UC San Diego
JACOBS SCHOOL OF ENGINEERING

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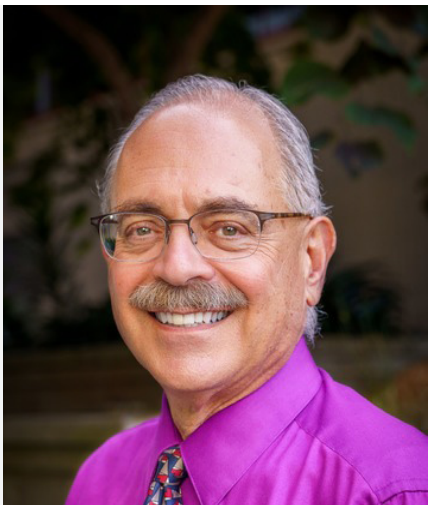
Math matters to all of us



As a mechanical engineering student, I learned the differential equations that govern materials. I applied these concepts in my early work to study and improve the strength of automobile engine parts. When I pivoted to research on thin-film sensor technologies, the bedrock math for mechanical engineering empowered me to understand stresses and strains of the new sensor materials I was developing. Math allowed me to advance my sensor technology research faster than I ever could have by just relying on trial and error, which to be honest, is how some people in the field were operating at the time.

Yes, I'm also a huge proponent of iterative design: it's an exceptional educational tool for introducing the practice of engineering, for example. But we can't stop there. We also need to inspire students to want to use math to deepen their practice of engineering. If I can arrive at an approximately correct answer in one step, why go through a set of slow, expensive experiments that are essentially laborious iterations without the math?

I bring this up because I think we all have a responsibility to talk more about math in personal terms. We need to share our experiences with how math empowers our work as researchers, as practicing engineers and computer scientists, as educators, as productive members of society.

Of course, math is just one of the many "languages of engineering." Critical thinking, communication, physics, ethics, security and privacy awareness, unintended consequences and societal impacts, design, modeling, prototyping, building – these are just some of the many languages of engineering. In the future, I will return to the topic of our responsibility to ensure students gain fluency in a broad and diverse range of these languages of engineering.

As we rightly embrace the many essential languages of engineering and computer science, we must remember to renew our focus on math. I would offer that we need to do a better job of providing concrete examples that show why math matters.

The pandemic has shown us time and time again why math matters to all of us. Calculations describing virus-laden aerosols floating in the air are just one example. Also, understanding the statistics that describe infection rates and hospitalization rates is key to understanding the impact the pandemic is having on our healthcare systems.

My own life experience has shown why math matters. It was fluency in differential equations that first enabled me to get comfortable in mechanical engineering and subsequently enabled me to change my research entirely. So as I think about how we can prepare engineers and computer scientists for an ever-changing workplace driven by cutting-edge innovation, I am convinced that we must ensure that our students are fluent in the math that matters.

I'm thankful to have gained fluency in math early in my engineering career, and I'm more motivated than ever to ensure that students at the Jacobs School of Engineering and across the nation are provided the experiences and support that will enable their own journey to fluency in the math that matters.

As always, I can be reached at DeanPisano@eng.ucsd.edu.

-Albert P. Pisano, Dean

UC San Diego Jacobs School of Engineering

Jacobs School research headlines 2021

From research into new ways to detect and prevent COVID-19, to new treatments for heart conditions, tools to make web browsers safer, and technology to combat natural disasters and climate change, the UC San Diego Jacobs School of Engineering has had an impactful year. We've collected some of the research that made headlines in 2021.

Learn more: bit.ly/2021ResearchHighlights

Jacobs School institutional highlights 2021

The UC San Diego Jacobs School of Engineering leverages engineering and computer science for the public good in many different ways. Here are a few 2021 institutional highlights from the Jacobs School, including new programs and research centers, new faculty, Franklin Antonio Hall nearing completion, and ranking the #9 engineering school in the country for the second year in a row.

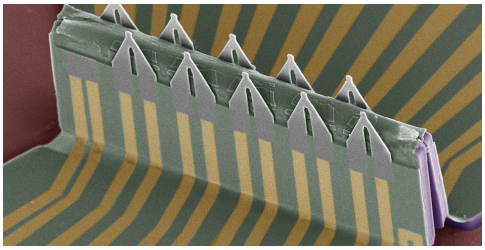
Learn more: bit.ly/2021JacobsSchoolHighlights

Improving security for all Firefox users

Researchers from UC San Diego, UT Austin, and Mozilla have designed a new framework, called RLBox, to make the Firefox browser more secure. Mozilla has already deployed RLBox on all Firefox platforms. "Well funded attackers are exploiting zero-day vulnerabilities and supply chains to target real users," said UC San Diego computer science professor Deian Stefan. "To deal with such sophisticated attackers we need multiple layers of defense and new techniques to minimize how much code we need to trust (to be secure). We designed RLBox exactly for this."

Learn more: bit.ly/RLBoxforFirefox

Detecting when individual heart cells misbehave



A new tool monitors the electrical activity within and between heart cells using tiny sensors that poke into cells without damaging them. In the future, this type of device could enable scientists to gain more detailed insights into heart disorders and diseases such as arrhythmia, heart attack and cardiac fibrosis. The device directly measured the movement and speed of electrical signals traveling within a single heart cell—a first—as well as between multiple heart cells grown in culture. It is also the first to measure these signals inside the cells of 3D tissues such as organoids. The work was led by nanoengineers at UC San Diego.

Learn more: bit.ly/PopupSensor

Developing sex-specific treatments for heart disease

While diseases like heart failure and heart valve disease progress differently in men and women, treatments for these diseases remain strikingly similar for everyone. Brian Aguado, a professor of bioengineering at UC San Diego, aims to change that. He is studying sex-specific differences in disease—starting with cardiovascular disease—from the molecular scale all the way up to the organism level. He uses bioengineering tools to develop more relevant, sex-specific models and treatments for cardiovascular disease, enabling better clinical outcomes for patients who have long been ignored. Aguado doesn't just focus on equity in his research. He's also a strong advocate of equity and diversity among the researchers doing this work, and co-founded the LatinX in Biomedical Engineering (LatinXinBME) community to support diversity within the scientific community.

Learn more: bit.ly/AguadoLab2021