



2009 - 2010 Electrical Engineering Year in Review

October 1, 2010

Volume 2, Issue 1

Greetings from the Chair

This past year marked the 20th anniversary of the College started in 1989 by founding Dean Susan Hackwood. In January of 1991, Prof. Bir Bhanu was appointed founding Chair of the EE Program. The EE Graduate Program was approved in 1997, the EE Program became the EE Department in 1998, and that same year, the first graduate students arrived. The rapid progress over these last 19 years has been fueled by the high-quality of our ambitious faculty members and the generous support given by the College and the Campus. Currently, we have 24 faculty members, 226 students in the EE Undergraduate Program, and 156 students in the EE Graduate Program. We also share with the CSE Department the teaching load for the 150 Computer Engineering students. Research in EE was supported by over \$4M in contracts and grants won this year by EE faculty.



*Roger Lake,
Professor and Chair*

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The NSF IGERT and UC-Light Center provide two highlights that indicate of the quality of our faculty. The NSF funded Integrated Graduate Education Research and Training (IGERT) Program in Video Bioinformatics started in Jan. 2010 with 6 PhD students. This highly competitive NSF program was won by Prof. Bir Bhanu who directs the inter-disciplinary, campus-wide effort. Prof. Z. Xu, Director of the UC-Light Center, led his center through a successful first year. The center is funded by \$3.5M from the University of California's Multicampus Research Program and Initiatives (MRPI), and it is the first MRPI led by UCR.

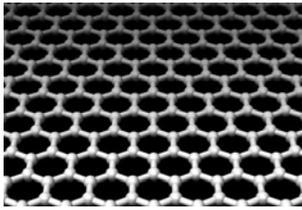
The report just released by the National Research Council, a 'Data-Based Assessment of Research-Doctorate Programs' shows the EE Graduate Program to be doing exceptionally well. The survey based rankings placed greatest weight on faculty research activity such as per capita publications and grants. Programs strong in those areas ranked higher, and we ranked very high. A comparison of the different UC and AAU EE Graduate Programs can be seen on the back page.

Major Grants Awarded



Professor Alexander Balandin received the U.S. Office of Naval Research (ONR) grant on development of graphene "quilts" for high-power GaN and SiC electronics. UCR receives \$420K for the experimental proof-of-concept demonstrations to be conducted in Balandin's Nano-Device Laboratory (NDL).

Major Grants Awarded (continued)



... Balandin's ONR grant comes in addition to his two new subcontracts, which address different aspects of graphene research. The three-year subcontract from the Interconnect Focus Center (IFC), based at the Georgia Institute of Technology, deals with graphene interconnects and heat spreaders for three-dimensional (3D) electronics. The subcontract from the Functional Engineered Nano Architectonics (FENA), based at UCLA, addresses the problems of energy dissipation in graphene nanostructures and nanodevices. Both centers are funded by DARPA and SRC. The total new funding from ONR, IFC and FENA to Balandin group for research on different practical applications of graphene exceeds \$1.16M.



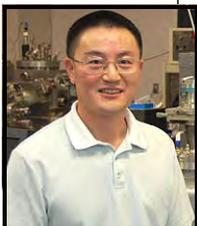
Professor Sheldon Tan (PI) received a three-year grant from National Science Foundation for exploring new techniques for parallel simulation and analysis of VLSI systems on many-core microprocessors. The NSF project is titled "SHF:Small:GPU-Based Many-Core Parallel Simulation of Interconnect and High-Frequency Circuits" with \$270K for three years.



Professors A. Balandin, R. Lake, J. Liu, and M. Ozkan all successfully competed to become members of the third phase of the MARCO Center FENA located at UCLA. The total 3-year support provided by FENA to the 4 EE faculty members is approximately \$1.8M. R. Lake has two projects, 'Material Selection for Cold Carrier Injection' and 'Molecular Assembly of Carbon Nanotubes.' The first topic focuses on understanding the effect of material choice on the performance of interband tunneling field effect transistors. The second topic includes an investigation of CNTs, graphene, and a relatively new class of materials, topological insulators. J. Liu's project is 'Wide Band-gap Materials for Nonvolatile Memories.' A material of particular interest is ZnO. M. Ozkan's project 'DNA-based self-assembly' will use the unique labeling capability of DNA to self-assemble nanoscale structures such as DNA tiles with affixed CNTs.



R. Lake was also appointed Theme Leader within FENA of Theme 2, 'Physical Processes and Devices.' The 5 members of the Theme from 4 different universities study the fundamental limits of materials and processes as they impact device performance metrics such as stability, speed, power, and energy.



Major Grants: New NSF IGERT Program



UC Riverside's NSF Integrated Graduate Education Research and Training (IGERT) Program in Video Bioinformatics started in January of 2010 with six PhD students.

The Vision of the Video Bioinformatics IGERT is to integrate expertise from the life sciences, computer science, electrical engineering, and bioengineering to enable breakthrough capabilities in understanding biological processes that are by nature continuous and dynamic.

Dr. Bhanu defines Video Bioinformatics as the automated processing, analysis, understanding, data mining, visualization, query-based retrieval/storage of biological spatiotemporal events/data and knowledge extracted from videos obtained with spatial resolution varying from nanometer to meter of scale and temporal resolution varying from seconds to days and months.

Engineering students will learn biological imaging techniques, design of experiments and modeling of phenomena, and they will gain a finer appreciation for the biological community's needs. These Ph.D. students will be pioneers with cross-disciplinary capability needed to solve societal problems in the 21st century.

In Related News: Two new courses were offered in Multiscale Biological Systems and Medical Imaging and Analysis for Winter Quarter 2010 and Spring 2010 respectively:

BIEN261: Multi-scale Analysis of Biological Systems instructed by Dr. Rodgers
EE290: Colloquium in Video Bioinformatics instructed by Dr. Bhanu

Innovative Approaches for Next Generation Vehicle Positioning



Matthew Barth



Jay Farrell

As new advanced driver assistance applications emerge, reliable vehicle-based lane-level position determination has become a critical need, while maintaining low on-vehicle and highway infrastructure cost. No single navigation technology has the potential to satisfy all the requirements needed in terms of positioning accuracy, availability, and continuity in diverse driving environments. Therefore, next generation vehicle positioning systems will require the fusion of a variety of sensors, potentially including Global Navigation Satellite System (GNSS) receivers, inertial measurement devices, wheel based encoders, and feature-based sensors such as computer vision, RADAR, or LIDAR.

In this research project, UCR is investigating a range of viable approaches that could provide lane-level positioning accuracy in diverse driving environments, satisfying the needs of accuracy, availability, continuity, and low-cost. An initial phase will assess the viability, benefits, limitations, and obstacles for different approaches based on technological, business, and deployment characteristics. In particular, the research focus will be on how public and cooperative vehicle infrastructure can serve as additional augmentation mechanisms to improve vehicle positioning. A second phase of research will focus on the testing of several of the viable approaches. Several prototype systems are being developed and tested that integrate a variety of sensors (e.g., GNSS, inertial, feature-based) along with ground based radio positioning (e.g., DSRC).

Project Duration: October 1, 2009 - September 30, 2012

Project Budget: \$620,000

Major Grants: Dr. Roy-Chowdhury Leads Team Developing Aerial Video Analysis and Communications Lab



Dr. Amit K. Roy-Chowdhury (far left), is principal investigator (P.I.) of a new project funded by the Defense University Research Instrumentation Program (DURIP) to create an Aerial Video Analysis and Communication Laboratory using remote-controlled drones and helicopters.



The Aerial Video Laboratory will be a unique facility providing researchers with the capability to collect video data simultaneously from aerial and terrestrial platforms. This, in turn, will open up a number of research problems in camera networks and wide-area scene analysis. This is a problem of growing interest in the video analysis community due to its applications in a number of military and civil domains, e.g., national and homeland security, disaster response, environmental monitoring, and others.

Faculty Awards and Promotions



Asst. Profs. Elaine Haberer and Anastasios Mourikis were recipients of this year's Regents' Faculty Fellowship Award. Prof. Haberer's award will support her research on "Viral-Templated Nanostructured Materials for Photovoltaic Applications". Prof. Mourikis' award will support his research on Merging Visual Perception and Inertial Sensing for Robot Navigation.



Mourikis was also one of five people to receive the 2009 IEEE Transactions on Robotics Best Paper award (King-Sun Fu Award) on "Vision-Aided Inertial Navigation for Spacecraft Entry, Descent, and Landing," IEEE Trans. On Robotics; Vol. 25, No. 2, Page(s): 264 - 280, 2009. This work presents a system that substantially improves the accuracy of position estimation during Mars landing. To date, Mars landers can only determine their landing location with a very large uncertainty, in the order of hundreds of kilometers. This work proposes a new paradigm for position estimation during entry, descent and landing (EDL) that is capable of achieving landing accuracy in the order of a few meters.



Electrical Engineering Professor Jianlin Liu received an Inventor Recognition Award from Semiconductor Research Corporation (SRC) for his invention on "Nanocrystal Memories and Methods of forming the same". The co-inventors are his former students and postdocs Dengtao Zhao, Ruigang Li, Yan Zhu and Bei Li. Under the support of Focused Center Research Programs (FCRP) on Functional Functional Engineered Nano Architectonics (FENA), National Science Foundation (NSF), and Center on Nanomaterials and Nanodevices, Liu's group has developed various silicide-based nanocrystal memory approaches to extend the scaling limit of flash memories.

Faculty Awards and Promotions (continued)



Professor Albert Wang was awarded with the 2009-10 Chancellor's Award for Excellence in Undergraduate Research. The award recognizes faculty members with a distinguished record of fostering undergraduate research or creative activity.

Promotions

- Bir Bhanu was promoted to 'Distinguished Professor,' a title reserved for scholars and teachers of the highest distinction.
- Sheldon Tan was promoted to Professor.
- Jianlin Liu was promoted to Professor.

Faculty and Student Research in the News



New experimental and theoretical results obtained in professor Balandin's Nano-Device Laboratory (NDL) research group were published in this week's *Nature Materials* journal. *Nature Materials* is the highest ranked journal in the field of materials science and engineering (impact factor of 23.132 in 2008). It has been predicted by theoretical physicists that the intrinsic thermal conductivity in strictly two-dimensional (2D) systems reveals logarithmic divergence.

Until now, this theoretical prediction remained an intellectual curiosity. Balandin group experimentally demonstrated the predicted dimensional crossover of the thermal conductivity using a set of suspended few-layer graphene samples.

The obtained results have important practical implications for heat removal and thermal management of computer chips and proposed 3D electronics. Professor E.P. Pokatilov and Dr. D.L. Nika – visiting researchers in Balandin – group performed numerical calculations of thermal conductivity. The first author of the paper – EE PhD graduate Suchismita Ghosh – currently works at Intel Corporation. EE PhD candidate Samia Subrina carried out computer simulations to help with the experimental data extraction.

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The initial set of samples for this research was produced in the lab of physics professor C.N. Lau. The Nature Materials paper was highlighted in scientific and engineering media world-wide (more than 50 technical news sites and journals highlighted the work). The photo on the previous page shows the NDL research group with three co-authors of the paper.

The UC Light Center's Freshman Year



The UC Light Center had its first successful meeting January 26th, 2010 with over forty people from government, industry, collaborating UC campuses, and UCR in attendance.

The University of California's Multicampus Research Program and Initiatives (MRPI) gave the Light Center a jump start by investing \$3.5 million last January. Since then, Professor Zhengyuan Xu's 5-year project has caught the eye of many big companies such as Intel Labs, Boeing Space & Intelligence Systems, Raytheon, Los Alamos National Lab and Northrop Grumman Space & Mission Systems. Representatives from these companies plan to

form an Industry Advisory Board for the UC Light Center with 10 members already established. Their first meeting will take place this Fall.

In Recent News :

- The UC Office of The President (UCOP) is currently funding the Light Center with \$663,811 for the FY 2010-11.
- Intel Corporation supported the Light Center in June with a grant of approximately 145K for research of visible light communication between traffic lights to vehicles. This is the first phase of Intel's multi-phase plan, aiming to develop and commercialize optical wireless communication and positioning technologies for vehicle networks. The effort will also cover investigation of possibilities to form an automobile industry alliance and develop a corresponding industry standard.
- Sutter Health donated a hospital building model with unrestricted use for the design of visible light communication systems in a hospital.

Furthermore, the Center is making progressive efforts to establish alliance with leading optical wireless industries through the Industry/University Cooperative Research Center program of the National Science Foundation.

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Jointly with Pennsylvania State University and Tufts University, the Center co-organized the Optical Wireless Applications Workshop in State College, Pennsylvania, June 2010. This workshop will discuss the potentials to establish a multi-campus industry/university research center, leveraging the UC-Light Center expertise and providing leadership to develop a new generation of environment-friendly, wideband optical wireless technology applications including communications, networking, navigation, imaging and remote sensing.

More news can be found on the UC-Light Center website at <http://www.uclight.ucr.edu/>.

Liu Organizes Workshop on ZnO Optoelectronics

Professor Jianlin Liu organized a workshop on “Perspectives of Zinc Oxide (ZnO) Materials and Devices for Optoelectronics”, which was held in Mission Inn Hotel, Riverside, California, from July 7 to July 9, 2010. Liu is chair and David Look of Wright State University is co-chair. This workshop was supported by Army Research Office.



The objective of this workshop is to identify scientific barriers and possible solutions of ZnO p-type doping and epitaxy for efficient optical devices such as LEDs, lasers, photodetectors, and solar cells, and to recommend future research and development directions that will address government and industrial needs. 14 leading experts in ZnO field from academic institutions, industries and government were invited to present state-of-the-art ZnO research and development. In addition to outstanding talks, the event featured plenty of discussion sessions to define the current status and future directions of this fundamentally sound material system for optoelectronics.

UCR and SBCCD Collaboration Provide Nanotech Training



In a unique collaboration between a UC campus and a community college, the Bourns College of Engineering (BCOE) at UCR is providing training for students who are part of the San Bernardino Community College District's (SBCCD) Nanotechnology Technician's Training program.

UCR Associate Professor of Electrical Engineering and Director of the UCR Microelectronics Teaching Laboratory Jianlin Liu developed the training curriculum in collaboration with UCR electrical engineer and graduate student Mario Olmedo.

With support from Bourns College Dean Reza Abbaschian, Department of Electrical Engineering Chair Roger Lake, and Center for Nanoscale Science and Engineering Director Robert Haddon, Liu is developing a new teaching clean-room facility in Pierce Hall on the UCR campus to provide the hands-on technical training to accompany the classroom lectures. UCR will provide 90 hours of training during each of the ten six-week sessions during the three-year grant.

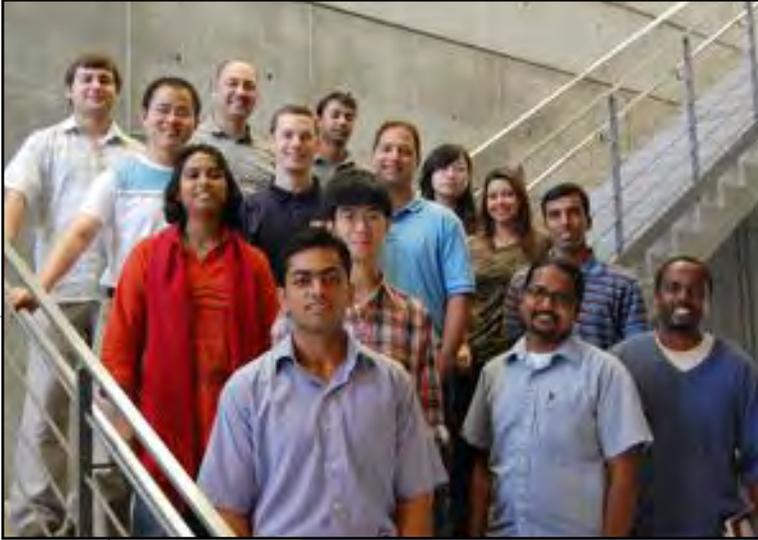


(Above: Graduate Student Mario Olmedo)

The six-week sessions will expose students to courses in electronic and optoelectronic devices, nanoscale characterization, device fabrication and characterization, materials characterization, micro/nano fabrication, bio-tech, and solar energy utilization. Afternoon and evening sessions are available and the next session will begin August 16.

"As far as I am aware, this collaboration between UCR and SBCCD is one-of-a-kind in California," said Lake. "SBCCD provides UCR a new opportunity to transfer our state-of-the-art nanotech expertise to the community. We hope to turn this collaboration with SBCCD into a long-term relationship."

Graduate News



The Optical Society of America (OSA) has approved a student chapter at the Bourns College of Engineering at UCR (UCROSA), thanks to the efforts of founding chapter president Craig Nolen and fellow Ph.D. students in the Department of Electrical Engineering Javed Khan (chapter vice president and secretary) and Pradyumna Goli (treasurer), a Ph.D. student in the Materials Science and Engineering (MS&E) Program.

Membership in the chapter is open to all interested students. The organization's first scheduled event was at the Optricks and Laser Extravaganza at the Discovery Science Center in Santa Ana on June 12.

Undergraduate News

BCOE students Alex Eisner and Andrew Juarez finished second in the micromouse competition held the regional meeting of the IEEE at California State University, Northridge, April 17.

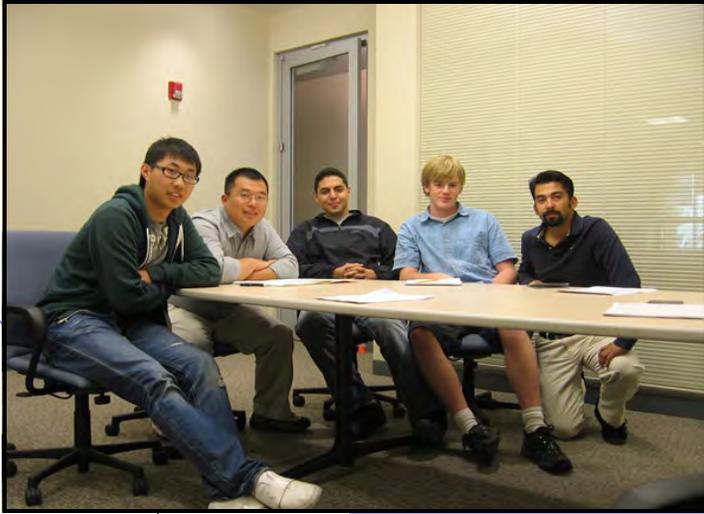
The micromouse Eisner and Juarez used in the competition is their senior design project. "I made a micromouse and competed two years ago, but this mouse looks and performs a whole lot better than my previous attempt," said Eisner, a computer engineering major. Juarez is an electrical engineering major and they are both members of the UCR student chapter of IEEE.

The BCOE team's mouse visited 72 unique cells, while the winning team from UCLA visited 102 cells. None of the teams were able to complete the challenge in the allotted time. They will get the opportunity to make improvements in their designs and compete in another regional competition later this spring.



(From left) Alex Eisner, Andrew Juarez

Undergraduate News (continued)



(From left to right: David Wei Dei, Mentor Jun Wang, Isaac Lomeli, Cody Lewis and Rosemblim Lugo)

Dr. Wang has set off to China once again this year to participate in the US-China IRES Program with a new team of undergraduate students: David Wei Dei, Isaac Lomeli, Cody Lewis and Rosemblim Lugo.

This is the 3rd year of the NSF sponsored US-China International Research Experiences for Students (IRES) Program designed to expose American undergraduates from UCR to fast-changing global research environments.

It aims to prepare American students to better understand the outside world and become globally competitive in their future careers. This US-China IRES program was directed by Prof. Albert Wang.



(David to the right looking at a wafer sample)

This year's research will be focusing on ESD protection for IC's. The UCR students will be staying at Tsinghua and Peking University . You can follow their daily blog at: <http://www.ee.ucr.edu/~ires/experience.html>.



Professor Wang



Student News



Participants at the 2nd ISRS-UCR.

The 2nd IEEE Student Research Symposium at UCR (ISRS-UCR) was held successfully on April 2nd, 2010, on campus. As a tradition, the 2nd ISRS-UCR was held concurrently with the IEEE Electron Devices Society Mini-Colloquium on Microelectronics. The events were organized by the IEEE EDS UCR Student Chapter and co-sponsored by the IEEE Electron Devices Society and the Bourns College of Engineering.

The Mini-Colloquium features three seminar talks given by invited EEE Distinguished Lecturers, including Dr. Nate Peachey from RFMD for a talk entitled “*ESD’s Middle Earth – Neither Device nor System Testing*”, Dr. Steven Voldman from Intersil for a talk entitled “*The Importance of ESD in the Electronic Industry*” and Dr. Bin Zhao from Freescale Semiconductor for a presentation entitled “*LED Backlighting Solutions for Energy Efficient Display*”.

The interactive forum consists of about 44 student papers, including 24 graduate student papers and 20 undergraduate student papers.

The review panel, formed by the guest speakers, reviewed all papers very carefully and selected the Best Student Paper Awards, which were presented to the student winners at the end of the symposium. The Symposium attracted over 100 students coming to listen, discuss and share their research experiences.

First place in the graduate division was awarded to Sushmee Badhulika for the poster *PEDOT:PSS coated single walled carbon nanotube gas sensor arrays*. (In the center of the photo at right, with Nate Peachey, left; and Dr. Albert Wang, right)



IEEE Club presents 2010 Merit Badge Day

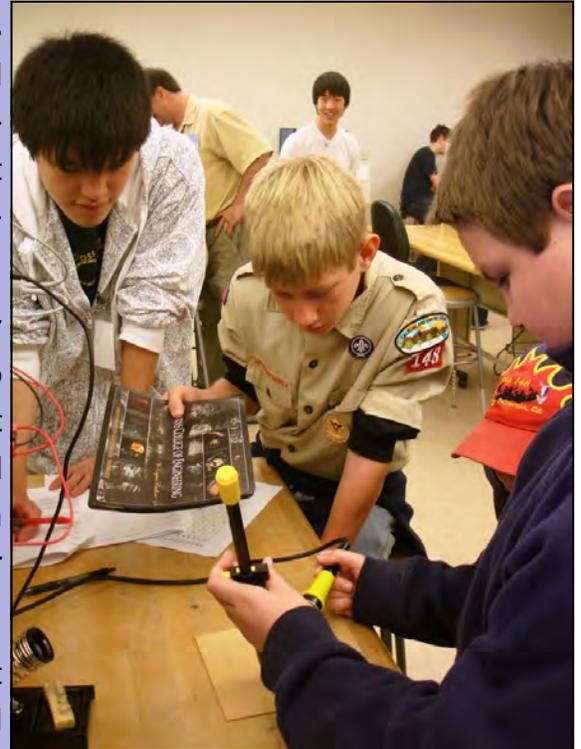


On February 10, 2010, UCR's Chapter of the Institute of Electrical and Electronics Engineers presented their annual Merit Badge Fair for Mt. Rubidoux District's boy scouts.

The event was not only for boy scouts but students, ages 8 to 12, to have the opportunity to learn about different areas of engineering, and especially increase their interests in electrical engineering and computer science.

Students were advised to fill out several Merit Badge work books and choose from a list of activities such as learning energy conservation, CAD, soldering circuit boards and learning electrical terms and equations just to name a few. The Fair was a great success with about 200 boy scouts and accompanying parents in attendance.

For more information about the IEEE club and it's events please visit their website at <http://www.engr.ucr.edu/~ieee/>.



Statistics

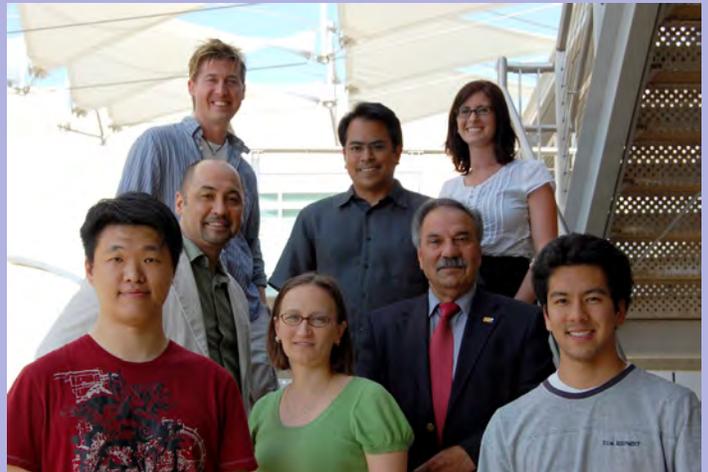


47 EE Graduate students received degrees this past year. Nine students received Ph.D. degrees and 38 students received M.S. degrees. 32 undergraduates received their B.S.E.E. This upcoming year for Fall 2010, 35 students have entered the Graduate Program, and 93 Freshman have enrolled in the Electrical Engineering Undergraduate Program. There are now 156 students in the Graduate Program and 226 in the Undergraduate Program.

The Computer Engineering undergraduate program, jointly administered with the Department of Computer Science and Engineering, graduated 15 students last year 2010. This incoming year there are currently over 150 students enrolled in the CE Program.

Materials Science and Engineering Program Update

The Department of Electrical Engineering plays an active role in the campus-wide inter-departmental Materials Science and Engineering (MS&E) Program. Seven electrical engineering professors are MS&E participating faculty members, while Professor Alexander Balandin serves

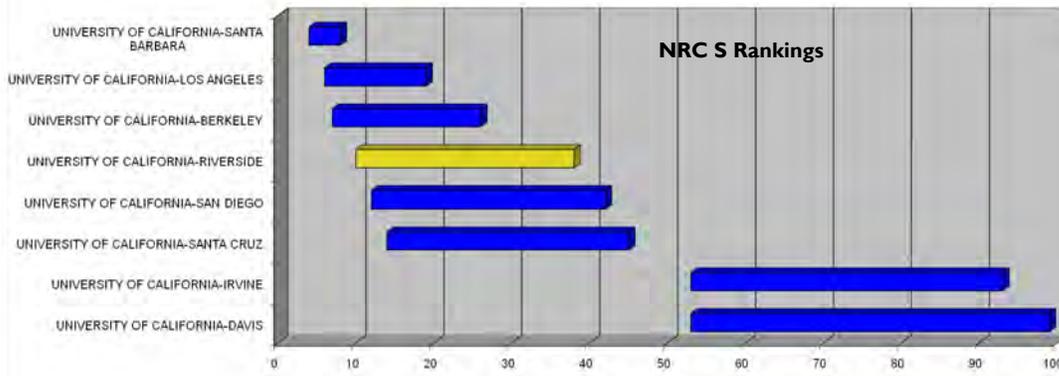


as a chair of the program. This year, the first students graduated with B.S. degree in MS&E (see photo of the graduates with the Dean and MS&E core faculty). The first cohort of eight MS&E graduate students (PhD and MS) was admitted for this Fall quarter, fulfilling the program's recruitment plans for the first year. The UCR MS&E program will experience a significant boost in its facilities and equipment with this year's completion of the Materials Science and Engineering building. Several EE faculty members, participating in the MS&E program, are expected to have laboratory space in the new building.

NRC Rankings



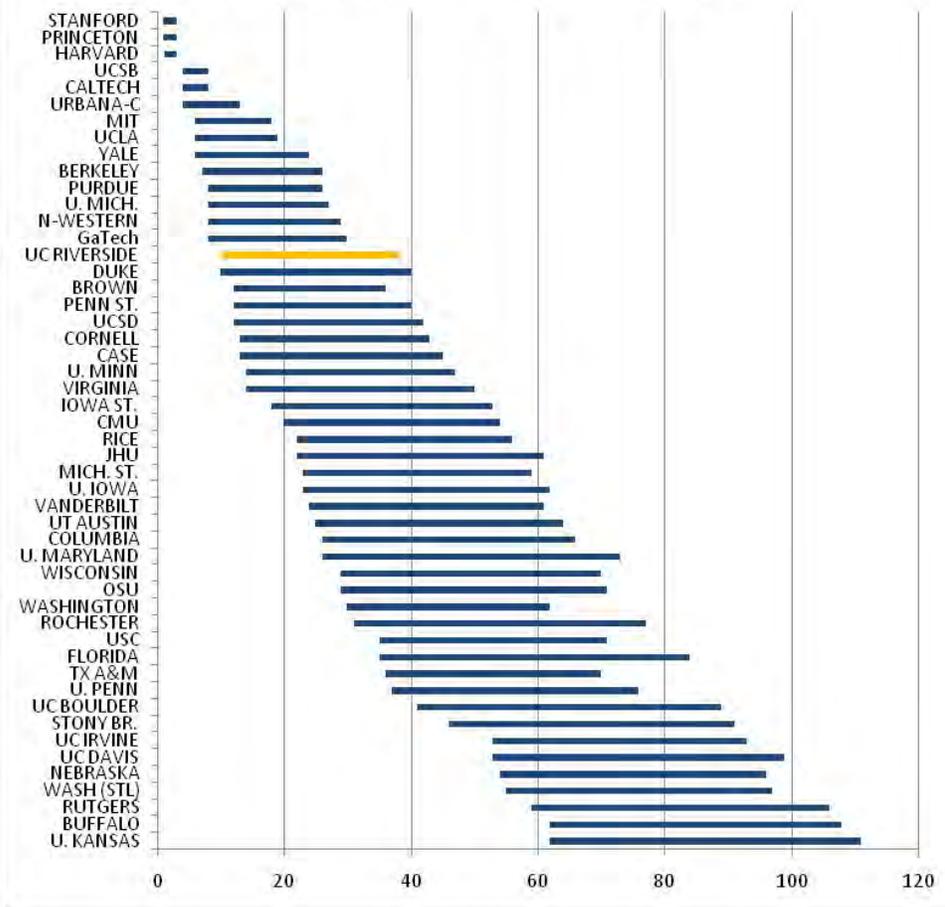
The report just released by the National Research Council, a 'Data-Based Assessment of Research-Doctorate Programs' shows the EE Graduate Program to be doing exceptionally well. The survey based rankings (S ranking) placed greatest weight on faculty research activity such as per capita publications and grants. Programs strong in those areas ranked higher, and we ranked very high. A comparison of the different UC EE Graduate Programs can be seen below. The NRC rankings include a range, but the short answer as to how to interpret them is that the closer to zero and the less spread, the better. As you can see



from the chart below, based on quantitative data, the EE Graduate Program at UCR looks very good in the comparison with the other UC campuses. The S ranking emphasizes per-capita research activity, whereas a separate reputation-based ranking (R ranking) gives

more emphasis to the overall size of the program and its reputation. Because of our youth, our quality precedes our reputation, and it is only a matter of time before our reputation catches up.

Comparison with AAU, S-rankings



From 'A Data-Based Assessment of Research-Doctorate Programs in the United States (2010)' by the National Research Council.