THE ECE CURRENT

FALL 2020

Research Initiative

Student Spotlight

UC **SANTA BARBARA**

Electrical and Computer Engineering

College of Engineering

Letter From The Chair

The Electrical and Computer Engineering department at UC Santa Barbara is one of the leading departments in the country with a rich history of fundamental and broad ranging contributions to the field. The department has continued its growth, adding two new faculty members, Peng Li in Computer Engineering and Galan Moody in Electronics & Photonics. Our junior faculty continue to excel, garnering best paper and young investigator awards. The department received close to $28M in extramural support during the 2019-20 academic year, continuing its tradition of exceptional research.

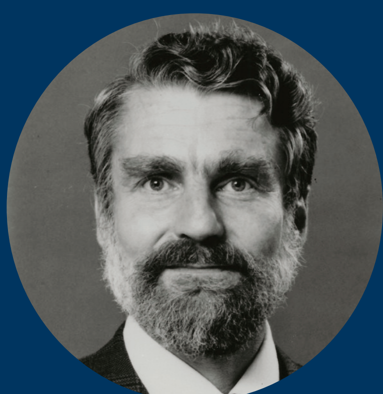
The past several months have been unprecedented due to the COVID pandemic that disrupted normal life around the world. Remote instruction, which started during the Spring quarter, will continue through the Fall'20 quarter, and we greatly appreciate the patience and cooperation of our undergraduate and graduate students and their families. In the middle of all of this, normal departmental and campus activities must continue, and our staff deserves special thanks for making the transition as smooth as possible.

As we welcome the new group of students and start a new academic year, we acknowledge the social, educational and intellectual challenges we face as a community. Electrical Engineering as a discipline has evolved significantly over the past few decades, and new opportunities continue to emerge in diverse fields such as information processing and quantum computing, machine learning, AI & robotics, advanced semiconductor devices and photonics. To address these emerging trends, the department has initiated a plan to revamp the undergraduate curriculum and advising to better suit the needs of the current students and their future careers in industry and academia.

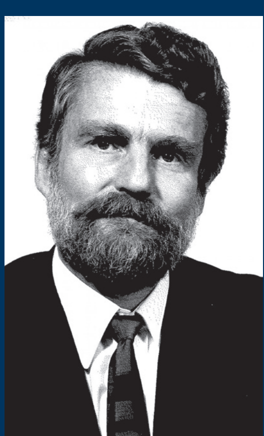
Our student body is diverse and the department aims at creating a healthy environment that students from all backgrounds can benefit. We look forward to a stimulating and productive year ahead.

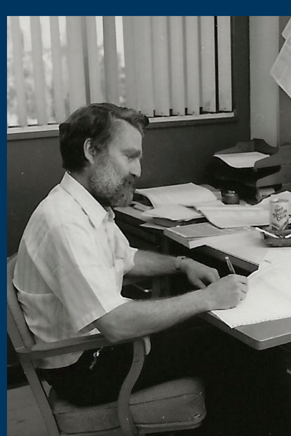
B.S. Manjunath, ECE Chair

In Memoriam



Augustine "Steen" Gray
1936 - 2019



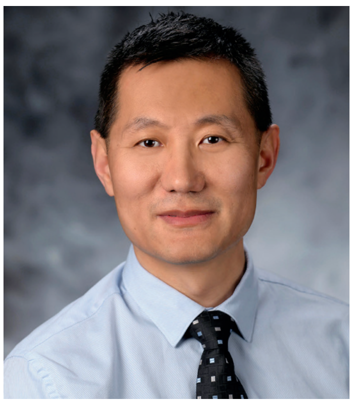


Professor Augustine Gray, known as "Steen," was a member of our faculty from 1964 to 1980. As one of the first three faculty members in the department, he helped to establish ECE on our campus, providing a strong foundation for its excellence today.

He received his BS and MS degrees from MIT, where he participated in the Electrical Engineering Cooperative program with General Electric. During this time, he worked in Menlo Park on the logic design of ERMA (Electronic Recording Machine Accounting), the first major banking computer. He went on to spend a year as a physics instructor at San Diego State College. He then continued his graduate studies at Caltech, where he received his PhD in 1964.

Professor Gray was a dedicated teacher and a highly respected colleague. Working closely with Professor Glen Culler, Gray made pioneering research contributions to real-time speech communication and processing through digital networks, from local academic networks to the ARPAnet and its successor, the Internet. He collaborated with UCSB PhD recipient John Markel on the theory and understanding of applications of linear prediction to speech processing. Two of their joint publications won professional awards from the Institute of Electrical and Electronics Engineers (IEEE) Group on Acoustics, Speech, and Signal Processing and its successor, the IEEE Signal Processing Society. In 1976 they co-authored *Linear Prediction of Speech*, which played a fundamental role in the early development of digital speech processing, and in 1982 were elected Fellows of IEEE. Together they founded Signal Technology, Inc. (STI), along with Larry Pfeiffer. After he retired from UCSB, Professor Gray held roles as senior scientist, vice president, and executive vice president of STI through 1988. From 1988 through 1993 he held various positions with derivative companies of STI, after which he became an independent computer consultant. In 1994, he and his wife, Averill, retired to Florence, Oregon, where they became active volunteers for the Oregon Coast Humane Society. Steen is survived by three of his siblings and their spouses, along with many nieces and nephews.

WELCOME New Faculty!



Peng Li

Professor in Electrical and Computer Engineering

Peng Li received his doctoral degree in electrical and computer engineering from Carnegie Mellon University in 2003, and subsequently worked as a post-doctoral research fellow at Carnegie Mellon. Before arriving at UC Santa Barbara, he was a faculty member of the Computer Engineering program at the Department of Electrical and Computer Engineering, Texas A&M University (TAMU) College Station since 2004.

Professor Li's research interests are integrated circuits and systems, brain inspired computing, electronic design automation, and computational brain modeling. He has authored or co-authored over 200 publications and co-edited two books. Among numerous other distinctions, Professor Li received five best paper awards from the leading conferences in his area of expertise, the ICCAD Ten-Year Retrospective Most Influential Paper Award, and the prestigious National Science Foundation (NSF) CAREER Award. He holds three U.S. patents and is a Fellow of the Institute of Electrical and Electronic Engineers (IEEE).

Galan Moody

Assistant Professor in Electrical and Computer Engineering

Galan Moody received his bachelor of science degree in engineering physics from the University of Colorado in 2008, master's degree and doctoral degree in physics, in 2011 and 2013, respectively, with an important thesis on "Confinement Effects on the Electronic and Optical Properties of Semiconductor Quantum Dots Revealed with Two-Dimensional Coherent Spectroscopy." Before arriving at UC Santa Barbara, he was a research scientist (2015-2019) at the National Institute of Standards and Technology (NIST) in Boulder, Colorado, a National Research Council postdoctoral fellow at NIST (2013-2015), and a postdoctoral associate at the University of Texas Austin (2013).

Professor Moody's research focuses on fabricating and characterizing nanophotonic devices and quantum materials relevant for quantum communications and computing, including 2D materials, semiconductor quantum dots, and hybrid quantum systems. Honors include the AFOSR Young Investigator Research Award; the ICSNN Young Scientist Award; an Innovations in Measurement Science Award, NIST; and a QISE-NET TRIPLET Award, NSF. Galan Moody is a co-author on over 40 journal papers, 50 conference presentations, and 25 invited conference presentations, seminars, and colloquia.

ALUMNI Q&A:

VIJAYSEKHAR JAYARAMAN

Founder, Praevium Research

Why did you choose UC Santa Barbara?

I had done my bachelor's degree and master's degree at MIT and was working at MIT Lincoln Labs when I started asking some co-workers what some of the good grad schools were. Several of them recommended checking out UC Santa Barbara. When I visited UCSB I was impressed by the faculty and students, and of course the beautiful environment. But what I saw was an uncommon spirit of cooperation among the faculty. They just really worked together and I think that is part of the success of UCSB.

Did you have a mentor during your time at UCSB?

I received a lot of mentorship from my adviser, Professor Larry Coldren. Even though he had a large research group of about 14 to 15 students, I received a lot of mentorship just through meetings and one-on-one conversations. In terms of academic mentorship, he was probably the strongest figure I had. I also worked with a unique group of students. They helped me understand how to solve problems, as well as balance work and life.

What was a pivotal moment or course for you at UCSB?

I took a course on semiconductor lasers with Professor Coldren and then I took another course on quantum mechanics with Professor Herb Kroemer. They were small classes, probably 20 students or less, and the faculty would take questions. I think hearing from world experts in a small classroom setting, and taking a fundamental class like quantum mechanics and then also taking a more applied class like semiconductor lasers, had an impact on me. Those were probably the two most impacting courses that I took as a student.

Many successful students come from UCSB's ECE department. What do you think makes the program so successful?

The faculty is unparalleled in their research experience and teaching ability. There isn't a trade-off between good research or strong teaching; UCSB has both. The faculty's ongoing experience in entrepreneurship and being in industry while at UCSB has contributed to successful students solving real problems and having applicable skills.

Yosemite trip with ECE and materials graduate students, 1990.

PhD graduation photo with Professor Coldren, 1994.

Larry Coldren's research group, 1992.

Is there anything you would advise ECE to do to help prepare their students for industry?
Santa Barbara has a really flexible internship culture so I would take advantage of that. Internships are helpful to companies and give a window for students to see what industry is like. I would encourage students to call local companies and pursue those opportunities.

Do you have any advice for entrepreneurial-oriented students within the College of Engineering, who really want to go out on their own to start a company?
Starting as an entrepreneur, one of the things I struggled with was thinking I didn't fit the profile of an entrepreneur. Maybe I wasn't hard-driving or extroverted enough or I didn't have some things that people think are necessary components. But it really comes down to perseverance more than any one quality.

How did the knowledge and research experience you gained in ECE propel you in your specialty and career path?
I had an extraordinary dissertation project given to me by Larry Coldren. It was the development of a new type of laser that ended up having a pretty big impact on telecommunications. I had first-hand experience seeing research in the lab make a difference in the marketplace and daily life. It was also interdisciplinary, which gave me confidence to venture into different areas. I started thinking about applying lasers to medicine and I had gained the confidence to approach a medical researcher and have a productive conversation. The confidence I developed really helped the entrepreneurial process.

From an alumnus perspective, why do you think it is important to give back to the College of Engineering and continue a sense of community?
It's always good to remember your roots. I want to be a person who is grateful for the opportunities I was given and recognize the role other people played in bringing me to where I am today. I aim to continue that cycle of gratitude by helping new graduate students to perpetuate that as well and instill in them that they can make a difference.

Tell us about your business that you started after graduating from UC Santa Barbara.
We named the company Praevium Research. Praevium is a Latin word, and means "to precede" or "lead the way." We're developing tunable lasers for medical imaging predominantly for three-dimensional imaging of the retina. They're also used in cancer imaging, environmental sensing and dental imaging.

What advice do you have for incoming ECE students at UC Santa Barbara?
My advice to students is to recognize and take advantage of the opportunities at UCSB. UC Santa Barbara is probably one of the top five institutions in the world in electrical engineering. Apply yourself by getting to know faculty and try to get into research early. I also recommend developing a rhythm of work and rest that is sustainable. The temptation is to work all the time and I think that actually makes you less productive. I worked seven days a week for the first couple of years, but at some point, I decided to take Sundays off. I became more excited about my research, having that day to recharge, and it's a habit I've continued for 30 years. I don't think Praevium would be where it is today if I hadn't developed that discipline of rest.

Vijay Jayaraman inside the Praevium Lab, 2020.

For an extended video interview, please visit:

ece.ucsb.edu/spotlights/vijay-jayaraman

Mahnoosh Alizadeh is an assistant professor of Electrical and Computer Engineering at UCSB.

Mahnoosh Alizadeh

Learning and Optimization for Sustainability

Designing algorithms to promote efficiency and decarbonization in modern infrastructure systems

Led by Professor Mahnoosh Alizadeh, the main focus of the Smart Infrastructure Systems Lab is to design learning and control algorithms that promote responsible and efficient use of large-scale societal infrastructure systems. Consider the canonical example of modern transportation systems. Every day, we experience the societal impacts of poor coordination in how users make travel choices through traffic congestion, accidents, parking scarcity and increased air pollution. But, the mobility scene is changing rapidly as electric vehicle (EV) adoption rates increase in conjunction with the proliferation of ridesharing and connected and autonomous vehicle (CAV) technologies. These advancements hold great promise in improving efficiency and reducing travel delays, accidents, the need for new infrastructure, and the carbon footprint of our societal transportation needs. However, without proper coordination, pricing mechanisms, and infrastructure interoperability, this vision cannot be realized. Consider how EVs are advertised as an environmentally-friendly commute choice. If the battery charging of EVs is left uncontrolled, it is expected that EVs will result in major increases in peak load and generation capacity and require significant infrastructure upgrades, hence exerting significant strain on electric power systems and heavily reducing the environmental benefits of transportation electrification. Instead of renewable energy resources such as wind and solar providing battery charge, expensive and potentially environmentally unfriendly generators would have to be dispatched to meet the uncontrolled charging load. Furthermore, due to significant increases in peak load, capacity violations could occur in power distribution systems, requiring major and expensive upgrades in assets, or policy changes to prevent residents from charging their vehicles at home. This highlights the importance of the design of smart charging initiatives to guide EV owners toward greener charging patterns. Alternatively, consider the case of ridesharing platforms. We all have first-hand experience of the importance of good vehicle routing and ride pricing algorithms employed by the system operator in order to manage travel demand, ensure low wait times, and promote driver participation in the platform. Last but not least, by managing traffic flow and reducing intersection wait times using smart traffic lights that coordinate vehicles virtually, CAVs can significantly decrease travel times and reduce the need for building new infrastructure. But, these clearly require interventions that enable coordination and cooperation among vehicles and their owners.

All of the problems mentioned share the same interdisciplinary and interrelated challenges: How do we *control* a cyber-physical system such as the power grid when its operation is directly affected by the choices consumers make? How do we *incentivize* customers toward a more socially-optimal behavior that potentially conflicts with their personal gains? And, while we are *learning* the correct mechanisms to optimize customer behavior, how do we ensure that the physical and cyber safety requirements of our infrastructure systems are not violated (e.g., preventing capacity violations in power systems in order to avoid blackouts)? The Smart Infrastructure Systems Lab studies these questions through a mix of tools from stochastic control, distributed

"We use a mix of tools from stochastic control, distributed optimization, signal processing, machine learning, and game theory."

optimization, signal processing, machine learning and game theory. We will highlight a number of recent efforts next, ranging from theoretical questions to real-world demonstrations of research results.

With the explosion of real-time data from infrastructure systems, machine learning (ML) algorithms are gaining popularity in systems that were classically operated using entirely model-based schemes and under strict safety requirements. Hence, we ask the question: how do we adapt recent advances in learning theory for better data-enhanced decision making in such safety-constrained complex systems? We have been able to provide theoretical guarantees for this challenging problem in certain instances. We have also demonstrated the value of such safety-constrained ML techniques using price-responsive electricity demand data to learn the optimal retail prices to charge for electricity in order to incentivize customers to become more environmentally friendly. Ultimately, the goal is to guide customers who want to minimize their electricity bills to consume more electric energy when supply is abundant and less when supply is scarce, while considering the load's impact on the operations of electricity transmission and distribution networks. This is one of many ways that learning from data can aid with renewable energy integration efforts.

> ***"How do we incentivize customers towards a more socially-optimal behavior that potentially conflicts with their personal gains?"***

In a related effort, the distributed and networked nature of coordination protocols to manage customer demand makes infrastructure systems susceptible to external influences and cyber-attacks which, if left untreated, can arbitrarily lower system efficiency. For example, price-responsive electricity customers may rely on automated home energy management systems, which can be hacked into by malicious agents. In our work, we design new control and optimization protocols to reduce the vulnerability of distributed multi-agent networks to external manipulation.

Last but not least, the Smart Infrastructure Systems Lab has been involved in multiple efforts to showcase the efficacy of our EV smart charging algorithms in real-world field demonstrations. In partnership with SLAC National Laboratory, Chargepoint Inc., and Google, we are implementing workplace charging protocols at the Google Mountain View campus and a new charging schedule for the EV bus fleet at Stanford University to showcase the benefits of smart charging in managing peak load, reducing local distribution system impacts, and developing methods to quantify value streams for EVs as a grid resource for renewable energy integration.

Smart Infrastructure System lab members (from right to left) Mahnoosh Alizadeh, Berkay Turan, and Nathaniel Tucker.

Chris Palmstrøm

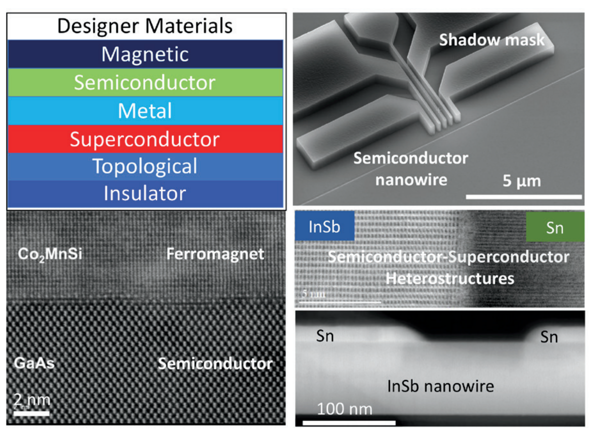
NOVEL MATERIALS FOR NEXT GENERATION DEVICES

Novel devices are key to the development of quantum information systems as well as ultra-low power electronics and photonics. These novel devices are made possible by new materials and materials combinations as well as breakthroughs in fabrication. Chris Palmstrøm's group focuses on integrating materials with different electronic and magnetic properties, ranging from semiconducting and insulating to metals and superconductors, in order to create single crystal epitaxial structures to be used in novel devices. These materials are fabricated using multiple molecular beam epitaxial growth systems interconnected by ultra-high vacuum sample transfer in order to grow novel heterostructures of dissimilar materials and characterized at the atomic level without breaking vacuum using scanning tunneling microscopy and electron spectroscopy techniques.

The Potential of Heusler Compounds

Heusler compounds are a class of ternary compounds with cubic crystal structures similar to III-V compound semiconductors. They can be metallic, magnetic, semiconducting, superconducting and topological. These characteristics suggest that Heusler compounds can go beyond the band gap engineering enabled by conventional compound semiconductors to engineer a much wider range of electronic and magnetic properties, thereby creating heterostructures with unique properties. The Palmstrøm group has grown a number of Heusler compounds epitaxially on III-V semiconductors. Through elemental substitution, they have demonstrated the ability to tune the properties from a semiconductor to a ferromagnetic metal.

Some ferromagnetic Heusler compounds have been predicted to have 100% spin polarization of the electrons at the Fermi level. This means that the electrons with majority spin behave as in a metal and the ones with minority (opposite) spin behave as in a semiconductor. Known as half-metals, these compounds are ideally suited for spintronic devices where the performance depends on the spin rather than charge properties of the electron. Heusler-based magnetic tunnel junctions have shown some of the highest magnetoresistance ratios to date with applications in magnetic hard disk read heads and magnetic random access memory devices. Palmstrøm's group, in collaboration with Paul Crowell's group at the University of Minnesota, have shown record spin accumulation in GaAs, opening up the possibility of semiconductor-based spintronic devices.

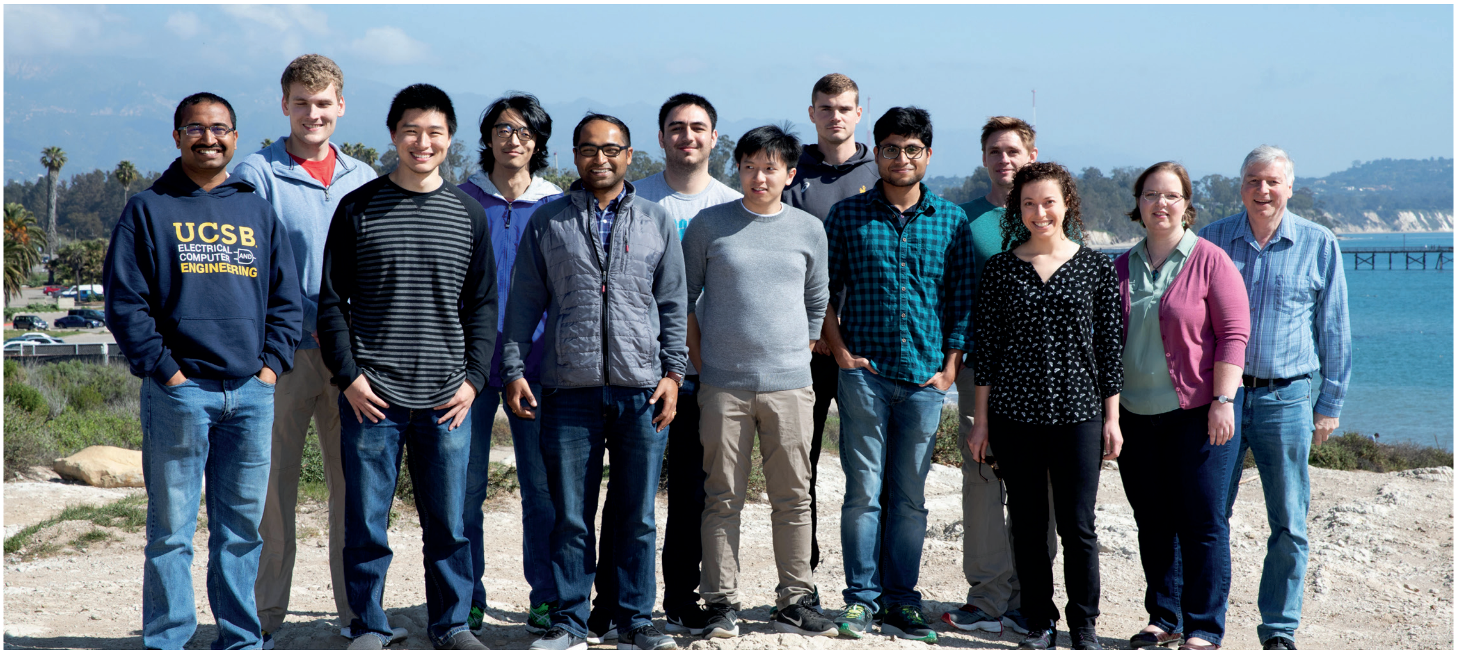


Integration of dissimilar materials through epitaxy for next generation devices.

Topological properties are predicted in a number of Heusler compounds, resulting in electronic states with linear energy-momentum dispersion where the electron spin and momentum are locked. Electrons with spins of opposite sign will move in opposite directions, a property that could prove useful for spintronic devices. To enhance the electronic transport properties, Palmstrøm group members Hadass Inbar, Alex Chang, Connor Dempsey, Aaron Engel, Shinichi Nishihaya and Shouvik Chatterjee are working on tuning the electronic structure through elemental substitution and strain. They are also investigating other topological materials that can be grown on III-V semiconductors including rare-earth monopnictides (rare-earth-group-V compounds) that have been predicted to be Dirac and Weyl semimetals.

Materials for Quantum Information Systems

The quantum information science revolution is opening up new ways of detecting, processing, manipulating and storing data. Secure data links relying on quantum entanglement between quantum states have been demonstrated. Specific algorithms are ideally suited for quantum computing, such as solving fundamental quantum mechanics problems in chemistry and materials and



Chris Palmstrøm Research Group, 2019.

the searching of large databases. A joint announcement from Google/UCSB on demonstrating 'quantum supremacy' - the demonstration that it could solve a specific algorithm much faster than any current classical computer - was a significant breakthrough in the field. However, scaling and error correction are still major issues for implementing large scale quantum computers. Each qubit is formed by an LC resonator consisting of a small Josephson junction that acts as a nonlinear inductor in parallel with a large co-planar capacitor. Palmstrøm group members Michael Seas and Anthony McFadden, in collaboration with David Pappas at the National Institute of Standards and Technology (NIST), are developing an all-epitaxial superconductor/semiconductor/superconductor where the Josephson junction and capacitor are the same device and much smaller, substantially reducing the qubit footprint.

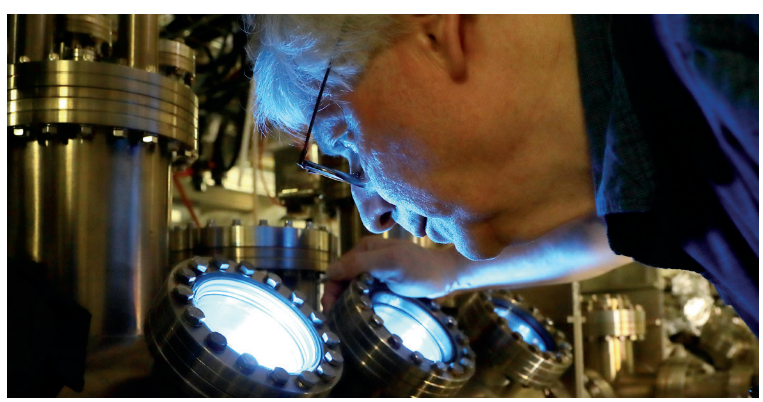
To create a logical qubit, a large number of physical qubits are required for error correction. If topological protected qubits can be made, the number of required physical qubits can be reduced by factors of 100 to 1000. It has been predicted that special quasiparticles can be used to create topological protected qubits. One such particle, the Majorana fermion, which has been predicted to form at the edge of a superconducting contact on a one-dimensional semiconductor nanowire, can be the basic ingredient for topological qubits. In collaboration with Microsoft Station Q, together with Erik Bakkers at the Eindhoven University of Technology and Sergey Frolov at the University of Pittsburgh, Palmstrøm group members Aranya Goswami, Jason Dong, Michael Seas and Mihir Pendharkar have been working on the selective area growth of semiconductor nanowire networks and creating atomically pristine interfaces between superconductors and InAs and InSb semiconductor nanowires and quantum wells. They have shown many of the signatures expected in the existence of a Majorana, but the definitive demonstration of its existence is yet to be achieved. A current focus in Palmstrøm's group is on creating device structures for this demonstration. Chris Palmstrøm and Andrea Young are co-leaders of the Interfaced Topological States thrust in the recently funded NSF-Quantum Foundry at UCSB, which is exploring a variety of topological states.

Novel Semiconductor Devices

Aranya Goswami, in collaboration with members of Mark Rodwell's and Jonathan Klamkin's groups, has been investigating confined epitaxial lateral overgrowth. A III-V semiconductor heterostructure is grown laterally inside a nanostructured dielectric box on a semiconductor substrate with the aim of developing ultra-low power, high speed, lateral tunneling field effect transistors.

The Next Generation

Chris Palmstrøm's group is advancing the design and structure of future devices through Heusler compounds, reduction of the physical qubit size, advanced in-situ processing and selective area semiconductor growth. New materials and novel structures play a key role in this next generation. While there remain many unanswered questions in this field, the Palmstrøm Group is hard at work finding the answers.



Chris Palmstrøm transferring samples in his laboratory's molecular beam epitaxial growth and characterization system.

Student Spotlight:
Zahra Fahimi

Why did you choose UCSB's Electrical and Computer Engineering department?

The Computer Engineering (CE) program offered at UCSB is one of the best in the U.S. The distinguished faculty, marvelous opportunities for collaboration, nutritious atmosphere to conduct research, and top-notch facilities are a few reasons that motivated me to choose UC Santa Barbara's ECE department for my graduate studies. Our group is one of the best in neuromorphic computing; we have state-of-the-art technology to fabricate memristors, and our research is mostly experimental and collaborative, which makes it both exciting and encouraging.

How did you learn about the program?

I did a lot of research in my undergraduate and graduate studies on the opportunities in integrated circuits and neuromorphic computing. I also did joint work with Professor Strukov's group as a visiting scholar for one year. The group is working on cutting-edge technologies. This experience led me to work hard, prove myself, and register in the PhD program.

What is campus life like for ECE students?

The ECE department offers a comprehensive curriculum that prepares students in a wide range of career options. While students are on campus we are involved in different academic activities. Either they attend classes, are in laboratories performing experiments and simulations, or they participate in academic events like seminars, lectures, and discussions. It is such a great positive atmosphere.

Looking back, what do you think you would have wanted your parents to know about UCSB ECE?

I'd like to assure them that the ECE department is a fantastic place for developing a career. They offer different research categories that provide a variety of options for students to choose their career. It is also located very close to Silicon Valley, which could be useful for finding internships or fulltime positions. It is a safe and wonderful place to live.

Students and parents often ask, what can you do with a computer engineering degree?

There are a lot of opportunities in this field. A lot of positions are available in industry for designing electronic devices, circuits, systems in mobile devices or smart vehicles. Many students secure jobs in software companies, for example as machine learning specialists. Some students start their own companies, and some enter research labs or academia.

What prepared you the most for studying engineering in college?

During high school, I studied very hard and put a lot of effort into learning physics and mathematics, which are the foundations of any engineering program. I also did the experiments in laboratories with a lot of passion and energy.

What were some challenges you faced as a student/researcher?

Experimental research is full of different challenges. For example, in our group we design large scale systems in centimeter scale using devices in nanoscale that translate into circuits with many millions of devices. Designing such systems is very complicated and requires so much effort, energy, and time. But the passion to build something useful, the love of this job, and the joy of looking at the micrograph helps us accomplish this.

Can you tell us of anyone who you looked up to?

Before entering into college, I looked up to my brother who is also an electrical engineer. His passion for electronic circuits inspired me to become an engineer myself. Now, I look up to women in scientific computing and electrical engineering.

What have you learned that has surprised you the most so far?

In the ECE department, the research on circuits spans over a wide range of frequencies and applications with some people working on Terahertz systems. I found (and still find) it very surprising that we can fabricate these systems in sub-deca nanometer scales and predict their behavior almost precisely.

Faculty Mentorship:

Professor Ramtin Pedarsani

What does mentoring mean to you and why is it important in your profession?

I think a good mentor is someone who cares about the future of their students, and fully supports them in their academic efforts and even non-academic difficulties. It might take time for students to find their research interests, so it is crucial that a mentor guide them to find their interests and equip them with tools to thrive in their careers.

As a student did you have faculty that you looked up to?

I received my doctoral degree at UC Berkeley and worked with top researchers in my field including my PhD adviser, Jean Walrand, and postdoc adviser, Kannan Ramchandran. I also collaborated with Pravin Varaiya, a faculty that I look up to. He has contributed significantly in many different areas and application domains, and is very broad, flexible, and visionary in his research. As researchers, it is important that we not limit ourselves to narrow fields and that we be open to new areas and applications throughout our career.

Do you think it is helpful for undergraduates to find a mentor?

Yes! Many students don't have a clear view of their future career options, their interests, and their goals. It would be great for students to talk to a mentor, get exposed to undergraduate research, get advice about different fields, ask about internship opportunities, and seek general career advice.

How do you measure your success as teacher?

A teacher is successful if students learn material that is useful for their career and future success in their field. I get most excited when students come to me after the class, and tell me that they want to know more about a topic, do research in a related field, or switch their research directions based on the information they learned throughout the course.

Do most students come to you with a clearly defined path and goal? If not, how do you help them get there?

Mostly no! I think the key is to care about their future, try to help them find their interests, and then explain their options to them. I try to elaborate on different paths they can take, the pros and cons of each, and how to be successful in each path.

What aspects of an academic career do you find most rewarding?

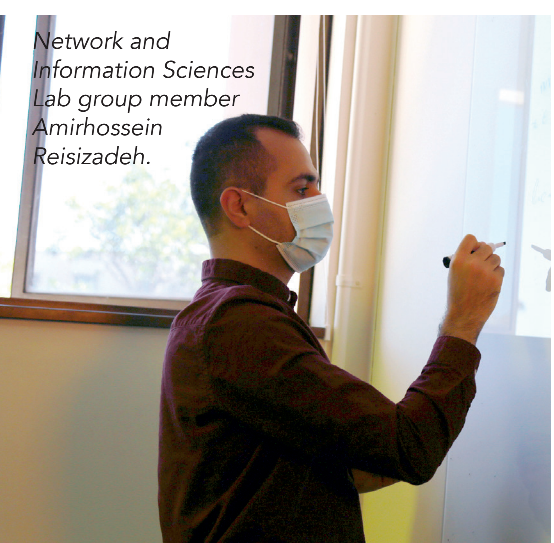
For me, solving new problems with students is most rewarding. These can be both purely mathematical problems where we prove a new theorem that is impactful in engineering systems, or a new algorithm designed for an application. The freedom to explore new research directions is also very rewarding.

What do you hope your students take away from their time in your lab?

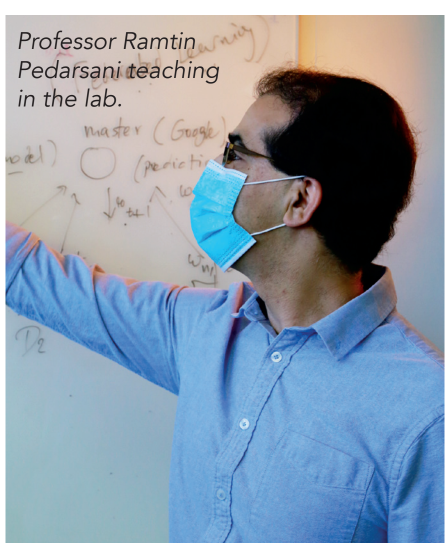
The most important thing they can learn in my lab is critical thinking and how to make impactful contributions to a field. While the thesis's contribution is important, I don't find it to be the most important thing in PhD education. Learning how to approach and solve a new problem is what I mostly want the students in my lab to learn.

Do you have any advice for ECE students?

Students should enjoy learning and the experience of being a student. The goal is not to maximize GPA, but to learn how to be a critical thinker and develop skills to help build their career. We have many opportunities at UCSB, and students should use these opportunities to the best extent without losing the joy of studying and the unique undergraduate experience.

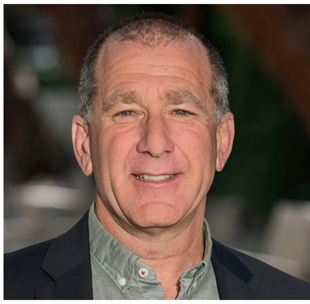


Network and Information Sciences Lab group member Amirhossein Reisizadeh.



Professor Ramtin Pedarsani teaching in the lab.

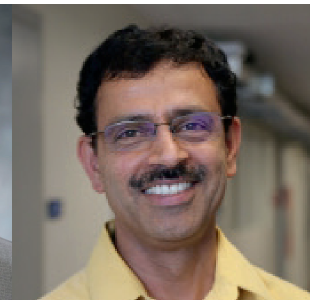
FACULTY **AWARDS** '19-20



Dan Blumenthal
2020 OSA C.E.K. Mees Medal Winner

Yogananda Isukapalli
2020 College of Engineering Outstanding Faculty Award for CE

Jonathan Klamkin
2020 Director's Fellowship from the U.S. Defense Advanced Research Projects Agency



B.S. Manjunath
2020 IEEE Computer Society's E.J. McCluskey Technical Achievement Award

Sanjit Mitra
2019 Fellow of the National Academy of Inventors

Galan Moody
2019 AFOSR Young Investigator Research Program

Yasamin Mostofi
2019 Fellow of the Institute of Electrical and Electronics Engineers

Mark Rodwell
2020 College of Engineering Outstanding Faculty Award for EE

Spencer Smith
2019 Presidential Early Careers Award for Scientists and Engineers (PECASE)

Yuan Xie
2019 AAAS Fellow; 2019 ACM Fellow; 2020 IEEE Computer Society's E.J. McCluskey Technical Achievement Award

STUDENT **AWARDS** '19-20

Jenna Bovaird (EE)
John & Sheila Lake Award

Boning Dong (CE)
Hynes-Wood Award

Rick Franc (CE)
Outstanding Senior

Weiyun Jiang (EE)
Outstanding Senior

Ryan Kirkpatrick (CE)
Outstanding Teaching Assistant

Raphael Ruschel dos Santos (EE)
Outstanding Teaching Assistant

Doluca Family Makes Generous Gift in Support of Undergraduate Lab Equipment

The Department of Electrical & Computer Engineering is deeply grateful to Tunç and Lale Doluca for their generosity in supporting the department's equipment needs for its undergraduate instructional laboratories.

"Maintaining and advancing the department's level of academic excellence is dependent on having the right laboratory equipment by which to teach the principals of electrical and computer engineering," said outgoing ECE Department Chair Nadir Dagli. "Through their gift, the Doluca family has made an enormous and positive difference in our ability to advance the quality of our undergraduate engineering program."

"Lale and I are happy to help the department secure lab equipment for our students," said Mr. Doluca. "I am a true believer in 'learning by doing.' In our profession, lab equipment is essential for hands on measurement, evaluation, and experimentation, to become outstanding electrical engineers."

The Doluca family's gift will make it possible to purchase a variety of needed equipment for the department's laboratories, such as oscilloscopes, function generators, power supplies and meters, a Bruker Dektak surface profiler, an E-Beam evaporator nano master NEE-4000, among others. Tunç serves as the president and CEO of Maxim Integrated and received his MS degree in Electrical Engineering from UCSB in 1981.

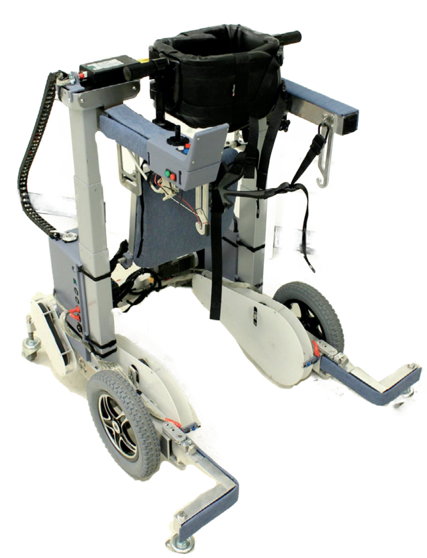
LegTrek Device Developed by ECE and ME Seniors Takes Second Place in New Venture Competition

During the 2018-2019 academic year, a team of 11 undergraduates from the ECE and ME departments took on a challenge posed by Sophie, a local seventh-grader, for their senior Capstone project. Sophie has triparetic cerebral palsy and uses a power chair for mobility, but would really like to walk because she dreams of one day being a teacher or owning a bakery. Her challenge to the students was to build her an assistive walking device.

With guidance from Sophie, her mother, and her physical therapist, the team designed and built LegTrek, a device that provided Sophie the comfort and stability needed for her to walk and which could also convert to a seated device much like her powered wheelchair.

The following year, while completing their MS degrees in ECE at UCSB, LegTrek veterans Kevin Huynh-Tran and Brandon Luu began looking into the possibility of commercializing LegTrek so that the millions of other children who, like Sophie, are confined to a wheelchair would also someday be able to walk. They assembled a team that also included Biological Sciences major Alice Wen, Sociology major Saloni Methi, and Economics major Matthew Davies. The team worked hard to create a business plan that they could enter in the UCSB New Venture Competition (NVC). As part of this effort, they demonstrated their device at the Abilities Expo in Los Angeles, where they were able to connect with and receive feedback from numerous experts in adaptive activities.

The team presented the initial version of their business plan at the UCSB New Venture Fair, where they were selected as one of five teams to advance to the New Venture Competition Finals. At the NVC Finals, the team presented their business plan to a panel of three judges. They received second place overall and were awarded $7500.



LEGtrek
Walk Empowered

More information about LegTrek, including a video which features Sophie using the device, can be found at: https://capstone.engineering.ucsb.edu/projects/legtrek

For more information about the Electrical and Computer Engineering Capstone Programs or to become involved as a project sponsor or mentor, please contact Illan Ben Yaacov <ilan@ece.ucsb.edu> or Yoga Isukapalli <yoga@ucsb.edu>

THANK YOU

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INVEST IN
The Department of **Electrical and Computer Engineering**

The goal of the Department of Electrical and Computer Engineering at UC Santa Barbara has always been to provide our students with the best possible opportunities to learn and develop. The faculty, students, and administration have created an atmosphere of interdisciplinary and collaborative research that is renowned throughout the nation and is the cornerstone of our success.

Your investment in the Department of Electrical and Computer Engineering plays a critical role in our ability to fulfill our mission and provides essential support of ECE's teaching program and research enterprise.

Department funding opportunities include:

- **Lab Naming Opportunities** provide funding for major capital improvements and equipment upgrades in our instructional facilities. Priority renovations and naming opportunities include: Digital Lab, Controls Lab, Computer Engineering Lab, Microwave Lab, Digital Signal Processing Lab, and the Instructional Clean Room.
- **Unrestricted support** is allocated to the highest priority needs of the Department.
- **Roger Wood Endowment** was established in honor of esteemed faculty member Roger C. Wood, supports undergraduate and graduate fellowships, faculty, and state-of-the-art teaching facilities.
- **Endowed chair establishment** honors, encourages, and supports the professors whose brilliant minds and commitment to education and research promote the University's mission.
- **Petar V. Kokotovic Distinguished Visiting Professorship** was established by Dr. Kokotovic's former students and colleagues as a vehicle for honoring and recognizing his contributions to UCSB students, the UCSB campus, and the academic community. The fund supports an annual named distinguished visiting professorship.

To give to ECE, please visit
giving.ucsb.edu/to/ece

Thank you for your generous gift.

ECE COVID-19 Recent Research

Joao Hespanha

ECE Professor Joao Hespanha and his Networked Control Laboratory are developing tools to inform and advise decision making for control of large-scale global pandemics. Key goals of the project include making reliable predictions for the state of a pandemic in the next few days/weeks/months, estimating effects of governmental measures in the dynamics of the pandemic, and designing protocols for effective control of a pandemic to prevent overloading the healthcare system. A key feature of his work has to do with "annotating" predictions/estimates/protocols with quantitative measures of uncertainty so decision makers can explore realistic best-case and worst-case scenarios.

B.S. Manjunath

Contributing to the worldwide fight against the Coronavirus, researchers at Vision Research Laboratory, UCSB, in collaboration with Santa Barbara Cottage Hospital, are working on an AI paradigm that will identify characteristic differences in Computated Tomography (CT) scans between COVID-19 and other similar types of viral pneumonia. Dr. Ashutosh Shelat, radiologist at Cottage Hospital and collaborator on this project, notes distinguishing other viral pneumonia from COVID-19 is difficult, even for experts, and can lead to nonspecific recommendations and diagnosis. S. Shailja, a graduate student in ECE, and Manjunath, ECE Chair and Director of the Center for Multimodal Big Data Science and Healthcare, are building computer vision models to detect characteristic signatures in lung CT scans of COVID-19 patients. In addition to aiding radiologists in diagnostic differences between COVID-19 and other viral pneumonia, this research will focus on differentiating the U.S. demographic from other worldwide sources and thus remove concerns of genetic drift of SARS-CoV2 over its progression. Methods developed will be available online using the UCSB BisQueMD web portal.