THE ECE CURRENT

Fall 2015

LI-C WANG
Big Data Analytics for Semiconductor Chip Design Industry

John Gerngross
Q & A with Alumni and Founder/President of Condor Engineering

CHAIR'S LETTER

And the Nobel Prize goes to... Professor Shuji Nakamura. For the second time, the Electrical and Computer Engineering Department received the news of a Nobel laureate among its faculty with great enthusiasm. Back in 2000, our colleague Herb Kroemer received the Nobel Prize in Physics and we became one of the only two Electrical Engineering Departments in the U.S. with a faculty member at the receiving end of the coveted prize (the other Department was at Princeton University). Last year, our colleague Shuji also received the Nobel Prize in Physics for his role on the invention of the blue LED. We could not miss the opportunity to include in this newsletter a short story by Steven DenBaars on Shuji's recruitment to UCSB.

Since 2013, the Center for Science and Engineering Partnerships at CNSI and Professor Jon Schuller here at ECE have been organizing The Art of Science competition. This initiative encourages UCSB researchers to "tell the story of their research through the aesthetic; whether it be spectroscopic images of a new material, data from a series of simulations, photos of a device or instrument, or some other aspect of research captured visually." Several of the images submitted to this competition were created by students and postdoctoral scholars in our department and can be seen in the front and back cover of this issue of *The ECE Current.* These are spectacular demonstrations that Science and Art can (and should) go hand in hand.

Please browse this issue of *The ECE Current* to learn more about what is going on in the department. You will learn that our recent recruiting season brought to our department four outstanding new faculty members, you will discover how we are encouraging local high school students to pursue a career in engineering, and you will see that our Alumni continue to succeed in the business world, while maintaining close contacts with the Department.

João Pedro Hespanha

2014 NOBEL PRIZE WINNER
SHUJI NAKAMURA

The 2014 Nobel Prize in Physics was awarded to Shuji Nakamura, Professor of Materials and Electrical and Computer Engineering at the University of California, Santa Barbara. The prize was awarded for the invention of efficient blue light-emitting diodes.

In a recent TIME Magazine article Shuji thanked ECE Professor Steven DenBaars as a colleague, business partner, and best friend. Steve shares his Shuji recruitment story.

Nobel Prize winner Shuji Nakamura has been a Professor with the UCSB College of Engineering since 2000, but the road to getting this future Nobel Prize winner to join the UCSB community did not come without great adventure and real bodily risk, as ECE Professor Steve DenBaars can attest. Steve and Shuji met at a conference in Japan in 1993, just after Shuji had announced his development of the first group-III nitride-based high-brightness blue/green LEDs. Impressed with his work, Steve and ECE Professor Umesh Mishra and Materials Professor James Speck kept in contact, getting him as a plenary speaker at conferences and citing his work often. In November of 1999 Steve received word that Shuji would be leaving industry to pursue academia, and had already received competitive offers. Knowing he would be a vital member of their team, Steve and Umesh quickly boarded a plane to Japan. As Steve recalls, "We took Shuji out for dinner and drinks late into the night in Osaka, and told him all of the reasons why Santa Barbara was the best place to be." Their efforts paid off, and within a few months Steve was flying back to Japan with an offer letter in hand. He touched down on a rainy day in Osaka, and boarded a bus to the meeting place, but in route the bus slid out of control and crashed into a wall. A bit bloody and in a rush, Steve flagged a cab and still made it to the meeting a half hour late and obviously injured, just as Shuji was leaving. Shuji joked, "What happened, did my company beat you up?" Despite outrageous circumstances, he officially accepted UCSB's offer.

STUDENT SPOTLIGHT

Justin Pearson, ECE Graduate Student Researcher

For the past five summers, Professor Hespanha's lab has mentored students from Dos Pueblos High School in Goleta, California. The original graduate student mentors (Daniel Klein and Jason Isaacs) presently work as a research scientist at Intellectual Ventures and as an Assistant Professor in Computer Science at the California State University at Channel Islands, respectively. The current mentors are Graduate Student Researchers in Professor Hespanha's lab: David Copp, Justin Pearson, Hari Sivakumar, and Henrique Ferraz.

A circular white robot the size of a large banana cream pie trundles across the floor toward an ordinary empty metal coffee can. It swoops in a wide arc around the can like a predator circling prey, then drives directly into it, nudging the coffee can across the floor. Like a child balancing a broomstick, the robot constantly adjusts its position behind the coffee can to keep it from rolling off the side. The robot pushes the coffee can past a small crowd of high school students, and as it enters a circular target of black electrical tape on the dusty floor, the robot stops.

"Time," announces a graduate student. A team of two Dos Pueblos High School students eagerly write their score on the whiteboard. Another two students reset the field and prepare their own robot. The fifth and sixth students turn back to their laptops, squashing the (hopefully) last bug before it's their turn to showcase their robot-driving program.

The robots in this can-pushing race perform autonomously — not under remote-control. Once the students start their program, they can only watch as their robot faithfully executes their pre-loaded program. This week's goal is to push the coffee can to a target on the floor as fast as possible. Next week the students will write programs to drive the robots like a flock of birds — moving together while staying a safe distance apart.

This is a glimpse into a robotics internship hosted by Professor Joao Hespanha and his lab in the UCSB Department of Electrical and Computer Engineering in collaboration with the Institute for Collaborative Biotechnology. Over the course of six weeks, Dos Pueblos High School students learn programming, control theory, and robot kinematics — everything required for a variety of robot challenges like can-pushing, flocking, and waypoint-following.

Students enrolled in the Dos Pueblos Engineering Academy will employ these skills while competing in the annual FIRST Robotics competition.

NEW FACULTY

Jim Buckwalter

Jim graduated from the California Institute of Technology (Caltech) with a BS with Honors in electrical engineering in 1999, an MS degree from the University of California, Santa Barbara in 2001, and a PhD degree in electrical engineering from Caltech in 2006. From 2006 – 2014, he was a faculty member in the ECE department at the University of California, San Diego, where he was the head of the high-speed integrated circuits laboratory. Jim has received the DARPA Young Faculty Award, NSF CAREER award, and IEEE Microwave Theory and Techniques Society Young Engineer Award. His research interests are in areas of high-frequency and high-speed integrated circuits and systems. He is the author of more than 90 peer-reviewed conference and journal papers.

Jonathan Klamkin

Jonathan received his BS (2002) and MS (2004) in electrical and computer engineering from Cornell University and his PhD in electronic materials from the University of California, Santa Barbara (2008). From 2008-2011, he was a member of the Technical Staff in the Electro-Optical Materials and Devices Group at MIT Lincoln Laboratory and from 2011-2013 he was an Assistant Professor at the Institute of Communication, Information and Perception Technologies, Scuola Superiore Sant'Anna, Pisa, Italy where he was the recipient of an Erasmus Mundus scholarship and a Marie Curie fellowship, and served as the director of the Integrated Photonic Technologies Center. In 2013, he joined Boston University (BU) as an Assistant Professor in ECE and Materials Science and Engineering. He is the recipient of a NASA Early Career Faculty Research Grant.

Jason Marden

Jason received a BS in mechanical engineering in 2001 from UCLA and a PhD in mechanical engineering in 2007, also from UCLA under the supervision of Jeff S. Shamma, where he was awarded the Outstanding Graduating PhD Student in Mechanical Engineering. Jason is a recipient of the NSF Career Award (2014), the AFOSR Young Investigator Award (2012), the ONR Young Investigator Award (2015), and the American Automatic Control Council Donald P. Eckman Award (2012). Jason's research interests focus on game theoretic methods for the control of distributed multiagent systems.

Clint Schow

Clint earned his BS, MS and PhD from the University of Texas at Austin. He spent eleven years at the IBM T. J. Watson Research Center demonstrating the first parallel optical transceivers capable of terabit/s data rates, setting multiple records for the fastest and most efficient photonic links, and developing a variety of Si photonics technologies for transceivers and switches. For many years he has helped to organize the leading conference in optical communications, Optical Fiber Communication Conference, serving on the Steering Committee and as a General Chair in 2015. Clint's research focuses on closely integrating electronics and photonics to push the boundaries of speed and efficiency for the optical links that data centers and computers increasingly depend upon to share and move data.

Q&A: ALUMNI JOHN GERNGROSS

MS ECE, UCSB, 1982.

Mr. Gerngross holds a Master of Science Degree in Electrical Engineering from the University of California, Santa Barbara and a Bachelor of Science Degree in Mathematics from Boston University. He founded Santa Barbara-based Condor Engineering in 1989, which was a supplier of avionics databus tools and solutions. The company's product portfolio included embedded, test, and simulation interfaces for commercial and military avionics databuses. Condor Engineering was acquired by GE Intelligent Platforms in 2006. Mr. Gerngross previously served on the Board of Trustees and Overseers of Sea Education Association, a nonprofit dedicated to undergraduate ocean education.

Q: Why did you choose UCSB for graduate school?

At the time I was actually working in engineering at Raytheon, here in Goleta. I knew that I needed more education and the department here was outstanding so it was an obvious choice. If it weren't so good, I would've had to leave town and go elsewhere, but since it is known as a great program it was just an obvious choice. In fact, looking back, I realize that I really would've preferred to come here for my undergraduate studies too. If I had known about it at the time, that's what I would've done.

Q: What do you think UCSB's strengths are in engineering, particularly in Electrical Engineering?

I think the Electrical Engineering Department's strengths are clearly the staff, the extremely strong faculty, and the forward-looking leadership that supports programs such as a capstone, which I think is a critically important piece of the undergraduate learning program. I firmly believe in the capstone program as an opportunity for students to get real world experience, which is one of the most important things they can get here. They learn to work with people, how to integrate technologies, and how to actually engineer something, so I think those are huge strengths. The capstone program is very important because it gives the students real world experience, working in teams, working to deadlines and specification, integrating the various disciplines in engineering into an end product. I've seen the products they create and it's fantastic; it's a great learning experience. The full support of the faculty is a very powerful and profound impact on the students.

Q: Do you have any advice for entrepreneurial students at UCSB in the College of Engineering?

Yes, I have advice for entrepreneurial students and I'll try and keep it to a modest list. My first piece of advice is: surround yourself with good people. You can't do it alone and you need high quality people around you. Secondly, don't listen to the naysayers. There will always be someone saying, "You can't do it. It can't be done.

It won't work. It's been done before." Don't listen to them, follow what you know, stick to your course, and stay with it. Third, you really have to know your customer. You might have a great technology, or a cool product, but without the customer it's not worth anything. You really need to understand who your customer is, what they want, what they need, what they want to pay, and how many of them there are out there. Finally, my last advice is to not sell yourself short. You're probably going to seek out financial support, and when it comes to the money you have to remember there are not that many people that have a good idea and can execute that good idea. Money is easy to find, good people with good ideas are hard to find. So, don't undervalue yourself, don't give it away, negotiate hard, and make sure you keep as much for yourself as you can.

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

I would say the pivotal course was CS 270, Advanced Operating Systems with John Bruno. He actually became a lifelong friend and mentor for me. The things that I learned in that course, in terms of low-level device control, software control, were what I used to leverage my career and ultimately became key elements of the products I created for Condor Engineering. Also, John Bruno became a colleague in my company and was responsible for an important part of our product line at one point. That course in particular was probably the single most important course in defining my professional career.

Q: Tell us about one of your proudest moments since joining the industry.

I'd say my proudest moment since joining this industry was the time I signed the paper to sell my company, Condor Engineering, to General Electric. For me, that was a tremendous validation of what we had done. Knowing that we had created something of such quality and importance that General Electric wanted to incorporate us into their embedded systems division. Knowing that our deal crossed the desk for approval by the Chairmain, Jeffrey Immelt – that's how important it was. It was also definitely one of the most poignant times of my professional career because I had to let go of my company, this business that I had nurtured for seventeen

years, my family. I knew there would be big changes ahead, and I also knew as an entrepreneur that it would be challenging to assimilate into a larger corporate structure like General Electric. It was a very proud time for us, nonetheless.

Q: Any advice to your fellow engineering alumni about getting involved with the college?

My advice to my fellow alumni is to come to campus, walk around, see what's going on, meet the people and the students, look at the projects, walk the halls, go see the labs. Alumni need to get involved. It's amazing what's going on here in the past 30 years, and it continues to grow. As soon as you visit the campus and see this progress, you're going to get inspired and motivated, just like I've been. I think that's the best way to kick-start your involvement here. This is not one of those "ivory tower" institutions – this is a fully engaged institution that wants to work with industry. They really want to work with us and develop a synergistic relationship. They want and need our support. I think they deserve it and we should give it to them.

Q: You've continued to give back and be involved in UCSB. What motivates you to continue to stay involved and give back to your alma mater?

My motivation to give back to my alma mater is primarily in two areas. First, it's a measure of my appreciation. Without UCSB, I wouldn't have gotten to where I went in my life. I'm very appreciative of everything the University has given me, both in terms of education and of the people who supported me throughout my life. For me it's very important to give back and show that appreciation. Secondly, I enjoy doing it. When I write the check, I feel good. When I write the check, I know I'm helping future engineers get out there. I go to the capstone program presentations and I see the kids doing their projects and know that in some small way I helped make that happen, and it makes me feel like I've contributed. The bottom line is, the University is an exciting, wonderful place and I believe in UCSB. I think it's a fantastic place. There are so many exciting things going on here.
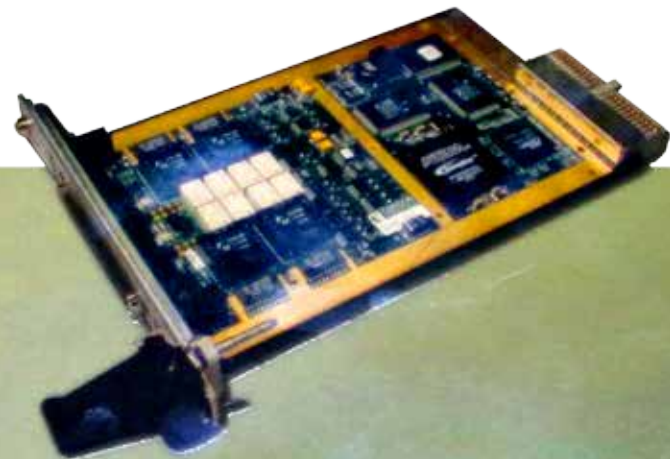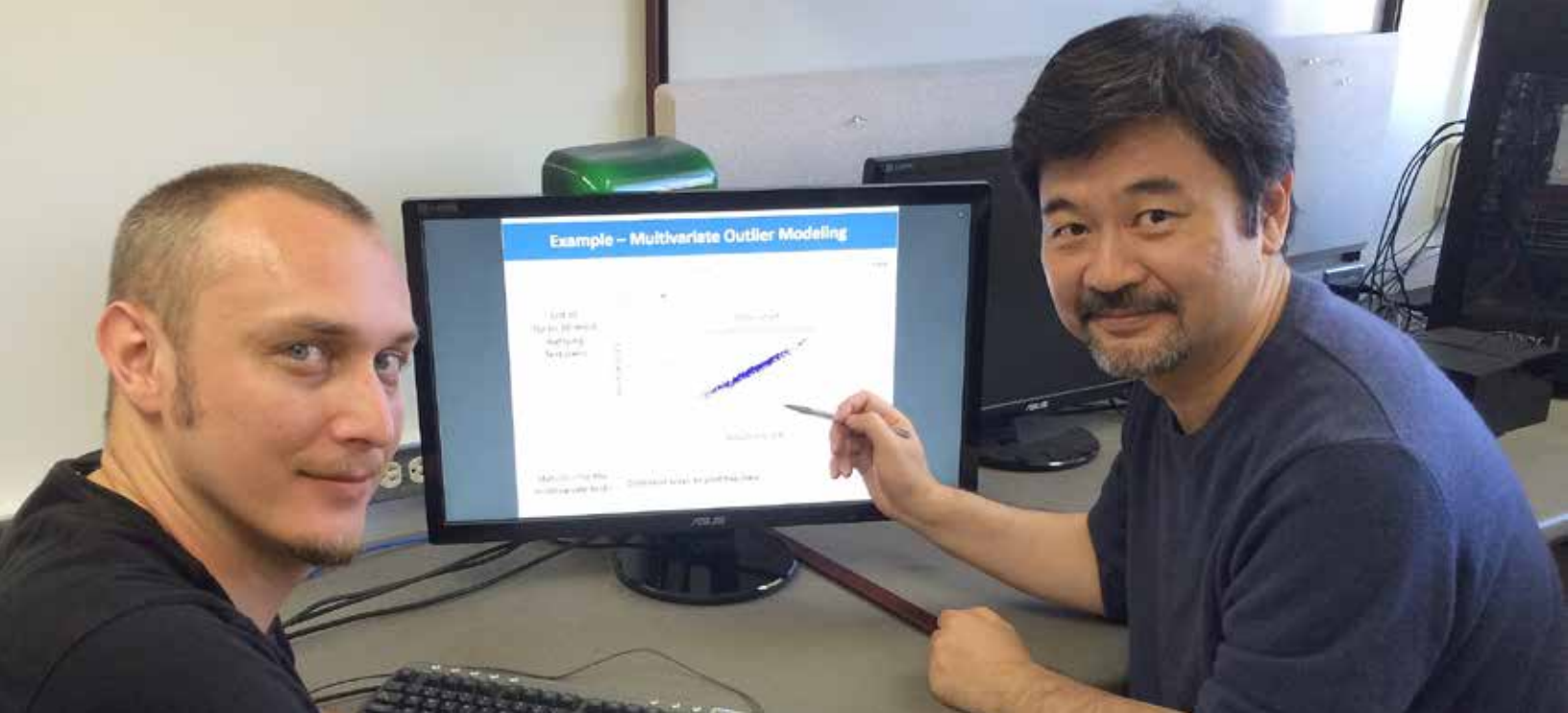
RESEARCH INITIATIVE
Professor Li-C Wang

Big Data analytics for semiconductor chip design industry

Modern semiconductor chip design follows a rather complicated process. Before the silicon chip is manufactured, design relies upon models and simulation for optimization and ensuring correctness. In this pre-silicon design stage, tremendous amounts of simulation data are generated by Electronic Design Automation (EDA) software tools. These data are essential for checking our confidence in the design quality and for debugging and improving on the design. Once the design is moved into production, focus shifts from design correctness and optimization to manufacturing yield, test cost, and product quality. In this post-silicon and production stage, vast amounts of measurement data are collected through a sequence of chip testing steps. These data are essential for improving the yield, ensuring product quality meets customer requirements, and driving down the test cost. The pre-silicon simulation data as well as post-silicon measurement data provide opportunities to Big Data analytics. This application is fundamentally different from other applications of modern data mining technologies. One key difference is that the data is based on chip design, which entails that much of the knowledge regarding the design is available. In a sense, data analytics are used to enhance this already-sophisticated design knowledge. This presents unique challenges not addressed in other data mining applications.

Data mining in design automation and test

Dr. Wang's group is among the first to pioneer the application of modern data mining technologies to the semiconductor chip design process. For more than a decade, his group has explored application of data mining in areas including verification of functional correctness, feedback of knowledge extracted from silicon data to design modeling, identification of potential problematic layout features which undermine manufacturability, performance yield improvement, prediction of maximum operating frequency (Fmax), parametric test cost reduction, and latent defect prevention. Several novel approaches developed by his research have been experimented on industrial designs and some were implemented as software tools, which have been adopted in industrial design flows.

Functional verification

Verification of functional correctness is a bottleneck in the design process. For a processor or system-on-chip (SoC) design, over a year of intensive simulation is often required to reach a bug-free design. The research has developed technologies to implement the concept of novelty detection in this context. The approach analyzes input stimuli, which for a processor or SoC are basically assembly programs, prior to simulation in order to identify novel stimuli that most likely contribute to the design quality. In one example, when this approach is applied to verify a commercial low-power processor, it demonstrates a savings of 80-95% of the simulation cost. Another approach is developed to extract knowledge from test stimuli that excite bugs and critical events. Based on architecture and micro-architecture features, rule learning is applied to discover unique properties of the assembly programs. A recent trial of this technology on a commercial processor demonstrated savings of manual engineering costs for design quality improvement.

Test data mining

In the post-silicon stage, the research aims to improve manufacturing yield, enhance quality, and reduce test cost. The research comprises two general sets of test-data-driven solutions: one for analyzing statistical dependency between two groups of parameters and the other for identification of outliers in a collection of samples. In a recent application, the solution of
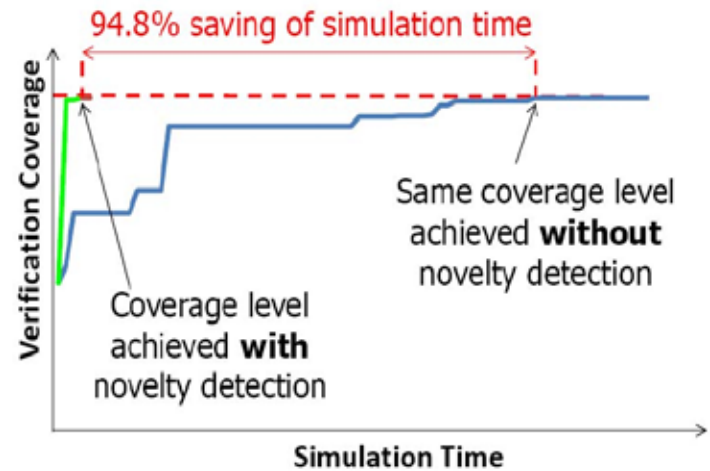
Example of simulation time saving for verifying a commercial processor

statistical dependency analysis helped find adjustments to the manufacturing process parameters, which resulted in over 25% improvement to the manufacturing yield for an automotive sensor product. The software tools and methodologies for outlier analysis provide a comprehensive solution for reaching the target of zero customer return rate, which is crucial for products such as those sold to the automotive market. One particular approach from the research has been adopted by a major chip supplier in the automotive market as part of its flow for analyzing customer returns. Several other approaches are being evaluated for enhancing the current flows of quality assurance and test cost reduction.

FACULTY MENTORSHIP

Professor Luke Theogarajan

Q: You were awarded the Outstanding Teaching Award in EE for 2009, 2010, 2011, and 2012; what qualities make an outstanding teacher?
Honestly, I don't think I'm an outstanding teacher; we'll start with that. Fundamentally, it's just that I care. I care about what I do and what people learn. I don't make it easy for my students; they are not given a recipe. I am a difficult professor, but I think it's because, for the first time in their undergraduate career, students are forced to think critically, they are challenged for the first time. The year they spend with me they scream, shout, tell me I need to see a therapist, and their reviews re-

flect those frustrations. But really, a year after they graduate they realize that they did learn something, and that they actually enjoyed it.

Q: Do you keep in touch with any of your former students?
I just received an email today from a former student that just started working in HRL; he graduated about two years ago with an undergraduate degree. A lot of them keep in touch with me, partly because I give them recommendations for jobs, but in general they send me emails letting me know what they're doing.

Q: Do you have any general advice for UCSB ECE students?
My general advice is to be passionate about what you're doing. Do not go into engineering because someone told you to, but because you want to be here. This is the most important advice I can give; you really have to want this.

Q: You always have an office full of students; could you tell us more about that? What keeps them coming back?
Well, I think they keep coming back because they do so poorly on my exams! No, it's

really because one, my door is always open and two, I do really care. I give my students the time of day, and enjoy working with them. I think a lot of the time professors are too busy; it's not that they don't care.

Q: Describe the work that you do as a faculty adviser for undergraduate students.

There are two things I do as a faculty adviser. First, I walk through the elective courses with the student and sign off or approve of the courses they choose. Second, my kind of unofficial duty to students is to be an outlet for them to discuss their education. Should they go to grad school? Should they go into industry? Is a masters degree good enough for the field they would like to pursue? Should they complete their masters, go to industry, and come back for a PhD? Having experience in industry and academia, I feel I can help guide them, or at least give them an idea of what each field would require of them.

Q: Do most students come to you with a clearly defined path and goal? If not, how do you help get them there? If they do, how do you push them to grow in ways they had not considered?

Most of them are kind of feeling the water and very few know exactly where they're going. Usually it turns out, that in a class of about 40-60 there are always about 10 students who will follow me around. They come to all my classes, no matter what class I teach they'll be there, they'll even take the same class three times in a row. So those kids, I generally try to see what they are good at, what their passion is. I'll try to help them make decisions about graduate school, or if they want to go into industry what kind of job they may be looking for. I like to give them a reality check, if you're going to get a bachelors and head into an industry position you're just going to be at the entry level for a long time and they

> "The most rewarding is educating students; the papers you publish are not really what makes you a professor. It's the students that you put out. Helping students understand is the best part."

should be prepared for that. There is nothing wrong with it, but they shouldn't expect a lot of responsibility. If they want more responsibility they need to earn a masters degree. Most of the time, it's about encouraging them to go to graduate school.

Q: What do you think are the most important factors in an engineering student's academic success?

Academic success means always questioning, being curious, not accepting the status quo, and making an effort to understand. It may be a generational thing, but I think a big problem these days is that students expect to come in, speed through a degree, and then push buttons. I don't think that is going to fly in the engineering field; that is not what makes us engineers. If you really want to be successful you have to question everything, and really work hard. This is not an easy field. Just because you show up I'm not going to give you the grade; that's not how this works. I think that's what people expect. That has got to change. Students can't be here because their parents told them to be an engineer, because they think it's an easy degree, or a way to make money. They have to be passionate and sure that this is what they really want to do.

2015 CAPSTONE WINNERS

During their senior year, all Computer Engineering (ECE & CS 189A/B) and some Electrical & Computer Engineering (ECE 188A/B) students take a multiple quarter Senior Project course also known as the Senior "Capstone" Project. The Capstone project gives students the opportunity to put their education into practice. Students, working in small teams, design and engineer innovative hardware and software systems. At the end of the Spring quarter the final projects are presented at a full-day, industry-sponsored event where student groups publicly present their projects and participate in an outdoor lunchtime project demonstration and poster event.

The Capstone design projects are coordinated by ECE Department Lecturers Dr. Ilan Ben-Yaacov and Dr. John Johnson. To become involved as a sponsor or mentor, please contact Dr. Ben-Yaacov: *ilan@engineering.ucsb.edu* or Dr. Johnson: *johnson@ece.ucsb.edu*

BEST COMPUTER ENGINEERING CAPSTONE PROJECT
Struct By Lightning: smart assistant integrated with video-conferencing that observes the stream and provides real-time assistance and info. Team: Trevor Frese (lead), Evan Crook, Britt Christy, Kevin Malta (co-winner).

BEST COMPUTER ENGINEERING CAPSTONE PROJECT
Open Sesame: a portable door security accessory that can unlock doors remotely w/ WiFi via an android or iOS app. Team: Eric Taba, Grant Apodaca, Jeffrey Bolin, Richie Agpaoa, Evin Sellin (co-winner).

BEST ELECTRICAL & COMPUTER ENGINEERING CAPSTONE PROJECT
Inferno: a wireless hands-free thermal imager for firefighting / search & rescue. Team: Jason Farkas and Sean Tauber.

2015 ROGER WOOD AWARD WINNERS

In recognition of their strong academic records and exceptional commitment toward their education at UCSB, this year's Roger Wood Award was presented to:

Duncan Alexander Sommer, CE
Vishaal Varahamurthy, EE

FACULTY AWARDS & HONORS

KAUSTAV BANERJEE
IEEE Kiyo Tomiyasu Award, 2015

The IEEE Kiyo Tomiyasu was awarded to Kaustav Banerjee for contributions to nano-materials, devices, circuits, and CAD, enabling low-power, low-cost electronics. It is one of the highest honors given by IEEE, recognizing outstanding contributions to technologies holding the promise of innovative applications.

JIM BUCKWALTER
IEEE MTT-S Outstanding Young Engineer Award (Microwave Theory and Techniques Society), 2015

This competitive award recognizes outstanding young MTT-S members who have distinguished themselves through a sequence of achievements which may be technical (within the MTT-S Field of Interest), may constitute exemplary service to the MTT-S, or may be a combination of both.

LARRY COLDREN
Indium Phosphide & Related Materials (IPRM) Award, 2015

Professor Coldren received the IPRM Award in recognition of his leading contributions to the development of InP-based semiconductor lasers and photonic integrated circuits for optical fiber communications.

HUA LEE & JOHN JOHNSON
UCSB College of Engineering Outstanding Faculty Award, 2015

MICHAEL LIEBLING
Northrop Grumman Excellence in Teaching, 2015

Professor Michael Liebling and co-recipient Matt Helgeson (Chemical Engr.) were awarded the Northrop Grumman Excellence in Teaching Award for their demonstration of commitment to high teaching standards. This award is given annually on several campuses by Northrop Grumman.

CHRIS PALMSTROM
Dept. of Defense National Security Science & Engineering Faculty Fellow

Professor Christopher Palmstrom was elected fellow for his work in functional materials and for his project titled "Engineered Heusler Compound Heterostructures and Superlattices." The NSSEFF program awards grants to top-tier researchers from U.S. universities to conduct long-term, unclassified, basic research of strategic importance to the DoD.

JON SCHULLER
Hellman Family Faculty Fellowship

This fellowship provides substantial support for the research of promising assistant professors who show capacity for great distinction in their research.

NSF CAREER Award
The CAREER Program offers the NSF's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research.

YUAN XIE
IEEE Fellow

Professor Yuan Xie was elected for contributions to design automation and architecture of three-dimensional integrated circuits (3D ICs) as well as world-class research in the areas of electronic design automation (EDA), computer architecture, VLSI design, and embedded systems.

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For more information please visit:
industry.ucsb.edu/cap

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:

- **Unrestricted support** to be allocated to the highest priority needs of the Department.

- **Roger Wood Endowment,** established in honor of esteemed faculty member Roger C. Wood, supports undergraduate and graduate fellowships, faculty, and state-of-the-art teaching facilities.

- **Undergraduate laboratory** renovations to maintain and upgrade the quality of essential facilities for teaching and research. Priority renovations and naming opportunities include: Digital Lab, Controls Lab, Computer Engineering Lab, High Speed Communications Lab, Microwave Lab, Digital Signal Processing Lab, and the Instructional Clean Room.

- **Endowed chair establishment,** which 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,** 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.

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**giveucsb.com/ece.htm**

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A competition organized by UCSB's Schuller Lab and Center for Science and Engineering Partnerships at the California NanoSystems Institute challenges UCSB researchers — undergraduates, graduate students, and post-docs — to express the joy of scientific discovery through aesthetics.
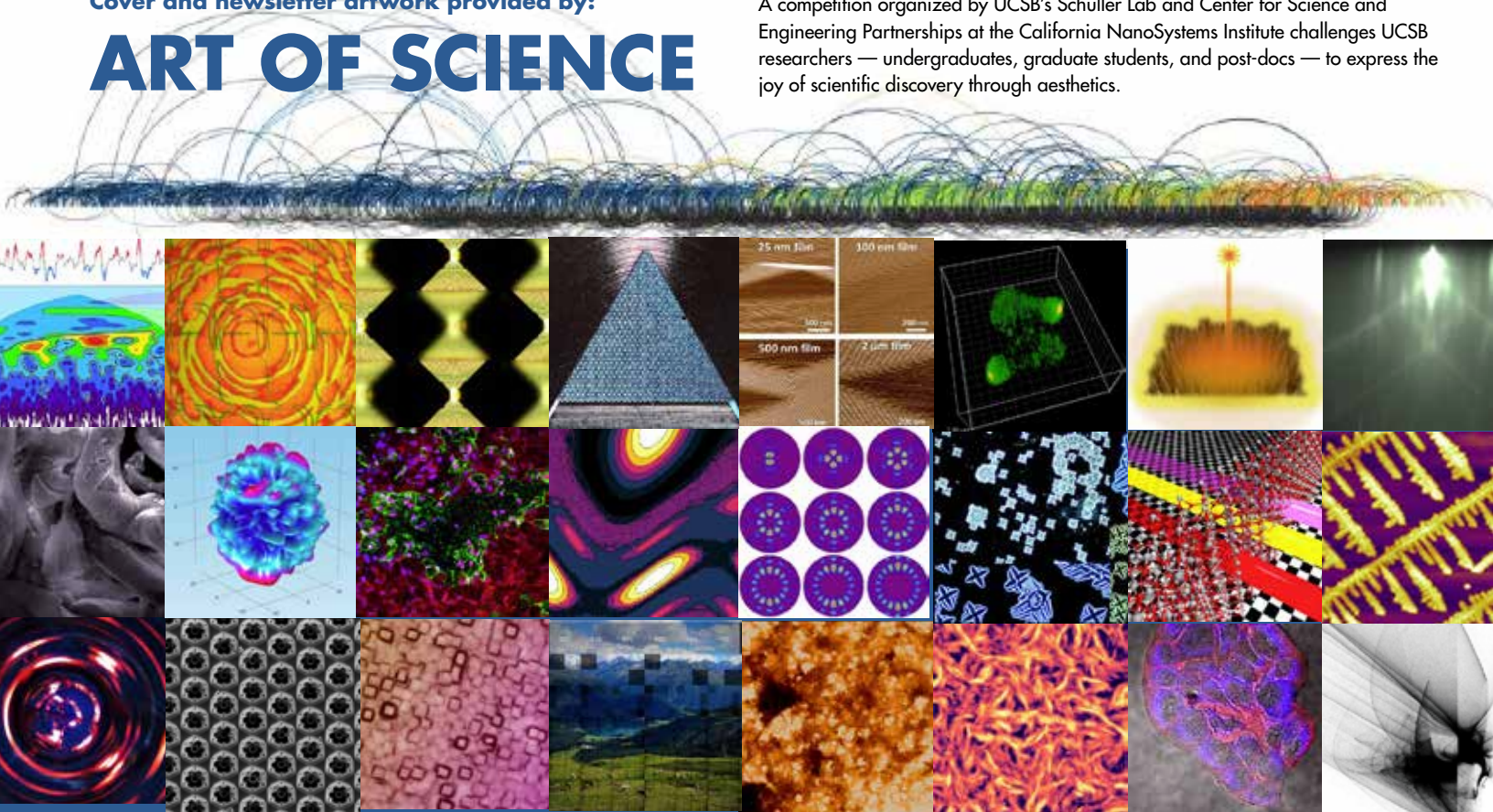
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