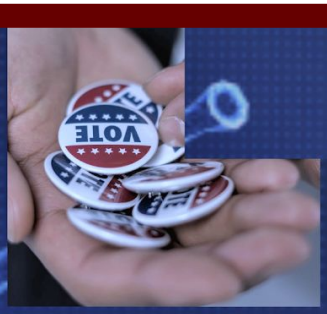
UC San Diego
Jacobs School of Engineering



BioEngineering Newsletter

Summer
2020

Special Summer Edition! --Voices in the Time of Chaos

The People of BEN

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BEN

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The BioEngineering Newsletter (BEN) is a student run publication that covers the people, research and events that occur within the U.C. San Diego Bioengineering Department. This special summer issue is dedicated to celebrate the inclusive nature of BioEngineering concepts and applications with sincerity and authenticity.

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The Fallen Star shines above us....

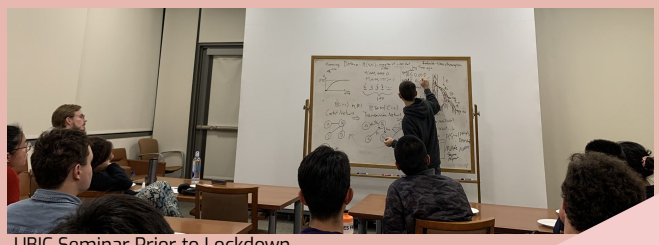
UBIC's Summer Transformation

Reflection of the Past and Insight into the Future

By Joyce Zou | Student Org Representative (UBIC)

UBIC Seminar Prior to Lockdown

The year of 2020 has been both eventful and uneventful to say the least. Cooped up in our homes taking online classes, cameras and mics off, as we are both connected and disconnected from the world. Through this whirlwind of crazy events and inexplicable emotions, our clubs and organizations have tried their best to come up with methods to make the most out of the situation. The Undergraduate Bioinformatics Club (UBIC) has made quite a smooth transition into the online-only requirements. As secretary of the UBIC board, I can confirm that our club has been putting all of its focus to creating and adjusting events to what our students need the most right now. We have been creating online events that students are interested in and advertising lab opportunities and potential internships in which students can get involved. In August, we hosted an AMA (Ask-Me-Anything) with professor Niema Moshiri. The event was formatted as a Q&A session where students posted all their questions on Reddit, Facebook, and other online sites. The event had a great turn out and we received a large number of both Bioinformatic and non-Bioinformatic related questions, ranging from what classes to take to future career choices both in the industry and research fields. The online format of this event allowed students to feel more comfortable asking all sorts of questions, and professor Moshiri was also able to share his own research that is currently focused on COVID, showing students how relevant research is to current times. Students were also able to ask questions live which made this event very versatile. The whole recorded session was posted on Youtube for anyone who could not make it. The online formatting of this event actually provided us with a greater audience. Although not everyone could synchronously tune in, students who were not able to attend were still provided with access to the event recordings and content. UBIC has also thought of the incoming freshmen who probably feel the greatest loss during these times. An already difficult transition of their lives was only made more complicated by the remote circumstances we all have been pushed into.

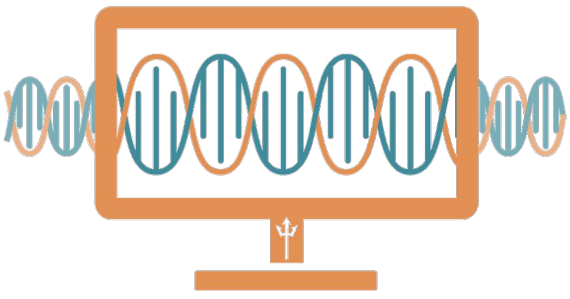


UBIC Seminar Prior to Lockdown

However, with our members having had experienced those times of freshly entering this intricately structured school that is UC San Diego (although not during a global pandemic), we are aware of how difficult it is to navigate information in such a large school.

We are trying to make it easier for incoming freshmen who are interested in Bioinformatics to connect with the greater campus and the Bioinformatics community at UCSD. We are putting together a student handbook that shows many of the classes that Bioinformatics majors need to take. As the major consists of three different tracks that are each split between three different departments, UBIC is creating a student handbook that can be accessed on many different platforms. The handbook will contain recommended classes to take, when to best take them, and what classes should be taken in conjunction or should never be taken together.

We want our members as well as potential incoming members to understand that we really value their presence in our club and that they can find a community, advice, and useful academic information in our club. Without the ability to meet in person, UBIC is trying to turn our usual events such as chalk talks and our coding bootcamps into virtual meetings that are easily accessible and remotely stimulating for students. We hope that regardless of all the stress being caused as a result of classes starting and the unstable condition our world is in right now, we can allow our students to feel welcomed and find a community within our club that provides them with the support and resources they need to succeed at UCSD.



UBIC

The Big BENG Is Here!!

Empowering Students From The Beginning

Maria Sckaff | Deputy Editor-in-Chief

Hard bioengineering courses? Helpless assignments? Hours on Google trying to figure out those challenging bioengineering concepts?

The wait is over. **The Big BENG is here**. We are an organization focused on maximizing your potential within the bioengineering major. We want you to spend less time looking up the material and more time actually learning it. Did something just not click in class, and now you can't reach out to your professor/TA because it is almost midnight on a Friday? We got you covered.

The Big BENG creates short educational videos and content, reviewed by your professors, to help you all do well on the classic UCSD bioengineering courses.

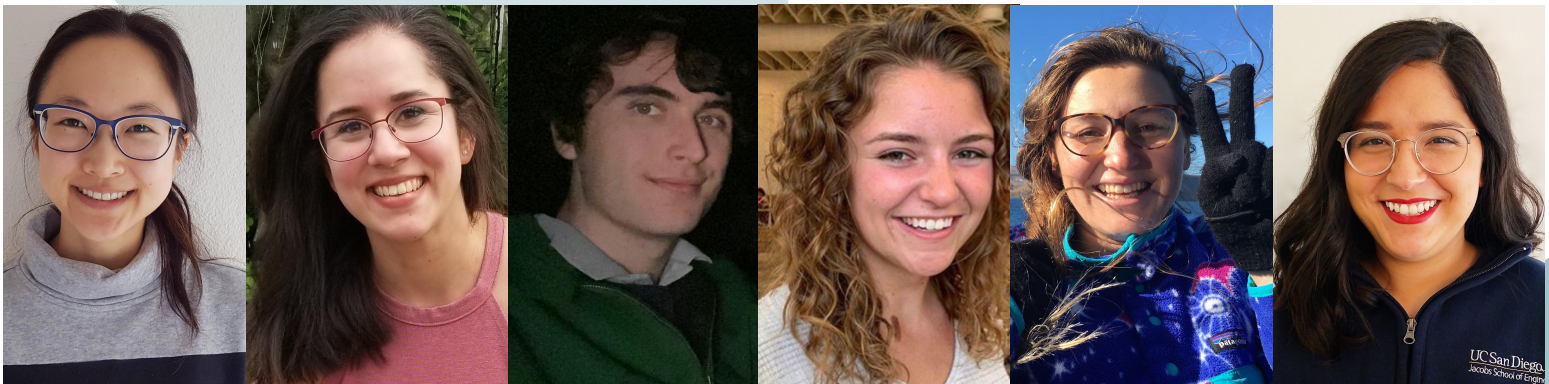
No more endless hours trying to understand biomechanics, bioinstrumentation, or bioengineering probability. Mass transfer? More like mass extravaganza!

So follow us on Facebook and subscribe to our Youtube channel to be the first to know when new videos are out. If you don't see a video there that you need, let us know!

Facebook: facebook.com/thebigbengucsd
YouTube: The Big BENG at UCSD
Email: thebigbeng.ucsd@gmail.com
Instagram: @thebig_beng

This quarter we will post videos on BENG 100, BENG 186B, and BENG 110. However, expect BENG 103B, 112A, 112B, and more in the future as those quarters arrive.

We will see you soon,
The Big BENG team



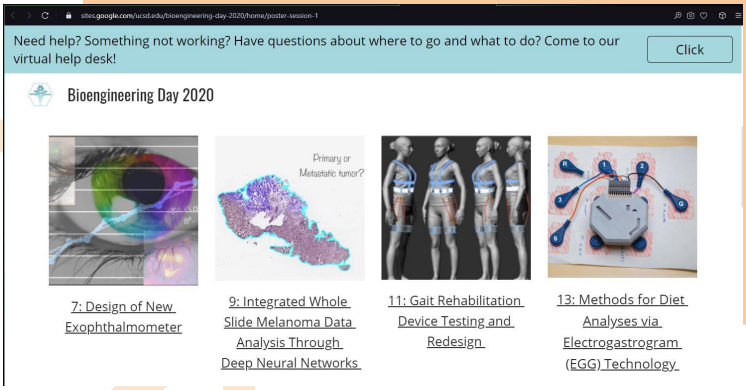
Left to right: Hope Leng, Maria Sckaff, Max Pendleton, Abbey Ervin, Sarah Schwab, and Dalila Mejia

Persistence through Pandemic:
BMES and the COVID-19 Lockdown

Kevin Yu | Head Student Org Representative (BMES)

Translational Medicine Day

Bioengineering Day



At the start of the COVID-19 crisis/lockdown, sudden and drastic measures had to be taken in order to curb the spread of disease. To many UCSD student organizations, this meant a total freeze on activities such as workshops, projects, and large-scale events. It became obvious to all that nothing would go as planned.

Yet, what would adversity be without an effort to overcome it? UCSD Biomedical Engineering Society (BMES) refused to be silenced by a global pandemic. Between efforts to maintain some of their largest events of the year and smaller outreach and project initiatives, they would not stay down for long amidst the hectic nature of 2020.

Two Days, and Growing Pains

Translational Medicine Day (TMD) is a conference-style event organized by BMES, dedicated to bringing together students, industries, and researchers interested in transforming research advances into patient-end medicine. TMD usually takes place around late February to early March, and in 2020 this would have been no exception. As a result, our event had already broken the horizon when Chancellor Khosla's advisory dropped on BMES: all conferences, meetings, and public events with more than fifty people would be strongly discouraged. We were given two days to restructure our event accordingly.

As one of the officers organizing this event at the time, the frustration was straining. We had prepared almost an entire year for an in-person event, expecting to handle crowds of two-hundred or more, and bring demonstrations of industry tech as well

well as valuable networking opportunities to the hands of eager, forward-thinking students. Instead, what we had to do was settle for less in the time we were given.

With pressure from both the Bioengineering Department and many researchers presenting at the event itself, UCSD BMES made the decision to transition our event into a primarily-online format. A skeleton crew of about thirty volunteers stayed on-site to manage our streaming cameras and ensure that the event progressed smoothly. Presentations themselves were remotely accessed through both the UCSD BMES and Translational Medicine Day Facebook pages. However, many parts of our event, such as our networking luncheon and our tours in the Center for the Future of Surgery, simply could not be translated into an online format.

In the end, what TMD 2020 developed into was a chef's main course, reduced to a stew — a difficult choice made under tough circumstances. Despite the difficulty to succeed with only two days to change things, the show did go on. The format of TMD 2020 would serve as an important lesson for the future BMES events, and our efforts to adapt turned the struggle into a memorable tale for everyone involved.

Metamorphosis

The annual Bioengineering Day (BE Day) is an event organized by BMES, in collaboration with the UCSD Bioengineering Department, in order to further awareness and education in bioengineering topics, ranging from the cutting-edge of industry tech to the innovative Senior Design presentations that showcase the efforts of soon-to-be graduates. Typically occurring around early April, the BMES BE Day committee had the time to find a solution to the COVID-19 crisis that the TMD committee unfortunately did not. Though this initially seems like a blessing, by then, the state of California had cracked down on large events as a whole — no half-measures in the form of hybridized events would work.

I spoke with the officers who headed the 2020 BE Day committee: Aoife O'Farrell and Kendra Worthington. Both shared an initial shock about the crisis — they would be committee chairs without a strong public showing to culminate their efforts. And with BE Day as a longtime tradition of the department, the gravity of the crisis weighed on the committee as a whole — would this year be the first in a decade without a BE Day?

Determined to live up to the past, the committee got to work. Prof. Bruce Wheeler and Dr. Peter Chen both served as committee advisors, immediately pointing out that BE Day 2020 would have to be fully-online. That meant most usual attractions of BE Day would have to be shed. Industry demonstrations, normally a cornerstone, could not happen. A formal keynote presentation, a tradition of the event, would not occur. In the end, with Prof. Wheeler's determination to give the 2020 Seniors the same chance to present their work that previous seniors had, it was decided that BE Day 2020 would champion the event's very roots — Senior Design presentations.

Consistent committee efforts throughout April and May culminated in a website to host various Zoom calls — each hosted by one Senior Design project team. Although plenty could have gone wrong through the bugginess of unfamiliar software, the committee

held test/practice runs to prepare for the day-of. The department helped advertise the website to local Bioengineering companies of San Diego, and the end result brought attention from multiple industry partners.

All in all, BE Day 2020 was an effort of a reshaping, a remodeling, and a metamorphosis. Just as the worm molts into the butterfly, BE Day took the time to reshape itself against the COVID-19 crisis. Half-measures and conventional event organization would not hold, but faculty advisors, past lessons, and a determined committee ensured that the online-only format was a success, championing its roots and displaying growth from adversity.

Branching through Barriers

Besides the large events that UCSD BMES puts on, our most impactful initiatives are headed by the Outreach and Project Team committees. The former seeks to promote science education in engineering topics for grade school students. The latter seeks to connect bioengineering undergraduates with lab positions and promote specialized professional education through workshops and hands-on demos.

The COVID-19 crisis momentarily put public schools on ice, abruptly forcing many students to switch to online schooling through Zoom calls and web communication. As UCSD was forced to do the same, it became very clear that the Outreach committee could use this new medium to streamline their efforts of educating younger audiences.

Outreach's primary initiative was College Conversations, a pair-and-share activity between two committee members and a classroom of high school students.

Committee members would host presentations on topics relating to college life, and respond to questions from prospective high school students. They concentrated their efforts especially on then-seniors and juniors, who are at a critical crossroads between choosing colleges to which apply, choosing their major and possible minor, or choosing whether or not to go to college at all.

The BMES Project Team found themselves challenged by the pandemic in a similar fashion to BE Day. Their usual spring quarter initiative is the DEBUT Project: a design project that tackles a bioengineering topic through undergraduate team efforts. In 2020, the project objective was to develop a low-cost telesurgical robot, operable from up to 500 miles away. Due to the COVID-19 crisis, however, the DEBUT teams could not meet in person, and physical prototyping would have been challenging following social distancing guidelines. The solution taken was the most direct route — change the objective of the project.

Rather than creating a physical prototype, a virtual prototype done in CAD software was developed to communicate a viable design without endangering committee members. The team's primary initiative then became to work over the summer to create this in Autodesk's Fusion 360 program. A review paper was also drafted, intended to outline what has, and should be done to advance the field. Both sought to achieve something significant despite the challenges ahead of them, and though abrupt, the DEBUT team stayed consistent with summer meetings that remained ongoing into August.

INTERVIEWS

"Research is the process of going up alleys to see if they are blind."
--Marston Bates

Integrated Systems Neuroengineering Lab

Advancing the frontiers of Brain-Machine Interfaces

By Meenakshi Singhal | Interview Writer

Introduction: *The Integrated Systems Neuroengineering (ISN) Lab, run by Dr. Gert Cauwenberghs, aims to advance the frontiers of both neuromorphic engineering and silicon neural interfaces through the creation of large-scale systems integrated circuits that mimic the structures found within the nervous system. As a dedicated group of project scientists, postdoctoral fellows, graduate and undergraduate students, the ISN lab exemplifies teamwork and innovation. Dr. Cauwenberghs notes, "Our lab is quite dry, literally. There are no chemicals in the lab besides some solder paste in the fume hood. Our wet lab experiments are then through collaborations, and it has really been thriving and productive." ISN lab is highly interdisciplinary, and interacts regularly with neuroscientists, biologists, physicists, and device fabrication engineers.*

Q: What is the focus of the ISN lab and current research being pursued?

Cauwenberghs: "Our research is at the crossroads of silicon and biology. One way or another we are all taking advantage of the unique properties of silicon to then interface with living tissue, or more generally understand how the brain works. We use silicon integrated circuits in two ways: (1) we gain inspiration from biology in developing the neural circuits of the brain"; and (2), "from the very invasive to the very noninvasive—even without making contact with the body—we can still measure potentials. We even have nano-needle electrodes that can perform intracellular recording for high throughput in vitro neuroscience."

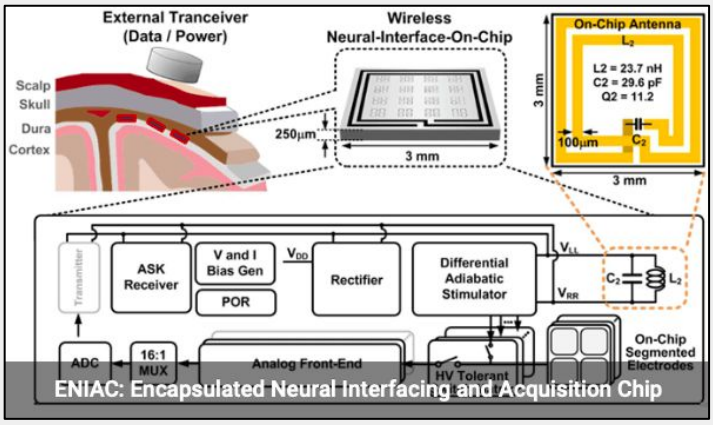
Recent work from the lab highlights how the researchers implemented trainable arrays of synapses connecting neurons in silicon that combine CMOS (complementary metal–oxide–semiconductor) and RRAM (resistive random-

access memory). CMOS technology is commonly used within integrated and digital logic circuits found everywhere from smart phones and laptops to hearing aids and pacemakers. RRAM is a novel type of nonvolatile memory storage that utilizes the dielectric properties of the materials. For each synaptic operation, the system only requires several Femtojoules of energy; this unprecedented gain in efficiency brings the team one step closer to the goal of developing systems that rival the brain's low-power computational abilities. This was made possible because the system holds the advantage of dual function: the synapses within the chip are capable of both memory storage and processing, preventing the necessity of a "middleman".

Q: How does the ISN lab promote the intellectual growth of its students?

Cauwenberghs: "When our students graduate, they become our future leaders. We've had some who are now faculty elsewhere in the country or the world, some go into industry, and some even start companies, like Cognionics. We also have our students interning in companies and taking leadership and pushing technology there. They are taking what we do here and applying it to the marketplace."

"I was naturally attracted to bioengineering. It's been great working with students." While the members work on highly technical and diverging projects, all agree that they have enjoyed their time in the ISN lab and are inspired by their Principal Investigator's ingenuity and inclusiveness.



ENIAC: Encapsulated Neural Interfacing and Acquisition Chip

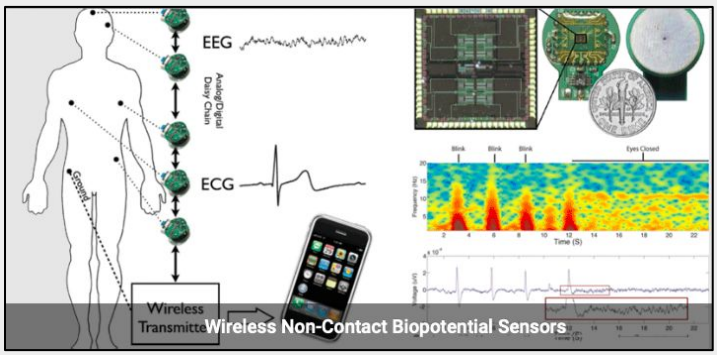
PhD student Andrew Perley collaborates with Dr. Todd Coleman on gastric electrophysiology. He aims to utilize surface electrodes on the stomach to diagnose diseases, as well as create new signal processing techniques to better extract the information at the gastric level. Perley says, "We're trying to explore the gut-brain connection in electrophysiology; the gut is often referred to as the second brain because of how densely it is aligned with neurons. It is thought to be very closely related to understanding things like mood, anxiety, and depression, but also physical indicators of health. There's this rich area of both neuroscience and clinical applications along the gut-brain axis. We could maybe take advantage of these feedback loops through noninvasive stimulation of the vagus nerve, which connects the brain to many other autonomic-functioning organs."

IBM Fellow and postdoc Dr. Bruno Pedroni earned his PhD in the ISN lab. He explains, "Gert has given us all the freedom to explore a vast number of fields. In the last year I've learned so much dealing with the highest technology of FPGAs (a type of programmable semiconductor device) and so I was able to learn things from a state-of-the-art perspective. I think this combi-

nation that Gert has with both government and industry projects is very good." Currently, Dr. Pedroni is working on a team to build a large-scale neuromorphic system of 32 FPGA boards, which they plan to contain 128 million neurons running in real time. Describing Dr. Pedroni's work, Dr. Cauwenberghs explains, "This is about building an infrastructure for the larger community to have neuromorphic engineering tools available at one's fingertips, as opposed to the very high barriers that exist for entering. The neuromorphic engineering community is very small; we want to increase the subscription."

Postdoc Dr. Yuchen Xu, who earned a PhD in nanoengineering focusing on cochlear implants, now focuses on in-ear diagnostics: "We are trying to develop a platform that can both function as an electroencephalogram (EEG) as well as adding more chemical sensing modalities, which I think many companies will be interested in."

Dr. Frederic Broccard, a project scientist and faculty at the Institute of Neural Computation focuses on neuromorphic engineering: "I was trained as a neuroscientist; although there are few people coming in with wetlab experience, it is a very nice environment for collaboration, so I fell right in place since the beginning. Thanks to Gert there's more interest in the department and across departments in neural engineering;



Wireless Non-Contact Biopotential Sensors

all the different aspects in the field can be tapped into by different labs with help from Gert. There's so many projects in the lab and always something new to do. For example, we have a chip that was made in the lab 10 years ago and is still running, so we are trying new things with the chip and in the meantime, developing a vast array of devices for different levels of biological organization. I think that's what people like about the lab: we can work at various levels of the nervous system."

How do you see the future of bioengineering taking shape?

Cauwenberghs: "In addition to modeling how the brain works, which is going to be a difficult task for a long time to come, the premise of our work is then to also benefit healthcare by coming up with new biofeedback strategies that embrace the mind-brain-body, using unobtrusive technologies and minimally invasive strategies. We hope these interfaces can better drive the body's natural propensity towards healing itself; there's plenty of feedback loops in the body, so having means to come in and doing it in such a way as to remediate some kind of disorder is a different paradigm; so we are looking at more gently intervening methods of promoting health."

"We have this international crisis now: the cost and availability of healthcare is a major challenge. At the same time, we have new opportunities in technologies that can take things out of the hands of caretakers within the centralized hospital framework and into those of the user. We see a future with less acute measures, and more preventative, long-term

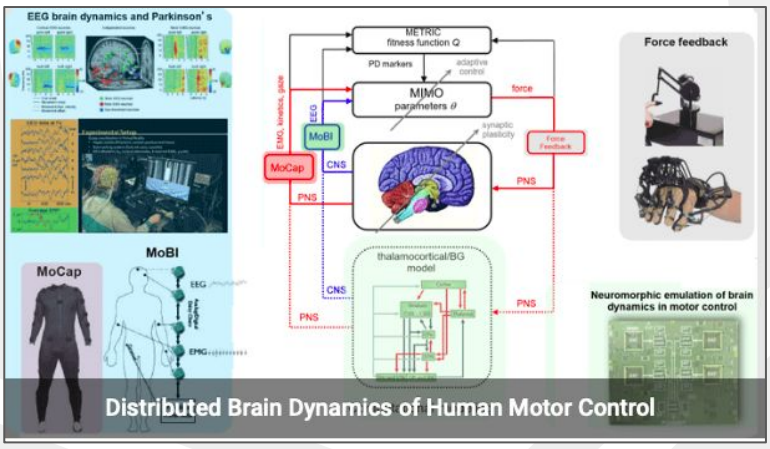
care that drives the plasticity of the brain."

"The technology should not harm the body, I cannot overemphasize that. Yes, deep brain stimulation may be remediating some symptoms of Parkinson's, but there are huge side effects. Rather than replacing function, we seek to enhance function. We still need hospitals, but for most of our ailments, we should have chronic monitoring. Many of the diseases that are very hard to solve from a pharmaceutical or surgical standpoint are neurodegenerative in nature; you really need to look at the neural circuit, rather than purely the anatomy or the chemical pathways."

Q: How has the lab and larger bioengineering community been affected by the COVID-19 pandemic?

Cauwenberghs: "COVID-19 has affected all of us, and it's really unfortunate that so many had to die. On the upside, hopefully we learn from it and are better prepared in the future. The key here is that there will be other viruses, and I hope there will be some greater bioengineering tools that can be more swift for detection and empower the immune system to fend off disease."

"Of course it's hard, but we're all connected (and) there's something missing when you don't have the actual classroom or lab, but we can still see each other and make it work. Now some people hate Zoom, but I think it's not too bad. Zoom has in a way kept us together, like we have our weekly lab meetings and also meet more often.



There is one benefit; we have all these conferences and meetings to go to, so we would literally hop on a plane, go to D.C. and have a 15 minute presentation, and then hop on a plane back. Now those meetings are online, which makes sense as we can communicate more effectively; we don't have to do all this long-distance traveling which can be really straining."

Pandemic or not, one thing is clear: the ISN lab is committed to improving human health through technologies that draw from the talents of many forward-thinking researchers in neuroengineering.

Dr. Andrew McCulloch

Engineering, Medicine, and the Implications of a Global Pandemic

By Nicholas Sada | Head Interview Writer

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

One of my jobs is being the Director of the Institute of Engineering in Medicine which has over 200 faculty members from both engineering and the health sciences. The Institute has 14 centers representing various technologies and disease research areas. One of my big jobs is to run that Institute and to run programs that promote interdisciplinary collaboration between engineers, physicians, and basic biomedical scientists. The other job I have, in addition to mentoring and teaching, is to run a research lab. We work on analyzing the electrical and mechanical functions of the heart, the mechanisms by which they're regulated, and how they change under diseases such as heart failure or arrhythmias as well as genetic diseases. We use a range of experimental and computational approaches ranging from the molecular scale to the scale of the whole patient, so we do everything from atomic resolution models of individual molecules in the heart to magnetic resonance imaging of whole patients with congenital heart disease or heart failure.

Q: You mentioned you're the Director of the Institute of Engineering in Medicine, so I was wondering how the pandemic affected this interdisciplinary cooperation within UCSD between departments and also cross-institutional cooperation between UCSD and other universities?

It has not slowed down people's interest in collaboration. In fact, we've been able to start many new collaborations through programs, some of which are run by the Institute of Engineering in Medicine. For example, with a donation from Dr. Chien and some matching funds from the Dean of Engineering, we created a GEM (Galvanizing Engineering in Medicine) COVID-19 rapid response program. We gave grants to several interdisciplinary groups between engineers and clinical faculty. They did a variety of different projects, some which have already had an impact on patients' lives, one of which has already prevented many patients from needing mechanical ventilation. If you look at the IEM website (iem.ucsd.edu) there's a COVID-19 page and it summarizes some of those different projects.

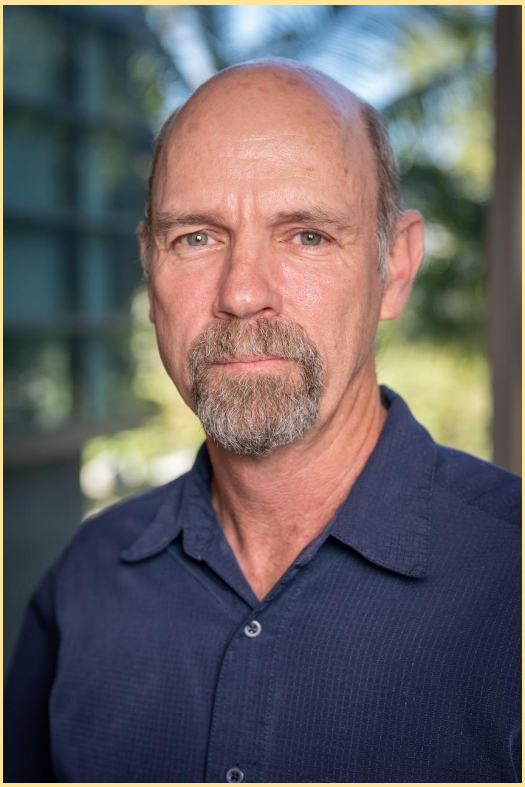
Q: Do you anticipate that there will be any aspects of online teaching that you prefer over in-person instruction?

No, although I do think it will help us to use technology better, that it will help us appreciate what's really useful about in-person instruction. Honestly, spending half the

time with your back to the students, writing with chalk on a blackboard, isn't a very good use of limited in-person time and that's the reason I have developed flipped classes for most of my courses. I didn't want to have less time with students, I wanted to make that time more interactive.

Now I have to say, one of the ways I tried to promote active learning was using i-clickers. I would have this stream of quiz type questions and I actually made those questions count, although not for very much. Many students didn't like that at all. But when I stopped doing it, I tried being interactive without using clickers, and students stopped paying attention. So I have to say that while students like having the videos online and like having content in a variety of formats, I think we still have to learn more together about how to promote active learning in the classroom. Part of the problem is that what you read about for one course or one discipline may not apply to another. So we really have to figure out what's best for a particular class, to make use of the in-person time to really promote active learning. I have been working with a group of students with a small grant from the campus to develop new short online multimedia resources as part of a project that they call The Big BENG. It is a lot of work, but also a lot of fun.

While we can't have much or any in-person time, we might as well get the remote approach optimized, to make the quality better, and the ability to communicate in real time easier. I can't imagine a day where people will ever think it's better to have entirely remote learning. The thing is getting the right balance. Do the best



you can remotely and do a better job of taking advantage of the time we have in person to be more effective in learning. Now, of course exactly the things I used to do to promote active learning are things that we can't do in person now. For example, I used to have the students get into groups to solve problems together. Breakout rooms are a poor substitute. I don't think we'll really solve that part of the equation until the pandemic is over.

Q: What do you think these students should be doing to prepare for a future in the field while under quarantine?

So I'm thinking of a few things. One is that the quarantine and the changed conditions create opportunities and challenges. We really encourage students to find methods to

overcome the stresses induced by these challenges and to take advantage of opportunities. Now, everyone has developed their own little systems, their ways of adapting. Like I didn't like that I had to pay so much for wipes and I didn't like the greasy sanitizer, so I came up with a system for making my own alcohol wipes that I carry around in conical cuvette tubes. When they are dry they're super small, less than a centimeter thick. If you put alcohol in the tube they just expand up. Now, you might say that's an awful lot of trouble, but these things cost a fraction of those wipes and they don't dry out. The money they're saving me is probably not important but it's just one of those examples of one of those funny little things we all do to adapt and so the creativity comes out of these things. So I'd just like to remind students that out of changed circumstance, out of challenging circumstances, is where the greatest inventions come. Out of the depression came the New Deal, out of the civil rights movement came the Civil Rights Act. It's the same for individuals. I think we should all remember that and know that sometimes little things we do to adapt can lead to the big things we do that can change the world.

So what would I recommend students do? To cope with the fact that things are not normal and that this causes us difficulty, anxiety, and stress, is to do two things. One is to try and exercise every day. I try to go for a run. I actually have a mask that I wear when I run. It's even harder with the mask on but it's better for me and it makes it more of an accomplishment when I'm done. The other thing is to practice mindfulness. The best way to deal with anxiety, depression, and stress is to remove yourself from the situation. For thousands of years, people have known to do this through mindfulness, practicing compassion and meditation. So I would recommend that students try a meditation app and let themselves be in the present. To focus on their breath, let thoughts come and go, not get caught up in all of their anxieties, and after a while of doing this they'll start to see their anxieties and worries, and they'll start to realize that they're not that bad and they'll learn to let them go. So those are the things I do to take care of myself.

In terms of your question on how to improve yourself, something we have a lot more time to do than normal is read. I have to say, it's true that all engineering students don't like to read, but I think it's more of a liability for bioengineering students. I didn't like to read very much when I was an engineering student. It was like "give me an equation I can understand it and I'll remember it because I can understand and use it." But think about biology, it's all about memorization. You can't be a successful biology student if you don't read the book. So I think that in biology, students learn that they have to read. In engineering, we get used to the idea that if you're smart you don't have to read, or even buy the textbook. Maybe there's some truth to that in computer science or mechanical engineering, but it's clearly not true in bioengineering. So I think it's a great opportunity for students to read.

Honestly, I don't what you read a book on, just getting into the practice of reading more will not only broaden your knowledge but also make reading less of a chore. Then when classes start, instead of just worrying about homework and the lectures, you'd think of doing the reading that was assigned. So I think that's some of my biggest advice, to realize that societal and individual accomplishments come out of challenging circumstances, to take care of your mind and body, and to read.

Q: How do you think the public perception of bioengineering will change as a result of this pandemic?

I think there's a very high chance, by the time all is said and done, that many people will come to understand that the solutions to both the medical and the socioeconomic problems that the pandemic caused are actually engineering and science solutions. A lot of people will never accept that, they'll blame politicians or the government or foreign countries, but a lot of people will realize that this pandemic was not caused by technology or made in a lab, but the solution was made in a lab. This also applies to the rapid tests that we will hopefully have instead of the slow ones we have now. This also goes for the contact tracing apps that maybe people will start to use once they realize that, if you really want to slow the spread of an infectious disease, you have to find out who has it. People are very reluctant to share information, but they're not so dumb as to not realize that if someone they were in contact with had an infectious disease that they're better off knowing that.

So I think that a lot of the solutions to these problems will come from bioengineers and scientists. Certainly at the NIH, a large part of the effort going toward fighting the pandemic now is not just on vaccine development, but on technology development, point of care diagnostics, better technologies for ventilators or respiratory distress, protein-based tests, new therapeutics, new data analytics that can help you detect outbreaks sooner, things like that. This is right at the center of modern bioengineering. I think some people in the public already realize that engineering and science are key, and I think that by the time this is past us, a lot of people will appreciate that science wasn't the cause, but it was the solution.

Q: Do you think that this greater focus on science and engineering as the solution will have a lasting impact on the field of bioengineering as a whole?

Yes, because bioengineering is not a medical discipline, but it's working on medical problems that tend to have long horizons. We've historically viewed ourselves as engineers doing biomedical science, which takes a long time to translate into clinical medicine. Engineers in other disciplines are used to short turnarounds. Computer scientists will develop new technology that could be a big commercial success in less than a year. We don't tend to think like that in the health sciences. It takes 10 years for a drug to be approved and 9 out of 10 of them don't. But there's a lot of areas such as in diagnostics, imaging, data science, analytics, and modeling where it doesn't take that long. In fact, new advances in molecular biology such as CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) Cas-9 mean that what used to take 5 years can now take 5 months. So I think that the field might change by bioengineers getting used to the idea that they can work more at the engineering speed and that technologies can help accelerate the deployment of new technologies, therapeutics, and diagnostics.

I think that bioengineering will only become more popular and probably, more translational as we start to realize that even something as complicated as a vaccine that usually takes 5 or 10 years to develop can actually be developed sooner, particularly if you have a platform. If you already have a technique for developing a vaccine and all you need is a sequence, then it accelerates everything. The same goes for tests such as the Polymerase Chain Reaction (PCR) tests for SARS COVID-2 very quickly because all we needed was a sequence. I think the same could be done for vaccines and ultimately even for therapeutics. You could have technology to develop the therapy before knowing what the target was. The shorter term and the more technology intensive and technology driven new discoveries and advancements are, the more interest there will be in bioengineering.

Student Spotlight

Dark is the night, thus born were people who invented light bulbs.

Sicily Rose Panattil

To Our Peers, We Are All Strong During This Global Pandemic.

By Yichen Xiang | Deputy Editor-in-Chief

Hi! I am Sicily Rose Panattil, an upcoming senior studying Bioengineering: Biotechnology. My hobbies include dancing, painting, cooking, making things and I like being creative in everything that I do. I also like the outdoors and playing sports. I have learnt a lot at UCSD and I hope that I can make a difference in what I set out to do.

Introduction:

Bioengineering is such a mysterious major. Some bioengineers are excellent mechanical engineers, some are experts in computer science, and some are able to explain the chromosomal difference between muggles and wizards and will one day find a way to make everybody magical. But regardless what what bioengineers do, they must be good at one particular skill: interdisciplinary cooperation. Sicily participated in the last year's Summer Experience at EnVision program and generously shared her experience with us. This interview provides a glimpse of what bioengineers can do and how undergraduate students at UCSD can conduct cross-disciplinary research.

Q: What is your research interest?

I currently work in a Biophotonics lab, and my interests are aligned towards the biomolecular/biotechnology side which is want I want to pursue after graduation as well. The way that research is conducted and what I learn from the research experience are invaluable and that is what I will take away from this at my current level. The lab lets me be independent, and I have learned how to do research in a group, with planning and undertaking projects which take a way for me as an undergraduate student.

Q: If you have a mentor, how does he/she guide you in your research?

My mentor is the graduate student I work with in the lab. The way he guides me through my research is informative. He tells me his broad ideas for his research and how I could fit into that, along with potential ideas he already has for me. Then I conduct research on my own and update him with potential avenues which I have explored and ask for his advice. He does give me a certain level of independence which I appreciate.

Q: Why do you choose to attend UCSD?

As an international student I did ample research before I made my decision, especially with universities known for excellent Bioengineering programs. I came from India. The level of exposure and experience with biotech at home has not quite matured, which

is why I applied to some American universities initially, alongside with some Indian universities. It was actually a professor in India in the field of biotech who recommended specifically that I should consider coming to UCSD. The professor was very knowledgeable in his field so my family took his recommendation very seriously.

Q: As an intern at the Summer EnVision Experience program, what aspects of this program attracted your attention? What was the project that you were working on?

I was part of the SEE (Summer Experience at EnVision), a program conducted through EnVision Arts and Engineering Maker Studio, which cooperated with organizations to allow students to become interns on campus. I participated in this program in the summer of 2019, working with Birch Aquarium. When I knew this program involves my peers in vastly distinct fields of studies, I expected it to be interesting. SEE did turn out to be a momentous learning opportunity for me, where I learned a bit of everything through the entire process. As an undergraduate student there was only limited opportunity to fully get involved in all parts of a comprehensive hands-on project, and this program offered me a way to communicate my wildest ideas with a group of open minded fellow students.

SEE has worked with Birch since 2018, and this time Birch seeked an informative and entertaining exhibit. The idea was for Birch to host an exhibit in the realm of virtual reality technologies or 360 views, in order to educate the general public in regard of not only the countless research projects conducted by Scripps, but also the two marine reserves (San Diego-Scripps Coastal State Marine Conservation Area and Matlahuayl State Marine Reserve) off the shore. In 10 weeks we had to present a working prototype. Through cycles of creative proposals and feedback, a handheld VR prototype, was born.

Q: Cross-disciplinary interaction is the foundation of Bioengineering. How does your experience help you to better understand the aspects of Bioengineering?

As a Bioengineering major, I had limited exposure to other fields and certain details about them that you can not learn through text-books. This project was an eye opening experience for me, as my first design-to-engineering experience. The interns ranged in all fields including engineering, visual arts, cognitive science, My learning curve was how to approach and solve realistic problems through the design process. I learned aspects of mechanical engineering to make prototypes and study suitable materials; I employed electrical engineering skills to learn how to build circuits for the VR sets; I studied VR technology to understand the mechanics behind it. My greatest take away was that there were multiple ways to approach a problem, and people from different experiences will look at problems differently. We should know how

to push our own ideas but also work together to achieve mutual satisfaction.

Q: What is your advantage as a bioengineer when cooperating with other engineering students?

One of my responsibilities in this VR project was to discover the proper materials and color to use on the VR tools, which happened to be concurrent with my research direction in the lab. Thus, I am familiar with the procedures of material testing which involves research for safe materials. After this, the process to form the material in the right shapes involved moulds with suitable curing under the right pressure followed by stress tests. For instance, I had to explore the suitable material as headset covers, which we ended up producing one set of silicone and another set made from cloth materials for Birch to use as they saw fit.

Learn more about this VR Exhibit at Birch :

https://ucsdnews.ucsd.edu/feature/uc-san-diego-undergraduates-design-birch-aquariums-first-virtual-reality-exhibit

Q: What inconvenience or bonus does the quarantine lifestyle bring to your life?

As a college student, I definitely miss out on my "college experiences", such as spending time with friends and at the library, rushing between classes, visiting office hours and socializing with classmates. But I wouldn't say this stay-at-home experience was all negative. It was also a chance for us to explore the side of us which we were too busy to notice. Things like cooking, reading, meditating, and creating art are other things that are important in life yet we often ignore. It is important to think about understanding the world and oneself, and this period presents the time for careful self-reflection.

Q: What difficulties do you perceive that our peers are experiencing during this hard time?

The first thing was the uncertainty of whether classes will be in-person or online and the difficulties that both these options present. The worries of signing a new lease or moving back to San Diego or continuing their classes at home. If they have to leave and return home in other countries. How would students manage situations from thousands of miles away, when the time zone, internet and family duties can be potential issues? How are students going to manage school? The loneliness brought out by the self-isolation is also a concern on the mental health of students. But the most important is the safety of students as they try to learn during these uncertain times.

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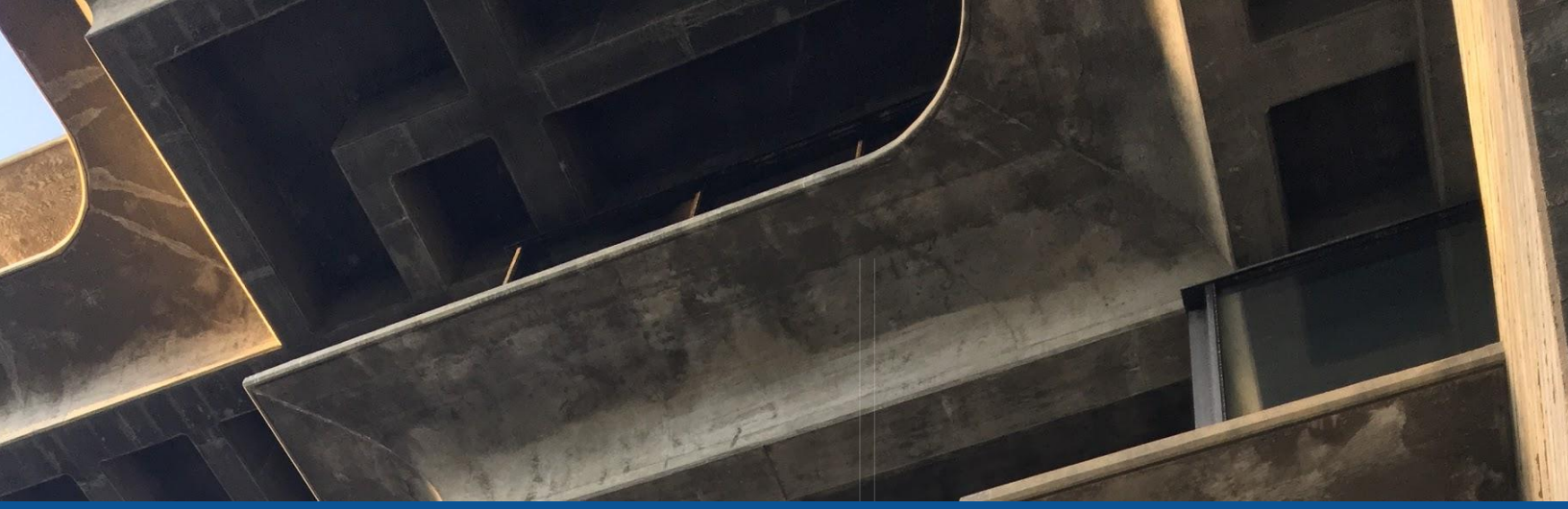

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