lab but now we have passed it on to a company I helped found nearby. They build implantable sensors using FDA standards. They are left in the body for a year and send a signal out every three seconds to a receiver (which can be a watch or a phone). We have clinical trials in Australia and we get data and analyze this and optimize the accuracy. Some of the material undergraduates learn in their courses is useful. For example, Digital Signal Processing, column filtering, signal modelling, and other computing techniques are necessary.

Q: What advice would you give to a student who wished to go into the startup field?

A: That is something we would like to encourage. There are so many opportunities in the biomedical world. We encourage students to find out about those things. Starting a company is a fairly easy thing to do once you have a good idea and this can ultimately lead to products that solve clinical problems. This material is largely taught in the senior design class as they focus on a certain medical project of some kind. Students must analyze background literature and learn about intellectual property and the FDA. That is a good launching point for starting a company. A lot of students in senior year will be going into industry soon and may want to start their own companies.

Dr. Nathan Lewis

Pediatrics and Bioengineering

By Nicholas Sada | Interview Writer

Q: What do you do as an associate professor? What's the focus of your research?

A: The focus of my research is really two different thrusts. I'm in the departments of Pediatrics and Bioengineering, and that gives me a unique view of research. We look at a few different things such as pediatric diseases and other diseases and think about how we can use big data analytics and systems biology to solve problems in those. The two major areas that we focus on are diagnostics and engineering better therapeutics. For the diagnostics part, a lot of diseases and disorders are highly complex. Single gene diseases are quite rare, so we must use algorithms to integrate signals from different molecules to diagnose diseases. For example, a portion of my lab focuses on Autism. To investigate the development of this disorder, we have to develop diagnostics and leverage various associated signals or cues. The general idea is taking different molecules, figuring out how they're connected together, and using that connectivity to make predictors of complex diseases.

The other part of my lab is trying to make better therapeutics. If you look at the top fifteen drugs by sales last year, eleven of them were not small molecules; they were proteins. You have to have some living organisms to make proteins; unfortunately due to the complexity of some of these organic molecules, we have to employ mammalian cells as factories of production.



We grow a lot of mammalian cells in a vat and induce them to produce large quantities of drugs. What we've been trying to do in my lab is to figure out how to turn these cells into not just the host for producing drugs but an engineerable system. To engineer a system, you have to have a list of parts, a wiring diagram, and the tools for engineering it. To improve the quality and quantity of the drugs, we map out the parts list, sequence the genome, and continuously improve the genome annotations. Then we map out the wiring diagram: what are all the pathways in the cell that are important for cell growth and the production of drugs? They are metabolism, secretory pathways and other pathways essential for cell growth and proliferation. We've been able to map out all

those pathways, enabling us to develop algorithms to develop ways to engineer cells to produce more drugs, or drugs with certain attributes. We can also go back and overlay data and determine the reason behind some cells' ability to produce drugs efficiently. To engineer a system, not only do you need the parts list and the wiring diagram, but you also have to have tools to edit it. We have developed and employed genome editing technologies to engineer these cells.

So that gives you a general idea of the two major areas: systems-level diagnostics and then engineering mammalian cell factories for recombinant protein drugs.

Q: What innovations or implications could result from your research?

A: On the base of the diagnostic, there are two major things. One of them is being able to diagnose a complex childhood disorder before a psychologist could. And we've already been able to start doing that. We just published a paper on neuroscience that demonstrated that if you take blood from a child who's one to two years old, we can predict whether or not that child will be diagnosed with autism a few years later and its severity. This is a really powerful technology. It still has some work that needs to be done. It doesn't diagnose all the children correctly, but it is a very strong current. On top of that, we've been able to demonstrate that we can, knowing the relevant pathways,

track the perturbed activity of that pathway while the brain is developing, which in turn provides a deeper understanding of this disorder. So that's on the diagnostics side. Now, going to the other side where we're engineering better cells, if we keep engineering these cells, we can start to gain much better control over the quality and quantity of drugs, enabling us to drive down the costs of these drugs. Most drugs are very expensive and there are even some that we can't make because they don't express enough to be economically viable; we want to see if we can make them economically viable by driving down the cost of production.

Q: What do you think the next big thing in Bioengineering will be?

A: So you're asking about where it's going to go, I think over the coming years we'll see some major innovations in Biotech that will change the way we handle pharmaceuticals. We may see a decrease in antibiotics and an increase in the use of phages. We may actually be treating diseases with engineered microbes, such as Crohn's disease. I think that engineered cells in one way or another will become major vehicles for drug production. Furthermore, people are using cells as anti-cancer therapies where you can reprogram your T-cells to go into your blood to

seek and destroy cancers. It's working and people are doing it, it's just really expensive right now, costing millions of dollars for treatment. I think we will see the price go down with a lot of technologies and innovations. And that's one of the exciting things about Bioengineering: you have the right skill set to make the engineering innovations to bring down the costs.

Q: Do you see any ethical concerns as the field of Bioengineering develops?

A: As with any technology, yes. It's not just Bioengineering; Computer Science with the whole AI thing has a whole range of ethical concerns to worry about, Bioengineering is no different. Realizing that every technology we develop has its positives and its negatives, and being able to balance that, we can put the safeties in to safeguard against the negatives. It's something that needs to be done. Bioethicists discussing at each stage and government agencies regulating the pathway forward to make sure that things are done safely and responsibly. As we speak, genome editing, human genome editing, and engineering plants and microbes are going into the world; are they going to have a negative impact on the eco-systems? How can we build in safeties?

Q: How do you think biomedical innovations affect the world in a socioeconomic context?

A: Well there can be a lot of benefits. If we can engineer, for example, cultured meats or meat substitutes, then suddenly we put a much

lower demand for water and land usage for animals and so fewer resources are necessary to maintain the population. There'll be less damage to the environment. So these are some things that Biotech can make major advances towards benefitting. Furthermore, if we can figure out how to use these big data analytics to understand mental health issues, we can ease the suffering of many people. These are but a few ways that it can impact and improve the well being of people.

Q: How do you factor in the epigenetic factors or genetic variations that can affect the way you model the metabolic network?

A: That's a tough one. We don't fully understand everything that's being done in this field. One thing we have done in the past in my lab was to take transgenomic data (which is kind of like a measure of the epigenetic state, rather than the gene expression state) and overlay it onto all possible metabolic pathways. We then tailor it down to what is active in that one single state. Another way to factor in epigenetics is to build logical models that control the metabolic network and tailor it to specific states.

Dr. Ziliang (Adam) Huang

From CAR-T cells to Mentorship

By Chak Hang (Julian) Ho | Editor-in-Chief

Bio: Dr. Huang obtained his PhD in Chemical Engineering at Tsinghua University. As a postdoctoral researcher in Wang's Lab, he is working on molecular engineering, protein engineering, FRET imaging, and engineering multi-functional molecular machines in cells.

Q: What is your current research topic? What motivates you to work on this topic?

A: My current research focuses on the development of new technologies based on optogenetic tools to address the adverse effects in current cell-based immunotherapy.

Our lab has developed a blue light-controllable gene expression system for chimeric antigen receptor T (CAR-T) cells, with which we can specifically activate the CAR-T cells only at the desired tumor region with very high resolution. This technology greatly reduces the health risks of on-target off-tumor cytotoxicity and cytokine release syndrome, which are common side effects of current CAR-T therapy.

I find my research particularly fascinating because it involves a multi-disciplinary approach to solving medical problems. Specifically, I use my knowledge and expertise in different fields of science and technology--molecular engineering, optogenetics and immunotherapy--to derive novel solutions for advancing the efficacy of immunotherapy.

Q: How does working as a postdoctoral researcher differ from being an undergraduate or graduate student?



Quite different. Working as a postdoctoral researcher means that you already received all the training for a PhD, so you have the ability and experience to solve a specific problem logically and independently. And you can develop semi-independent projects with the guidance of the PI with your own strength in science. Experiment-wise, what you do in the lab as a postdoc may seem very similar to what you do as a graduate student, but you need to consider more things. You need to have an overall big picture of the work, and be clear about the meaning of each step under this whole framework. You need to keep thinking whether your plan is reasonable and logical. Besides, you also need to keep track of the recently published papers related to your current research and keep your mind open to new methods or opportunities.

Q: Mentorship is crucial in any field of study. Can you describe one mentor who inspires you along your career path?

A: Absolutely. Professor Yingxiao (Peter) Wang is my postdoc advisor and we have worked together for a number of years. He always demonstrates to our lab members that to accomplish a goal you have to be ambitious and to keep thinking in a creative way, which benefits me a lot when I was considering my career path at the beginning of my postdoc training and when I encountered difficulties in research. His passion for science also inspires me along my career path as a researcher. "Professor is the best job", he always says, because you can choose your most fascinating topics to study and provide answers and solutions to the problems where you will feel the most sense of accomplishment. All these inspired my confidence in choosing scientific research as my career.

Q: What do you think are necessary components of being an engineer?

A: The passion: Being an engineer means that you first need to have a passion for making changes to the current world. The view: You need to identify where changes are needed and picture what kind of changes can be beneficial. The skill: You have to deeply master the engineering skill sets and knowledge in your field during your training. You also need to quickly pick up new skills whenever needed.

Q: Where do you see bioengineering heading in the future?

A: Bioengineering is a dynamic field with endless possibilities. But I can imagine that bioengineering will become more involved with artificial intelligence and computer science. In the immunotherapy field that I am currently working, the trend is to have more and more control over these cell-based therapeutics and to make their behaviors more predictable after infusion into patients. Perhaps one day we could have fully synthetic and controllable cells as therapeutics of which the sequence can be designed through artificial intelligence based on the health information of each individual and their needs.

Student Spotlight



Erica Pursell

Investigating Pulmonary Arterial Hypertension

By Chak Hang (Julian) Ho | Editor-in-Chief

Bio: Erica Pursell attended the University of Arizona where she obtained her bachelor's degrees in biomedical engineering and applied mathematics with a minor in mechanical engineering. She then began her graduate studies with Dr. Valdez-Jasso at the University of Illinois at Chicago. Before transferring to UCSD to continue studying with Dr. Valdez-Jasso, Erica obtained her Master's degree in Bioengineering. Her current research aims to determine the relationship between mechanical and structural changes of pulmonary arteries in pulmonary arterial hypertension.

Q: What is your current research topic? What motivates you to work on this topic?

My current research topic is the biomechanics of pulmonary arterial hypertension. I've always had the drive to help others and found that biomechanics allowed me to apply my love of mathematics to real-world health problems.

Q: Have you encountered any challenges in your research? How do you solve these challenges?

There have been many challenges such as how to come up with a new protocol (harvesting vessels from rat lungs) and fitting mathematical equations to data sets. The way I work through new protocols is by reading relevant papers and through trial and error. In general, it helps to go through literature and network with others who have more experience.



Q: Mentorship is crucial in any field of study. Who inspires you to partake in bioengineering?

I've had many mentors over the years. Many of the teachers I have had impacted my decision to pursue bioengineering, but I think those with the highest impact were my high school biology and mathematics teachers.

Q: As a mentor to other students working in Valdez-Jasso's lab, what strategies do you employ to effectively communicate with your mentees (undergrad in your lab)?

Repeated messages. I try to email and if I do not get a response when one is needed, message again. I also try to use words that convey when something is urgent such as "this needs to be done ASAP" or tell students when something must be done by.

I also encourage them to let me know if they have questions or need help. If they are doing something I have worked with before, I will show them what I have done in case they can find improvements.

Q: Women are historically underrepresented in engineering. Have you faced any challenges pertinent to gender?

I feel that I have been fortunate in that my parents and teachers have always encouraged me to pursue what interests me. I also ended up in great universities with faculty that did not directly discriminate against female students, at least that I noticed - in fact, there are programs in place to help minorities pursue higher education in the STEM fields. However, I have heard stories from others who were discriminated against in some way - so I am aware that this is still an issue, even though I haven't experienced it first hand.

Q: What advice would you give to undergraduate students who wish to work in a lab but don't know where to start?

Do some research: look at the faculty list online and visit the research web pages of various faculty. If what you read sounds interesting, look up a couple of papers by that individual. If you're still interested, reach out to someone in the lab. You can contact graduate students to make sure that the research you are interested in is still being conducted (sometimes the websites are not up to date) or even contact the professor, asking to meet and talk about how the work they do interests you and see if you can get involved in their work.

Student Organization Events



Light the Night 2019

Biomedical Engineering Society (BMES)

By Kevin Yu | BMES representative



Cancer is a disease simultaneously at both the forefront and rear of medical understanding. While being known and studied for decades, progress towards cures remains a moving target. In fact, because of this, cancer seems to garner an almost otherworldly reputation. The vast variety of cancers, costly treatment methods, and seemingly intangible nature mean that a diagnosis can often feel like a time limit on one's life — that they are facing an invisible and insurmountable enemy, exceeding the remarkable advancements made in modern medicine.

The Leukemia and Lymphoma Society (LLS) seeks to challenge and change the outlook on their name-designated types of cancer. Through their work, over \$1.3 billion has been donated towards blood cancer research — vital efforts towards finding a cure for a disease that was once completely lethal.

Their annual event, Light the Night, drives these efforts. Hosted this year at San Diego's

Waterfront Park on November 2, 2019, the event drew a crowd of hundreds in solidarity against leukemia, lymphoma, and other kinds of blood cancers. Attendees enjoyed festivities such as photo booths, live music, and food in a fair-like fashion. Later in the evening, after sunset, both individual donors, as well as teams that have donated a significant amount to LLS, circled the block in unison, carrying lit balloon-shaped lanterns as they walked — displaying a potent message through this simultaneous action of hundreds.

Being both a volunteer at the event and a student interested in seeing the impact of biomedical research, I was naturally inclined to learn more about the event. I was curious to see what drew such a wide variety of people there, and what Light the Night meant to them all.

The immediate visual that struck me was the union of three colors, represented in those balloon-lanterns that attendees carried with

them. White, the rarest, represented survivors — those who have fallen ill to some kind of blood cancer and are still fighting or have achieved remission. Yellow represented remembrance — those who have lost relatives or loved ones to blood cancer and wish to show their support for those still fighting. Finally, red, the most common, represented those in support of LLS and cancer research efforts. Through the unison of these colors, I could immediately see that the intangible, fearful nature of cancer is something that affects people equally, regardless of each person's individual background.

I spoke with some of those carrying white balloons — the survivors, though they all seemed to be thriving in the midst of the festivities. I wanted to hear their stories, what Light the Night meant to them, despite what they'd been through.

One woman, carrying the baldness of chemotherapy but an energetic fire in her eyes, mentioned Light the Night as a milestone — a celebration of her journey thus far, and an opportunity to look forward towards the future.

Another man, rough-shaven but hardy-looking, mentioned a desire to spread awareness of blood-related cancers, especially in the face of other cancer types such as breast and lung cancer, which receive far more funding for research. The woman he was with told me about her own family's experience with cancer: her mother, aunt, and uncle had all died in various forms, and she was determined to raise awareness so that people like her own family wouldn't be forgotten.

Finally, another man I spoke with, a grey-haired scientist-turned-patient, mentioned his own story as one of coming full circle. He had once studied oncology and was passionate about his work, but ended up falling victim to the very illness he must've once been determined to make an impact against. As ironic as it was mortifying, he knew that events like Light the Night were necessary for raising awareness and funds towards research, and made these facts rather clear to me. It was almost as if he was talking to me on a more meaningful level; as both a volunteer and as a student.



As a student. That's what I was missing. Though I wore the word "volunteer" on my shirt, I was still first and foremost a bioengineering major. Despite the irony of a researcher falling to the illness he'd studied, there were others who'd take the mantle he'd been forced to leave behind. Today's students, and tomorrow's researchers, who'd bring the hopes of so many of these attendees to light.

I spoke with my pseudo-supervisor, Amador Lagunas. BMES normally provides plenty of volunteers for Light the Night, and as one of the BMES Outreach Committee co-chairs, he'd been the one to file paperwork and arrange the transportation needed to carry the many student volunteers like me over there. He said that what Light the Night meant to him, and what he believed drew many of the volunteers there, was the sense of community, and contributing as a part of a greater whole. Even if we're students, he said, the willingness to help out and be involved in a community of those impacted by cancer is meaningful in itself.

I'd say I'm inclined to agree. Seeing the many multicolored balloons from the perspective of a volunteer, I saw a group of people that we were fixing up an event for. But taking a step back, and seeing them as a bioengineering student, I saw a community of people whose lives were directly impacted by the work that bioengineering researchers and companies do. These are people whose lives could be changed for the better by students like me, and the other volunteers, who'd end up being part of the community on display at Light the Night.

And inevitably, the community's hopes are on us, the students. As future problem-solvers – engineers, scientists, researchers, technicians – our work will be necessary to bring that hope to reality. Or, in other words: we light the night, to give them the kinds of changes I'd taken for granted until then.

Illumina Industry Tour

International Society for Pharmaceutical Engineering

By Asyria Holland, Seth Barragan | ISPE Representatives



Every undergraduate is all too familiar with pondering what it might be like to work in the industry or the professional research world. Aside from actually landing that vaunted internship or research position, few things fulfill this knowledge gap. Additionally, taking on either of these roles is a huge commitment, if an undergraduate can even get accepted in the first place. This is why as one of the student board members of ISPE (International Society for Pharmaceutical Engineering) I was proud to co-host an Illumina Tour with Illumina representatives during the Spring 2019 quarter.

During the evening of the tour, Illumina representatives guided us from the main lobby to the workrooms where they conduct scientific strategy. Throughout the tour, they continually explained how the campus architecture optimized and minimized the proximity between scientific and business sectors. As an undergraduate learning the importance of entire team integration in the modern world, I appreciated seeing this effort in action. The organization of indoor workspaces continued this competitively modern mindset to allow seamless communication between teams as well.

We then took a trip to the general wet labs of the campus, peering past large gallery-style windows and observing the analytical research conducted within. Even though analytical labs are a common feature across the biotech industry, it was immediately apparent that the technology, as well as the personnel operating these instruments at Illumina, were strides ahead of the pack. Some of the more notable features included robotic liquid handlers, data science workstations -- only the most modern equipment. Our tour towards the lower levels of the facility revealed labs even less familiar to our understanding, where the intensive genomic research and technology that Illumina is known for takes place. Representatives explained the equipment required by Illumina's operations to process the sheer volume of data at high accuracy.

Eventually, the representatives brought us to a sort of showroom where several of Illumina's products (sequencers, liquid handlers, etc.) were located. A few Illumina experts even joined in to explain to us the technology and operations involved. Wherein this was supposed to be at most a 20 min culmination of the tour, these professionals eagerly took the time to answer every question, ending beyond an hour. These elaborations included guiding physical molecular models of reagent products, opening up the equipment to view, and allowing students to operate the million-dollar NovaSeq 6000 sequencer in a guided hands-on demonstration.

However, the truly invaluable experience was actually seeing teams operate through the large glass observation panes. These visuals are not available anywhere else and enabled us to better consider ourselves in those positions. When it comes to high-quality internships, Illumina is a long-time partner with not just ISPE, but the entire UCSD community as well. These highly-regarded positions are known to range not just within STEM but also amongst business and marketing sectors as well. Regardless of whether students actually get that opportunity, taking a campus tour was irreplaceable in guiding our career choices.



Chalk Talk by Dr. Lukas Chavez

Undergraduate Bioinformatics Club

By Alexandria Tran | UBIC representative

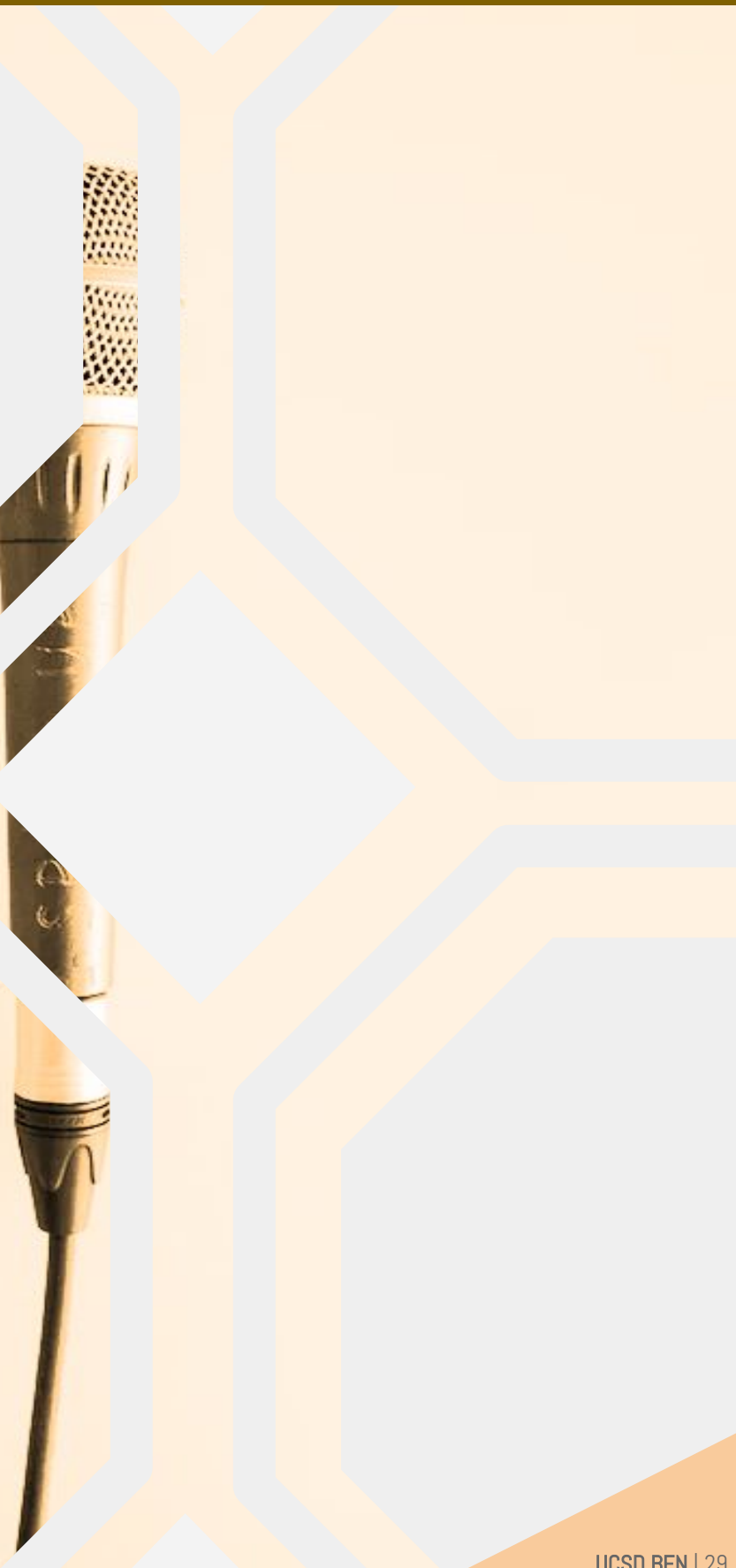


We at the Undergraduate Bioinformatics Club (UBIC) believe that next-generation sequencing and multi-omics technologies are the next steps in biotechnological innovation. Newer students and people with biological expertise struggle with the steep learning curve associated with computational and quantitative approaches to biological data analysis. In response, UBIC organized Chalk Talks. Every week at Chalk Talks, we invite a professor to present their research interests and background using only a chalkboard. This limitation forces speakers to simplify data-heavy talks and reinforce conceptual fundamentals. Topics can range from molecular interactions to plant biology to precision medicine.

By introducing students to ongoing biological studies dependent on computational methods in an intellectually accessible manner, students build a foundation of knowledge that can stand up to the rigor of bioinformatics.

This quarter, we are pleased to announce five lectures and a special graduate student panel to wrap up the fall 2019 introduction to research in bioinformatics at UC San Diego.

At our first seminar, Dr. Lukas Chavez gave an excellent talk about measuring and characterizing epigenetic biomarkers associated with specific cancers.



According to epigenetics, biochemical interactions affect chromatin accessibility and thus influence genetic expression. There are many methods for measuring these markers. The chromatin immunoprecipitation sequencing (ChIP-seq) technique helps Dr. Chavez and his team learn more about the areas of the genome where important markers are found. Dr. Chavez also introduced the concept of topologically associating domains (TADs), a chromatin organization theory that many had never heard of, and the existence of DNA pockets that preferentially associate only with other fragments in the region. In patients with cancer, these domains can change due to differences in regulatory pathways. This theory fueled an intense discussion among all about targeted and personalized cancer therapies. Students were jumping at the opportunity to work with Dr. Chavez on his ongoing projects.

We were happy to see over forty undergraduates in attendance. With Chalk Talks, UBIC adds to the supportive community of students interested in bioinformatics and encourages members of that community to pursue this field in spite of any challenge.

Bioengineering Graduate Initiative (BEGIN)

Bioengineering Graduate Society (BEGS)

By Hao Mu | BEGS Representative



The beginning of graduate school is an exciting time, but without proper guidance, new students could easily overlook the opportunities around them, leading to a difficult and frustrating experience. Although the department orientation covers important topics from academic success to work-life balance, input from the current students provides a complementary perspective of daily life in the bioengineering department. This motivated our former President Marty Spang to create a 2 day New Graduate Boot Camp (BEGIN). BEGIN aims to form a community by linking together all graduate students new and old.

This year BEGIN hosted three events: a post-department orientation info session, a Happy Hour Welcome, and a Saturday beach bonfire right before the start of the fall quarter.

The info session began by explaining the role of the Bioengineering Graduate Society (BEGS) and announcing upcoming events. All our events are free and offer great chances to meet new people! Students got to know each other better with our icebreaker activities.

There were senior graduate students at every table for the entire period. No one was left unattended and all questions were answered immediately. After icebreaker activities, we started the campus tours. All six tour routes covered important student services such as the libraries and Career Service Center, as well as a few research buildings selected based on the registration information. Senior graduate students performing research there led the specialized tours and provided relevant information to new students.

That night, we threw an informal Welcome Happy Hour for the incoming students who wanted to meet and mingle with senior grad students.

As new students expressed their interest in certain topics, we directed them to network with professors and seniors specializing in these fields of study. The new students appreciated and enjoyed hearing about these opportunities from us.

The Saturday before the quarter began, the Welcome Bonfire concluded our two-week-long BEGS BEGIN with a s'mores party by the beach at La Jolla Shores. The bonfire was a great chance for new students to develop personal bonds with both senior students and UCSD in a scenic setting. With this last push, newcomers are better prepared to explore every possibility in grad life.

Like all good scientists and engineers, we conducted a survey after BEGIN to verify our positive claims. We were correct! People loved the event. New students said they liked talking with their peers and senior students. We are also constantly reforming this event every year to best-fit students' needs based on the result of the survey. With the support of the department and fellow students, BEGS BEGIN will continue introducing new students to the vibrant grad student community at UCSD.

STAFF NOTE

All of us at the UCSD Bioengineering Newsletter (BEN) would like to thank:

The Bioengineering Department for their overwhelming support of this project, Dr. John Watson, Dr. Kun Zhang, and Omar Vasquez for their ideas and suggestions. The Biomedical Engineering Society (BMES), The International Society for Pharmaceutical Engineers (ISPE), Undergraduate Bioinformatics Club (UBIC), Bioengineering Graduate Society (BEGS), for their help in publicizing and sponsoring BEN, and The Jacobs School of Engineering.

SPONSORS

Advanced Technology Leadership
Advanced Biologics
BD Biosciences (Becton, Dickinson
& Company Biosciences)
Biological Dynamics, Inc.
BioMedical Strategies LLC
Dexcom, Inc.
Drug Delivery Experts

Medtronic, Inc.
NuVasive, Inc.
Organovo
Synthasome, Inc.
Targeson, Inc.
Xenco Medical, LLC
Independent - Iman Famili
Independent – Lou Obertreis

DEPARTMENT INFO

MAILING ADDRESS:

Department of Bioengineering
University of California, San Diego
9500 Gilman Drive MC 0412
La Jolla, CA 92093 - 0412

Fax Number: (858) 534 - 5722

Department Site: <http://be.ucsd.edu>

Department Chair: Dr. Kun Zhang	(858) 822 - 7876
MSO: Irene Hom	(858) 822 - 0493
Asst. to Dept. Chair/MSO: Gabriela Moreira	(858) 822 - 3441
Graduate Affairs: Jan Lenington	(858) 822 - 1604
Undergraduate Affairs: Vanessa Hollingsworth	(858) 822 - 0006
Safety Officer: Doug Gurevitch	(858) 534 - 2345
Front Desk/Web Developer: Omar Vazquez	(858) 534 - 7303

UC San Diego

JACOBS SCHOOL OF ENGINEERING
Bioengineering

FROM THE DEPARTMENT TO YOU

UC San Diego

JACOBS SCHOOL OF ENGINEERING
Bioengineering

Thank you to our family and friends who donated to our various initiatives to advance our educational, research, and community aims.

For more information on giving,
Visit us at be.ucsd.edu

University of California, San Diego Department of Bioengineering