UCLA

Electrical Engineering

UCLA
Electrical Engineering Department

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UCLA
Electrical Engineering Department

Annual Report 2006-2007

The UCLA Hannah Carter Japanese Garden

From the
Department Chairman

The 2006-2007 academic year was both a laudable and demanding time for our department. During fall 2006, the department underwent two major reviews. First was the ABET accreditation visit, which brought together our faculty, undergraduate students, alumni, and staff in a coordinated effort to highlight the strengths of our program and the sophisticated mechanisms that we have put in place to assess and enhance the quality of the program on a regular basis. The second review was the UCLA Senate Review visit, which occurs once every eight years. This is a major evaluation undertaken by a committee of UCLA scholars and outside examiners, and assesses all facets of the department including its strategic plan, graduate and undergraduate programs, instruction, laboratories, faculty, lecturers, students, staff, and infrastructure. Considerable effort went into preparing for these reviews, and the department is most thankful to all its members. They took their duties seriously and helped us prepare for these events in a stellar and successful manner.

The department has continued to recruit tirelessly and as a result hired three junior and one associate-professor faculty members. These hires strengthen our reach into embedding computing, bio-photonics, cognitive radios, and nano technologies. We also extended courtesy appointments to three faculty members from the Computer Science and Statistics Departments working in the areas of computer vision, embedded medical devices, and statistical modeling.

Our faculty continue to be recognized for their outstanding research and teaching achievements. One of our faculty members, Professor Asad Abidi, was elected to the National Academy of Engineering for his contributions to the development of integrated circuits for MOS RF communications. During the same year, Professor Abidi was also recognized with the prestigious 2008 IEEE Donald O. Pederson Award in Solid-State Circuits for his pioneering and sustained contributions in the development of RF-CMOS. These recognitions confirm the outstanding quality of our circuits program, which is among the finest in the world. Likewise, Professor Bahram Jalali received the 2007 R. W. Wood Prize from the Optical Society of America, which recognizes outstanding technical achievement in the field of optics. Furthermore, Professor Yahya Rahmat-Samii received the 2007 Chen-To Tai Distinguished Educator Award from the IEEE Antennas and Propagation Society, and Professor William Kaiser was selected to receive the 2007 UCLA Gold Shield Faculty Prize. The latter prize recognizes faculty members with extraordinary accomplishment in undergraduate teaching and in research. All these awards speak to the dedication of our faculty to both teaching and research.

Our revised graduate program also went into effect. The new program emphasizes flexibility in the selection of courses for graduate studies and facilitates both in-depth and broad training across areas. The selection of courses for both the M.S. and Ph.D. programs is now tailored to the student's professional objectives and is done in coordination with the faculty advisor.

We are proud of our energetic department and of the accomplishments of its faculty and students. While we continue to work steadily for greater goals, we never forget that the collective standing of our department is the reflection of the individual efforts of all its members.

Ali H. Sayed
Department Chairman

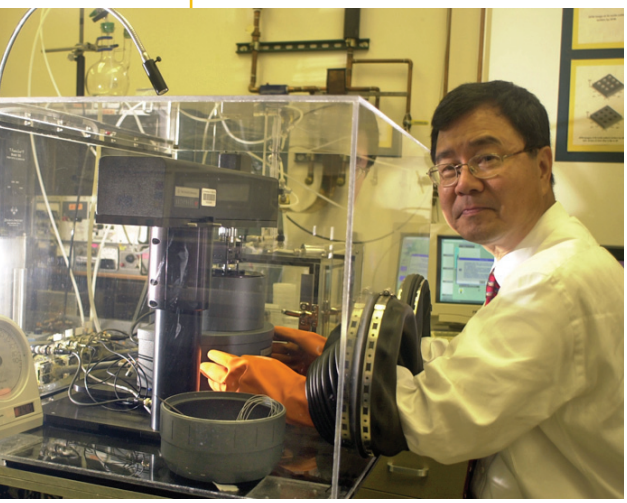
Overview

Faculty and Staff

Ladder Faculty	42.8 FTEs
Courtesy Appointments	9
Visiting Faculty	3
Emeriti Faculty	8
Adjunct Faculty	12
Lecturers	34
Staff	44

Recognitions

Society Fellows	32
NAE Members	8
NAS Members	3
National Medal of Science	1



Professor Kang L. Wang uses a clean manipulator in the laboratory of the Nanoelectronics Research Center.

Research Facilities

Laboratories and Research Groups: 32

Space: 102,669 square feet

Department Contributes to 9 Research Centers:

California NanoSystems Institute (CNSI)

Center for Embedded Networking Sensing (CENS)

Center for High Frequency Electronics (CHFE)

Center for Systems, Dynamics and Controls (SyDyC)

Flight Systems Research Center

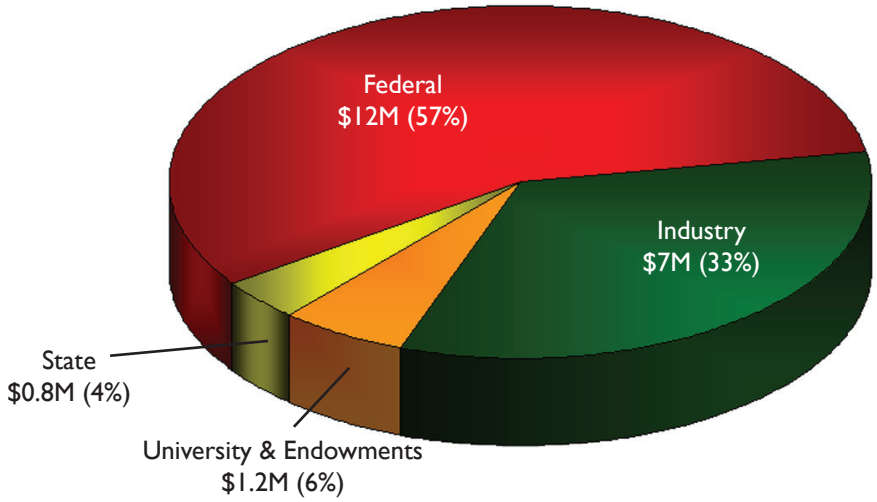
Functional Engineered Nano Architectonics Focus Center (FENA)

Institute for Cell Mimetic Space Exploration (CMISE)

Nanoelectronics Research Center (NRC)

Western Institute of Nanotechnology (WIN)

Research Funding 2006-2007 ($21M)



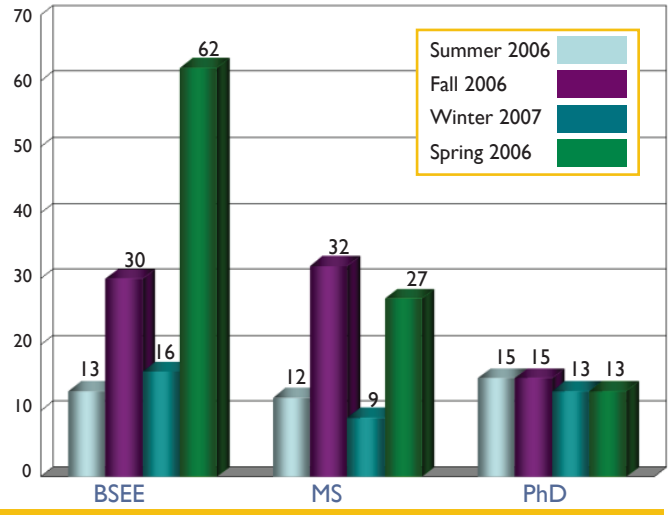
Undergraduate Students

Students Enrolled	477
Applicants	898
Admitted	369
New Students Enrolled	133
Average Freshman GPA	3.83

Graduate Students

Students Enrolled	386
Applicants	1122
Admitted	281
New Students Enrolled	94
Average Incoming GPA	3.80

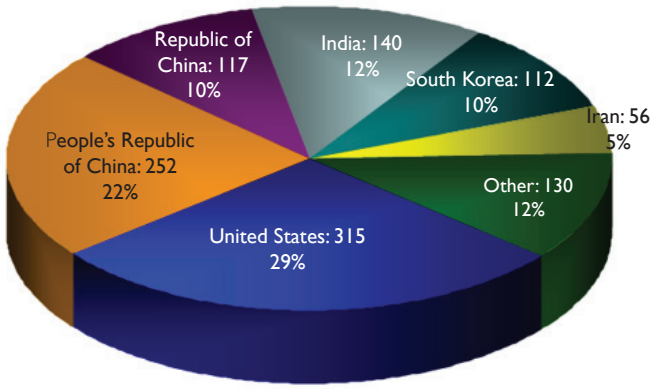
EE Degrees Conferred 2006-2007



Totals:	121	80	56

Graduate Applicants for Fall 2006

Countries with over 5% of 1122 total applicants



Fellowships Received by Electrical Engineering Graduate Students	
Full Fellowships	$ 494,868
CNSI/CNID Fellowships	$ 299, 686
Full Fellowships w/Dean's GSR Support	$ 270,068
Non-Resident Tuition Support for Teaching Assistants	$ 210, 614
Henry Samueli Full Fellowships	$ 177, 608
NSF Graduate Fellowship	$ 153,142
Combination Fellowship/Graduate Student Researcher Positions	$ 123,717
One Quarter Merit Fellowships	$ 67,771
Dissertation Year Fellowships	$ 53,604
Dean's Graduate Student Researcher Support	$ 50,415
Mindspeed Fellowship	$ 45,000
Henry Samueli Partial Fellowships	$ 38,407
Chancellor's Prize/Cota Robles Fellowship	$ 26,286
Raytheon Fellowship	$ 12,792
Partial Fellowships	$ 10,915
Fishbaugh/Pollak/Affiliates	$ 2,500
Conference Travel Funds	$ 1,200
TOTAL	**$ 2,038,593**

Faculty Highlight: Professor Asad A. Abidi

UCLA Electrical Engineering professor Asad Abidi has been elected into the National Academy of Engineering (NAE), the highest professional distinction accorded to an American engineer. He has also been selected to receive the 2008 IEEE Donald O. Pederson Award in Solid State Circuits.

Professor Asad A. Abidi

The National Academy of Engineering Award: Honored for his contributions to the development of integrated circuits for wireless communication in metal–oxide–semiconductor (CMOS) technology used to fabricate microprocessors and digital signal processors, Professor Abidi is now among a select 2,217 members nationwide, along with 188 Foreign associates.

Academy membership honors those who have made outstanding contributions to engineering research, practice, or education. Established in 1964, the NAE shares responsibility with the National Academy of Sciences to advise the federal government on questions of policy in science and technology.

"I feel the key importance of my election into the Academy is that it highlights the ground breaking work my colleagues at UCLA electrical engineering and I have undertaken over the last two decades in CMOS radios," Professor Abidi remarks. "It is this research that has really helped to define a new industry, and that is my greatest reward. Every mass-produced wireless communication device today is in CMOS."

Abidi has been an electrical engineering faculty member at the UCLA Henry Samueli School of Engineering and Applied Science since 1985,. Abidi's research career has focused on research in CMOS RF design, high speed analog integrated circuit design, data conversion, and other techniques of analog signal processing. His work has led to new architectures in modern wireless devices, and a new way of designing the circuits that enable them.

"The work I conducted with my colleagues has always had the overarching theme of industry impact. We did not try to keep the work under wraps," Abidi says. "We strove to innovate so that we could share the knowledge with the rest of the world. I'm proud to have been part of this philosophy of research."

The IEEE Donald O. Pederson Award in Solid State Circuits: Shortly after receiving the NAE Award, Professor Abidi was selected by the IEEE Board of Directors to receive the prestigious 2008 IEEE Donald O. Pederson Award in Solid-State Circuits for his "pioneering and sustained contributions in the development of RF-CMOS."

This award was established by the IEEE Board of Directors in 1987 to honor an individual, or team of up to three, for outstanding contributions to solid-state circuits, as exemplified by benefit to society, enhancement to technology, and professional leadership. This is an IEEE-wide award and the highest in the field.

With this recognition and the NAE Award, Professor Abidi joins a distinguished list of "Who's Who" in the field. With his hard work and well-earned reputation, he has helped our department build a first-rate circuits and devices program, one that is recognized and respected worldwide.

The Millimeter Wave and Optoelectronics Laboratory

Polymer device technologies

Professor Harold R. Fetterman, Director

Harold Fetterman, whose research was recently honored with a LEOS Streifer Award, has been developing new polymer electro-optic devices for several years. Recently, his collaborators, Professors Dalton and Jen (U. of Washington) have been successful in making new materials that have more than an order of magnitude improvement in optical non-linearities. The problem is now to incorporate these new materials into new communications and control systems, which will have a major impact on technology.

One of the first tasks that Fetterman and his students looked at, with the new materials, was fabricating new forms of optical modulators that could work at very high frequencies. As an example, they studied configurations of micro-ring devices and measured their performance up to 165 GHz. A typical structure is shown in Figure 1 along with a traveling wave electrode driver. In making these structures, a broad range of fields are brought together ranging from material science, microwave design and optical simulation.

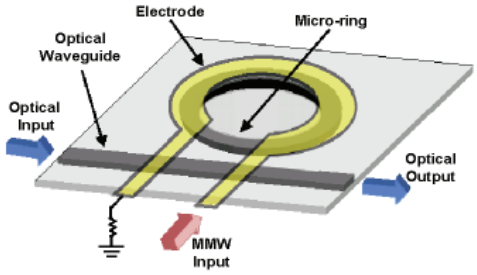


Figure 1: Basic polymeric ring resonator modulator working at 165 GHz.

Next came the need to make the modulators extremely linear to achieve large dynamic range at high frequencies. Fetterman's team came up with a new approach of tailoring the material's index of refraction using UV bleaching techniques (see Figure 2). The result of this effort yielded some of the very best devices for optical communication systems ever fabricated.

Difficulties arose with these new materials because of their relatively high absorption. There are many ways of dealing with this problem and they are being actively explored. One way is to use passive, low loss materials wherever possible. Using these concepts, 1x4 optical DOS switches have recently been developed for phase array radar applications. Active materials are only used in the optical switching portions of the new devices

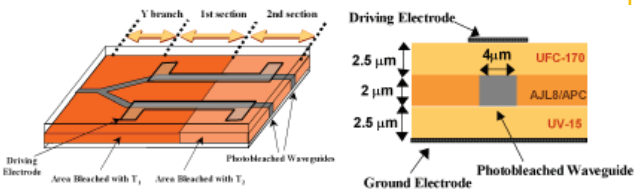


Figure 2: Bleached ultralinear coupled guide modulator showing optical waveguide cross section

After dealing with these new types of devices with the latest materials, it was decided to apply this technology to a broader, more important, range of structures. This is called optical signal processing, and can be understood using the same formalism as developed for electronic digital signal processing. In making this step in technology, new designs were developed based upon the experience obtained in the initial work., which included micro-ring resonators, optical bleaching, and passive elements. The basic design that Fetterman and his students developed is called a OSP unit cell and is shown along with the laboratory test setup in Figure 3.

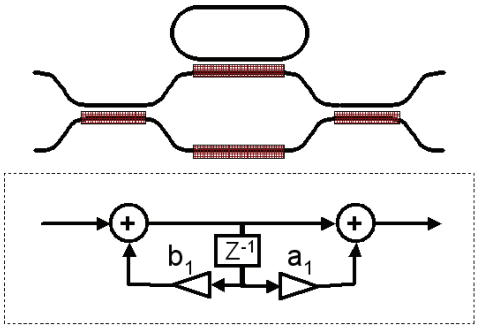


Figure 3: Unit cell for Optical Signal Processing using rings, passive elements and bleaching. It is to be repeated in series for major devices. The basic logic structure is the same as DSP.

This unit cell is now being incorporated in series structures to do amazing things from arbitrary waveform generation, to highly linear modulators, to true time delay units for radars. Research is supported by the Air Force Office of Scientific research and DARPA through the MORPH program.

Research Highlight

NEPTUNE Laboratory for Advanced Accelerator Research

Plasma-based particle accelerators

Professor Chandrashekhar Joshi, Director

In the highly sophisticated technological world that we live in today, examples of paradigm shifting breakthroughs that revolutionize entire fields by introducing truly substantial benefits are relatively infrequent. More than two decades of painstaking work by Professor Chand Joshi and his colleagues, is on the threshold of introducing such a paradigm shift in the extremely successful yet mature field of high energy particle accelerators. Accelerator based experiments have produced many key breakthroughs in our understanding of the physical world in the past 50 years. However, machines needed to explore the so-called Terascale Physics are extremely large, costly and time-consuming to build. Professor Joshi's research promises to miniaturize these gargantuan machines much in the same way as the introduction of integrated circuits miniaturized vacuum electronic devices.

The Neptune Laboratory for Advanced Accelerator Research is a flagship research laboratory funded by the U.S. Department of energy for exploring high-risk, high-payoff concepts for accelerating charged particles. At the outset it was recognized that developing an entirely new concept for charged particle acceleration, would be a multi-disciplinary endeavor that would require a sustained research effort of several decades to bring to fruition. The Neptune Laboratory is therefore operated collaboratively by several faculty members from both the Electrical Engineering and Physics departments at UCLA. The research being done brings together fields of high power lasers, plasma physics and microwave engineering. Starting from scratch in the late 1980s, the UCLA group has developed the Plasma-based particle acceleration scheme to a point where it has now become an internationally recognized field of research with many leaders of the field having received their training as students or postdocs at UCLA.

Particle accelerators are enormous in size because the microwave field that is used to accelerate charged particles can break down the walls of the accelerating structure as its intensity is increased. This limit is expressed as the accelerating gradient, which is typically 50 million volts per meter. In a total break with the present microwave based technology, UCLA researchers instead proposed to use the electric fields of a space charge density wave in plasma to accelerate particles. The phase velocity of the wave has to be at the speed of light so that the accelerating particles interact with the wave over a long distance and therefore gain a great deal of energy. The accelerating gradient of such a wave can be three orders of magnitude greater than that in a typical microwave powered structure. This means that for the same final energy the accelerator can be a thousand times smaller.

Experiments carried out in the Neptune laboratory show that intense laser pulses propagating through a plasma can excite plasma waves suitable for accelerating externally injected electrons. The laser used for this purpose is currently the highest power carbon dioxide laser in the U.S.. The electrons have to be pre-accelerated to relativistic energies (or moving close to the speed of light) so that they can "catch and surf the wave" and gain energy from it. The work sheds new light on wave-particle and wave-wave interaction in plasmas and gives stimulus to the birth of a new subfield "nonlinear-optics of plasmas".

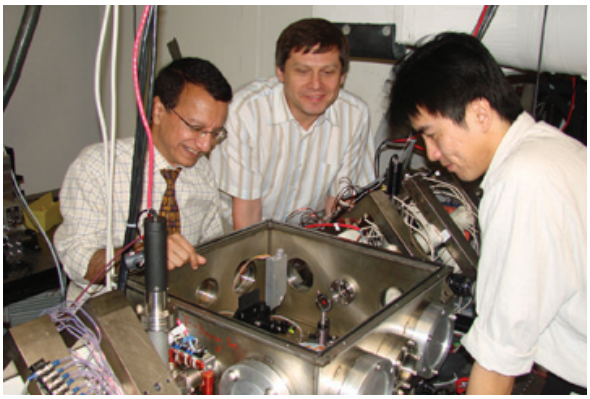


Figure 1: The NEPTUNE team of student Jay Sung (right), researcher Sergei Tochitski (center), and Professor Chan Joshi (left) examine the "laser-acceleration of electrons" experiment

On a grander scale, the work being carried out in the Neptune Laboratory has spawned a much larger experimental effort on plasma particle acceleration that is being carried out at the Stanford Linear Accelerator Center (SLAC) by Professor Joshi's group in collaboration with groups from U.S.C. and SLAC. This work has recently led to the demonstration of energy doubling of 42 billion volt electrons from the SLAC linear accelerator in a plasma device less than one meter long.

The Antenna Research, Analysis and Measurement (ARAM) Laboratory

Multi-function array antennas for remote sensing

Professor Yahya Rahmat-Samii, Director

Yahya Rahmat-Samii has developed novel antenna designs and measurement techniques for a variety of applications in personal communications (cell phones, wearable and implantable), radar and satellite applications (ground and space), planetary applications (solar system and outer space), etc. His recent work on the design of a novel array antenna for earth remote sensing application has been considered a significant advancement in the state of the art of antenna designs.

Soil moisture and sea surface salinity are described by NASA's Earth Science Enterprise (ESE) Strategic Plan as required measurements for addressing two ESE science questions: "How does the Earth system respond to natural and human-induced changes?" and "How well can we predict future changes in the Earth system?" In response to these questions, various missions for measuring soil moisture and sea surface salinity were recently selected for the NASA Earth System Science Pathfinder (ESSP). Knowledge of the soil moisture at approximately 10 km resolution or better is needed for evolving weather systems that are influenced by surface characteristics through atmospheric boundary layer coupling, . For climate studies at longer time scales, knowledge of boundary characteristics at approximately 40 km scale is adequate.

Future missions propose a combined L-band radar (1.26GHz) and radiometer (1.413GHz) instrumentation. The radiometer and radar channels separate the soil moisture and sea surface salinity signals from other perturbing factors such as vegetation and roughness over land, and roughness over the ocean. In order to achieve these objectives, the development of antenna systems capable of operating at dual frequencies with dual polarization capabilities is required. As a precursor to the spaceborne missions, preliminary airborne missions with aircrafts are required to test the concept feasibility. Traditional aircraft-based antenna systems addressing the needs of ESE have relied on the use of conical horn antennas. The lengths of these horns prevent their easy deployment on aircrafts. Rahmat-Samii's team, collaborating with their JPL colleagues under an NASA contract, have developed a lightweight and high performing alternative to the horn antennas, with particular focus on the development of a sixteen-element microstrip stacked patch array (MSPA), which can be deployed on small aircrafts and used in airborne remote sensing applications in an economical manner. An integrated radar-radiometer (center-frequencies: 1.26GHz, 1.413GHz) array antenna with dual-polarization (horizontal and vertical) capabilities. The array topology, its optimized design using particle swarm optimization, prototyping and measurements were performed at Rahmat-Samii's ARAM laboratory as shown in Figure 1 below. The results of their work recently appeared on the cover page of the *IEEE Antennas and Propagation Magazine*, December 2006 issue. Figure 2 shows this very unique, innovative and successful design aboard the aircraft in a recent measurement campaign.

From this design and performance study, the technology readiness of the dual-frequency dual-polarization microstrip antenna to meet the science and measurement requirements for future remote sensing missions will be established.

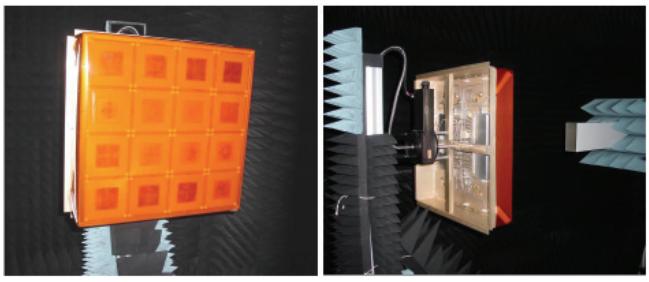


Figure 1: A novel 16-element dual frequency and dual polarization microstrip patch antenna in the spherical near field measurement chamber at UCLA Electrical Engineering. Left: front view of antenna. Right: side view of antenna with open-ended waveguide probe.

Figure 2: A 16-element array antenna mounted on the belly of an aircraft for remote sensing measurement campaigns (courtesy of Dr. S. Yueh of JPL).

The Cyber-Physical Systems Laboratory

Redefining the interface between control and real-time scheduling

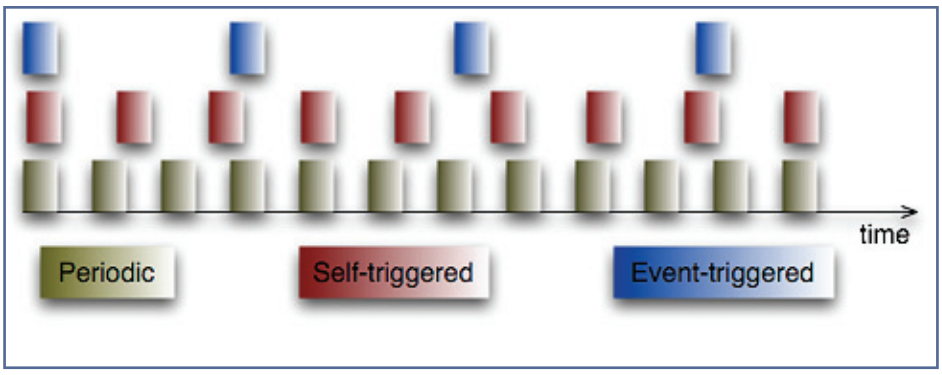
Professor Paulo Tabuada, Director

Existing technological systems are remarkably efficient and reliable despite the wide variety of conditions they operate in. A major contributor to this success is the field of control engineering, which provides the scientific principles and design tools to guarantee desired levels of performance under uncertainty. The principles of control, and the concept of feedback in particular, are routinely used across the whole spectrum of engineering applications. Examples range from the very small scale, such as nuclear magnetic resonance spectroscopy and quantum information processing to the very large scale, such as electrical power grids and the internet, while including more familiar systems such as aircrafts, automobiles and consumer electronics.

Prof. Tabuada's group is currently conducting research at the boundary between control and real-time scheduling. Nowadays engineering applications continue to require a high degree of autonomy and performance under uncertainty. However, they pose new challenges to control engineering as they combine distributed information processing, networking and the usage of severely resource constrained embedded microprocessors. To increase the functionality and reliability of these systems, one has to question standing assumptions and develop new methods to divide processor time among competing tasks.

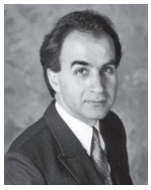
The co-design of control and real-time scheduling was initiated less than a decade ago when researchers in the US and Europe started optimizing the frequency at which control tasks are executed in order to increase performance while guaranteeing a fair allocation of processor time. Prof. Tabuada's group is taking these ideas one step further by abandoning the paradigm of periodic execution of control tasks. "Consider a juggler tossing balls into the air", Tabuada says. "If he devotes an equal amount of attention to every ball, he will only be able to juggle a small number of them. However, if he pays more attention to the balls that are about to hit the ground, he will manage to juggle more balls while dropping none. This is the same principle that we are applying to real-time scheduling. The decision of executing control tasks is based on the observed performance of the system being controlled rather than on an a-priori computed period. Strangely, this can be seen as an application of feedback to the software implementation of feedback control."

The novel methods developed in Prof. Tabuada's group lead to a new scheduling paradigm where performance requirements are explicit while timing requirements are implicit and time varying according to operating conditions. This new paradigm, its mathematical principles and corresponding design tools are being developed at UCLA's Electrical Engineering Department under NSF support.



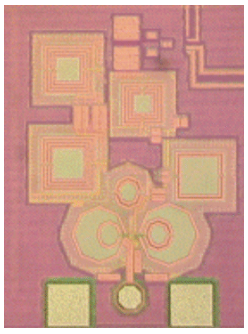
Execution of a control task for different scheduling strategies.

60-GHz CMOS Chips


Prof. B. Razavi

Professor Behzad Razavi and his students have recently introduced the first highly-integrated 60-GHz CMOS wireless receiver. Operation at 60 GHz will exploit 7 GHz of unlicensed band for transmitting high data rates, paving the way for high-speed wireless links. Such links will not only eliminate the jungle of cables that presently surrounds our office and home electronics, but will also provide much greater mobility for computing and entertainment devices. In fact, a fast real-time connection allows the mobile device to carry much less intelligence than the base serving it and hence benefit from a low cost and a small size. For example, your camcorder may simply transmit the recording to a server rather than store it.

The 60-GHz band offers another interesting capability: miniaturized antennas that can be built on the chip along with the transceiver system. The short wavelength — a few millimeters — at these frequencies allows antennas with dimensions on the order of one millimeter to provide a moderate efficiency. It is now possible to integrate multiple antennas and transceivers on one chip so that they can focus or "steer" the electromagnetic radiation in a desirable direction.



The principal challenge in designing 60-GHz chips relates to the very high operating frequency. Work on RF transceivers has thus far remained mostly below 6 GHz. Running RF circuits at 60 GHz therefore introduces new issues. For one thing, the speed of transistors has not gone up so much as to allow a ten-fold increase in the frequency by a simple redesign of 6-GHz wireless circuits. For another, the parasitics of the wires connecting the transistors on the chip play a much more adverse role in the performance at 60 GHz. These issues are much more pronounced in CMOS realizations.

These design challenges are met through innovations at the architecture, circuit, and device levels. In particular, the receiver developed by Professor Razavi incorporates new circuit and device techniques to achieve a high performance in a standard CMOS technology. Examples include a new method of "quadrature generation" and the

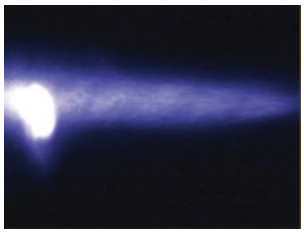
Miniaturizing Particle Accelerators


Prof. C. Joshi

Accelerators are the largest and arguably the most expensive scientific devices built by humans to understand matter and forces at their most basic level. The Large Hadron Collider at CERN and the proposed International Linear Collider are both based on fifty-year-old microwave technology. To push the frontier of elementary particle physics beyond these machines, an entirely new paradigm must be invented for building colliders.

Now a totally revolutionary technology developed in the Electrical Engineering department by Professor Chandrashekhar Joshi's research group promises to miniaturize these gigantic machines by a factor of a thousand or more. Here the accelerating structure is produced in a diluted plasma and powered by a laser beam or a particle beam.

In a culmination of more than two decades of research, Professor Joshi and his collaborators from the University of Southern California and Stanford Linear Accelerator Center (SLAC) successfully doubled the energy of the electrons from the Stanford Linear Accelerator in a distance of less than one meter using a plasma. The electrons first traveled through three kilometers of the linear accelerator at SLAC gaining 42 billion electron volts (or GeV) energy. Then they passed through a meter long cell of lithium where they excited a space charge density wave or a wakefield, rather like the wake produced by a motorboat as it speeds through water. The electric field of this plasma wave accelerated the electrons in the back of the same beam up to a maximum energy of 85 GeV. The researchers call their scheme a Plasma Afterburner because, like an afterburner on a jet engine, the plasma is used to provide extra thrust.


Photograph showing the recent breakthrough on energy doubling of the beam at SLAC as reported on the cover of the journal *CERN Courier*.

The experimental results, published in the February issue of *Nature,* demonstrated one of the biggest acceleration gradients ever achieved. The gradient is a measure of how quickly particles gain energy. In this case, the electrons zooming through the plasma chamber gained 3000 times more energy per meter than they usually do in the accelerator.

Center for Embedded Networked Sensing (CENS)

CENS is one of six National Science Foundation Science and Technology Centers established in 2002, and is projected to receive $40 million in core funding from the NSF over 10 years. CENS has successfully competed for substantial supplementary funding from both the NSF and other federal agencies to support new research activities generated within the Center. A truly interdisciplinary venture, CENS has also received institutional funding to support the activities of the more than 25 UCLA faculty, 20 graduate and 65 undergraduate students from disciplines across campus, as well as faculty and students from UC Merced, UC Riverside, the University of Southern California, California State University, Los Angeles, the James Reserve, the Jet Propulsion Laboratory and Caltech.

CENS is pursuing fundamental science and engineering research needed to create scalable, robust, adaptive, sensor/actuator networks including both Embedded Networked Sensing (ENS) technology research and ENS applications research. ENS-facilitated education and outreach activities are intertwined with the technology and application development.

ENS systems will form a critical infrastructure resource for society — they will monitor and collect information on such diverse subjects as plankton colonies, endangered species, soil & air contaminants, medical patients, and buildings, bridges and other man-made structures. Across this wide range of applications, Embedded Networked Sensing systems promise to reveal previously unobservable phenomena.

CENS Mosscam used as a physiological sensor (dry season vs wet season).

Electrical Engineering Professors Jack W. Judy, William J. Kaiser, Gregory J. Pottie, Mani B. Srivastava, John D. Villasenor, and Kung Yao contribute the resources of their research groups to the Center's goals. Professor Pottie is the Deputy Director of CENS.

California NanoSystems Institute (CNSI)

The California NanoSystems Institute is a research center that is run jointly by UCLA and UC Santa Barbara. CNSI was established in 2000 with $100 million from the State of California and an additional $250 million in federal research grants and industry funding. Its mission is to encourage university collaboration with industry and enable the rapid commercialization of discoveries in nanosystems. In particular, CNSI is working to:

- establish a world-renowned center for nanosystems research and development
- develop commercial applications of CNSI's technology
- educate the next generation of scholars in nanosystems R&D
- promote regional development through commercial use of nanotechnology
- generate public appreciation and understanding of nanotechnology

The work conducted at the CNSI represents world-class expertise in five targeted areas of nanosystems-related research including: Renewable Energy, Environmental Nanotechnology and Nanotoxicology, NanoBiotechnology and Biomaterials, NanoMechanical and NanoFluidic systems, and NanoElectronics, Photonics and Architectonics. CNSI's new building on the campus of UCLA is home to eight core facilities which will serve both academic and industry collaborations.

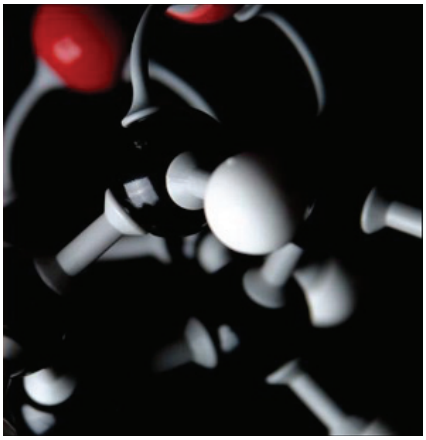
In 2007, the CNSI moved into a brand new 188,000 square foot, world-class research facility on the UCLA campus.

CNSI members who are on the faculty at UCLA and UCSB represent a multi-disciplinary team of some of the world's preeminent scientists in the fields of materials science, molecular electronics, quantum computing, optical networking and molecular medicine, to cite but a few examples. Professors Eli Yablonovitch, Kang Wang, Jack Judy, Vwani Roychowdhury, Bahram Jalali, and Jason Woo of the Electrical Engineering Department are members of CNSI. Professor Wang is the Associate Director of CNSI.

Center on Functional Engineered Nano Architectonics (FENA)

FENA is a multi-disciplinary center that aims to create and investigate new nano-engineered functional materials and devices, and novel structural and computational architectures for new information processing systems beyond the limits of conventional CMOS technology. FENA is part of the Focus Center Research Program initiated by the Semiconductor Research Corporation in an effort to expand pre-competitive, cooperative, long-range applied microelectronics research at US universities. The center, which was established in 2003, will receive $13.5 million over the first three years, and as much as $70 million over 10 years.

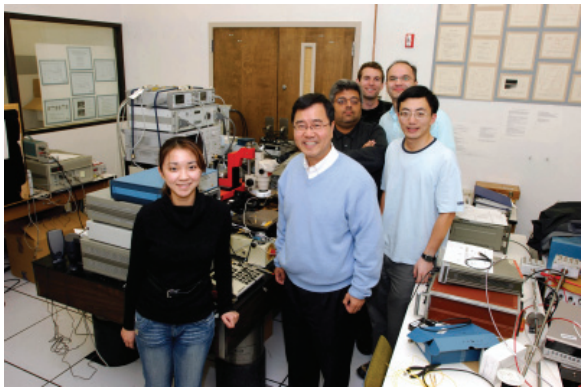
FENA has 28 distinguished principal investigators from broad areas such as Materials Science, Chemistry, Electrical Engineering, Bio Engineering, Mathematics, Applied Physics, and Computer Engineering, from 11 of America's most elite research universities. The center is led by Professor Kang Wang of the Electrical Engineering Department. FENA embraces the current opportunity to create and explore the next generation of nanoscale semiconductor technology to the borders of ultimate CMOS and beyond: inventing the heterogeneous interfaces of new nanosystems, enabling a combination of biological and molecular functions, and revolutionizing the paradigms of information processing and sensing. These new nanostructured materials will provide the basis for the continued expansion of the semiconductor industry and the creation of new applications of monolithically integrated (CMOS, molecular and biomolecular) nanosystems. FENA involves faculty from several institutions including UCLA, UCSB, UC Riverside, UC Berkeley, USC, Caltech, Stanford, MIT, New York University, University of Minnesota, North Carolina State University, and SUNY.



Simulation of DNA, peptides, phage and microtubules that will serve as nano-templates for the assembly of electronic building blocks.

Western Institute of Nanoelectronics (WIN)

The Western Institute of Nanoelectronics is a multi-disciplinary center that is among the world's largest spintronics efforts. It is headquartered at UCLA and led by Electrical Engineering Professor Kang Wang. The institute involves collaborations among teams from UCLA, UC Santa Barbara, UC Berkeley, and Stanford. The program is co-managed by the four participating campuses and semiconductor industry sponsors, with nearly 10 researchers from semiconductor companies working with the students and faculty on all of the university campuses.



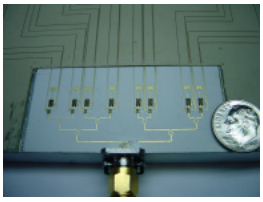
Kang Wang and his research team in the WIN lab.

The institute's mission is to explore and develop advanced research devices, circuits and nanosystems with performance beyond conventional devices, which are based on the current industry standard, complementary metal oxide semiconductors. The Western Institute of Nanoelectronics is being established with starting grants of $18.2 million: an industrial support total of $14.38 million and a matching $3.84 million UC Discovery Grant. The $18.2 million includes $2.38 million from a Nanoelectronics Research Initiative grant funded by six major semiconductor companies — Intel, IBM, Texas Instruments, AMD, Freescale and MICRON. The amount also includes an additional Intel grant of $2 million. The institute also will receive a separate $10 million equipment grant from Intel.

Endowed Chairs

Professor Deborah Estrin of the UCLA Computer Science and Electrical Engineering Departments holds the Jonathan B. Postel Chair in Computer Networking in recognition of her ground-breaking research. This position was established by Dr. Postel's former colleagues to honor and recognize his extraordinary achievements in the networking field over the course of his 30-year career as a leading spokesman and architect of systematic organization in the rapidly growing online community. "Having worked with Jon Postel for many years as a researcher in his Computer Networks division, and as a member of the larger Internet research community, the Chair is particularly meaningful," says Prof. Estrin. She is also Director of the Center for Embedded Networked Sensing (CENS), an NSF Science and Technology Center. CENS is a major research enterprise developing wireless sensor systems and applying this revolutionary technology to radically transform critical scientific and societal applications. In 2003, Estrin was named one of Popular Science's Brilliant 10, an annual list of young scientists conducting ground-breaking work, for her research in embedded sensor networks and its applications in environmental monitoring.

Professor Tatsuo Itoh, Northrop Grumman Chair in Microwave and Millimeter Wave Electronics, is a pioneer in electromagnetic engineering for microwave and wireless components, and heads the UCLA EE Department Microwave Electronics Laboratory. The laboratory has been engaged in a number of research projects, ranging from theoretical investigation to practical implementation of various microwave-related topics. The laboratory is working on enhancing the capability of retrodirective array for automatic target tracking and communication. Prof. Itoh's group has accomplished several unique capabilities previously unavailable, including a retrodirective array that can be reconfigured from the retrodirective mode to a direct conversion receiver/transmitter. The laboratory has also spearheaded the research and development of microwave applications of metamaterial structures. Unlike other research efforts in the world working on this subject, Prof. Itoh and his group have invented a uniquely different approach that provides low loss broadband capability. They have developed many microwave components with unusual or unique capabilities, including an electronically controlled antenna with 180 degree coverage and a variable radiation pattern, a very compact directional coupler, dual band circuits for high power high efficiency amplifiers, etc. A spin-off project is the development of small antennas for wireless communication (ten times smaller than conventional antennas).

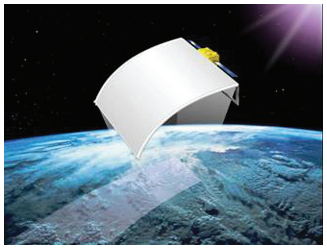


8-Antenna Millimeter-Wave Radar Receiver with Performance of 12 Antennas

Professor Yahya Rahmat-Samii was recently selected to hold the Northrop Grumman Chair in Electromagnetics in recognition of his outstanding and diversified research contributions in the areas of electromagnetics and antennas. He is a well-known international authority in his field and heads the UCLA EE Department Antenna Research, Analysis and Measurement (ARAM) Laboratory. Dr. Rahmat-Samii has authored and co-authored over 720 technical journal articles and conference papers and has written 25 book chapters and three books. He has received numerous awards, including the 2007 Chen-To Tai Distinguished Educator Award of the IEEE Antennas and Propagation Society.

Prof. Rahmat-Samii's pioneering research activities cover many areas including: (a) Advanced Reflector Antenna Designs and Compensations (in which antenna concepts and designs are utilized in many planetary space missions, soil moisture remote sensing instruments, direct broadcast satellites, and outer space missions); (b) Personal Communication Antennas including Human Interactions (ARAM is considered one of the prominent research groups in the area of communication antennas for mobile units, MIMO, wearable and implanted applications. It is among the pioneering groups to include the effects of the human biological tissues in simulation models); (c) Nature-Based Optimization Techniques in Electromagnetics (Prof. Rahmat-Samii pioneered activities in the application of the genetic algorithms

and particle swarm optimizations in electromagnetics and antenna research. Many innovative and multifunction communication antennas, radar absorbing structures, and antenna array topologies have been designed using these techniques); (d) Antenna Measurements and Diagnostics Techniques (Advanced measurements and diagnostic techniques for antenna characterization have been developed). For the first time ever, the indoor bi-polar near field measurement technique has been demonstrated. A microwave holography technique for antenna diagnostics including phaseless measurements has also been developed.



Remote Sensing Antenna

Professor Kang L. Wang, recently appointed as the Raytheon Chair Professor of Physical Science, received his BS (1964) degree from National Cheng Kung University and his MS (1966) and PhD (1970) degrees from the Massachusetts Institute of Technology. He is recognized internationally as a leader in nanotechnology. He serves on the editorial board of the Encyclopedia of Nanoscience and Nanotechnology (American Scientific publishers). He also currently serves as the Director of the MARCO Focus Center on Functional Engineered Nano Architectonics (FENA), an interdisciplinary Research Center funded by the Semiconductor Industry Association and Department of Defense to address the need of information processing technology beyond scaled CMOS, and was named the Director of Western Institute of Nanoelectronics (WIN) — a coordinated multi-project Research Institute. WIN is funded by NRI, Intel and the State of California Current ongoing projects are aimed at spintronics for low power applications. Prof. Wang was also the founding director of the Nanoelectronics Research Facility at UCLA (established in 1989) with an infrastructure to further research in nanotechnology. In addition to these technical leadership contributions, he has provided academic leadership in engineering education. He was the Dean of Engineering from 2000 to 2002 at the Hong Kong University of Science and Technology. Prof. Wang's research includes nanoelectronics, spintronics and new architectures for nanodevices.

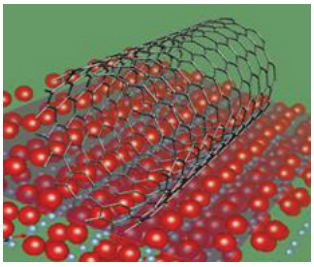
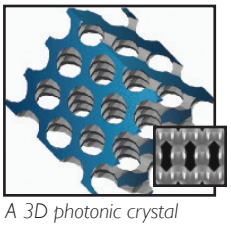


Figure representing nanowire synthesis

Professor Eli Yablonovitch, a pioneer in the field of opto-electronics and photonic bandgap research, is the Northrop Grumman Chair in Optoelectronics. He also heads the UCLA EE Department Optoelectronics Group, which is focused on the future of electronics and optoelectronics. Among the technological changes that will be forthcoming in the near future are:

1. The full integration of optics and electronics in silicon chips. This is being accomplished in part by the incorporation of two-dimensional photonic crystal concepts into silicon design. An example of a three dimensional photonic crystal is in the figure at right, which is the electromagnetic analog of a conventional crystal for electrons.
2. New paradigms for very-short-distance intra-chip communications will have to be developed before we can create nano-electronics. Current signaling schemes consume too many joules per bit, dissipating the advantage of going to the nanoscale. A new short distance communications paradigm must emerge, so that the energy efficiency of nano-storage and nano-logic will be matched by equally efficient communications.
3. After the culmination of the current semiconductor road map, quantum information processing will emerge as the dominant information processing technology of the 21st century. It is currently unclear which quantum information technology will emerge as dominant, but the Yablonovitch group is emphasizing semiconductor hosts for the qubits.



A 3D photonic crystal (above), with an example of a side view (inset)

Representative Distinguished Alumni

Elias J. **Antoun**	CEO, Genesis Microchip	BS '79
Balu **Balakrishnan**	President and CEO, Power Integrations	MS '76
Leonard G. **Bonilla**	Program Manager, Raytheon Company	BS '70
James S. **Cable**	CEO and Vice President of Technology, Peregrine Semiconductor	PhD '92
Ta-Wei **Chien**	President and CEO, TCG America Inc., Co-inventor of TiVO	MS '80
Edsel **Dunford**	Former CEO, TRW	MS '73
John **Gifford**	Founder, Maxim Integrated Products Co-founder, AMD	BS '63
Klein **Gilhousen**	Co-founder, Qualcomm Corporation	BS '69
Armond **Hairapetian**	Founder of NewPort Communications (acquired by Broadcom)	BS '87, MS '88, PhD '93
Linda **Katehi**	Provost, University of Illinois, Urbana-Champaign	MS '81, PhD '84
Asad M. **Madni**	President and COO (retired), BEI Technologies	BS '69, MS '72
Henry T. **Nicholas** III	Co-founder and former President and CEO, Broadcom Corporation	BS '82, MS '85, PhD '98
Robert **Nunn**	President and CEO, Fulcrum Microsystems	BS '84
Gary L. **Patton**	Vice President IBM Semiconductor Research & Development Center	BS '80
James **Plummer**	Dean, School of Engineering, Stanford University	BS '66
Reza **Rofougaran**	Founder, Innovent (acquired by Broadcom)	BS '86, MS '88, PhD '98
Henry **Samueli**	Co-founder and Chairman, Broadcom Corporation	BS '75, MS '76, PhD '80
Dwight **Streit**	Vice President, Electronic Technologies, Northrop Grumman Corporation	MS '83, PhD '86
Ronald **Sugar**	Chairman, CEO, Northrop Grumman Corporation	PhD '71

Asad A. Abidi – National Academy of Engineering

Professor Asad A. Abidi has served the Electrical Engineering Department of the University of California, Los Angeles since 1985. He was inducted to the National Academy of Engineering for his contributions to the development of MOS integrated circuits for RF Communications. Prior to his tenure with the School, Abidi worked at Bell Laboratories, Murray Hill, NJ, as a member of the technical staff in the Advanced LSI Development Laboratory. He has received a number of awards and honors throughout his career, including the 1988 TRW (now Northrop Grumman) Award for Innovative Teaching, and the 1997 IEEE Donald G. Fink Award, presented for the most outstanding survey, review, or tutorial paper published in the IEEE transactions, journals, magazines, or in the proceedings during a given year.

Nicolaos G. Alexopoulos – National Academy of Engineering

Nicolaos G. Alexopoulos is the Dean of the Henry Samueli School of Engineering at UC Irvine and an Adjunct Professor in Electrical Engineering at UCLA. The NAE honored Alexopoulos for important work in "microwave circuits, antennas, and structures for low observable technologies, and for contributions in engineering education." Professor Alexopoulos' research covers electromagnetic theory, integrated microwave circuits, micro strip antennas and arrays, multi-function antennas, non-reciprocal materials, numerical methods, and percolation theory and applications. His work focuses on the modeling and design of three-dimensional integrated circuits and printed antennas in multilayered materials, wireless communication antennas and systems, and includes interconnect problems in complex networks, novel materials and smart structures in low observable systems, and computational methods.

Robert S. Elliott – National Academy of Engineering

Professor Emeritus Robert S. Elliott has had a long and illustrious career at UCLA. He served as the first Electrical Engineering Department Chair in the (then) School of Engineering and Applied Science and was the first person to hold the Hughes Distinguished Chair in Electromagnetics at UCLA. He became a Fellow of the IEEE in 1961, and was the recipient of the APS Distinguished Achievement Award in 1988. Also in 1988, and even more importantly, Dr. Elliott was honored by the National Academy of Engineering "for basic contributions to the electromagnetic theory and design of array antennas, and for outstanding leadership in engineering education". During his career at UCLA Prof. Elliott also was the recipient of several Best Teacher Awards, and two IEEE Best Paper Awards. In 2000 he received an IEEE Third Millennium Medal. Dr. Elliott is also the author of two seminal electrical engineering textbooks, *Antenna Theory and Design* and *Electromagnetics*.

Tatsuo Itoh – National Academy of Engineering

Professor Itoh has pioneered a research area in interdisciplinary electromagnetics beyond traditional electromagnetic engineering. Elected to the National Academy of Engineering in 2003, his citation reads, "For seminal contributions in advancing electromagnetic engineering for microwave and wireless components, circuits, and systems". In his early career, he developed a number of numerical methods for microwave problems. Based on one of these methods, he then developed the first CAD program package for design of E-plane filters for millimeter wave systems such as radio, radar, and remote sensors. More recently, his effort has been directed to coherently combining solid state devices and electromagnetic circuits for improved cost effectiveness and system performance. From this effort, the first global simulator for the RF frontend was developed, dealing with antennas, passive and active microwave circuits at the same time. He has also created the Active Integrated Antenna scheme in which the antenna is not only a radiating element but also serves as a circuit element for the RF front end, particularly at millimeter wave frequencies.

Members of the National Academies

Stanley Osher – National Academy of Sciences

Professor Stanley Osher was elected to the National Academy of Sciences for "major contributions to algorithm development and applications in level set methods, high-resolution shock capturing methods, and PDE-based methods in imaging science." He has been at UCLA since 1976 and is Director of Special Projects at the Institute for Pure and Applied Mathematics. He is the co-inventor of level set methods for computing moving fronts, numerical methods for computing solutions to hyperbolic conservation laws and Hamilton-Jacobi equations, and total variation and other PDE-based image processing techniques. Dr. Osher was a Fulbright and Alfred P. Sloan Fellow, and has received the NASA Public Service Group Achievement Award, the Japan Society of Mechanical Engineers Computational Mechanics Award, the SIAM Pioneer Prize, and the SIAM Kleinman Prize.

C. Kumar Patel – National Academy of Sciences, National Academy of Engineering

Professor Patel holds a joint professorship with the Electrical Engineering and Physics Departments at UCLA. He has made numerous seminal contributions in several fields, including gas lasers, nonlinear optics, molecular spectroscopy, pollution detection and laser surgery. He has received numerous honors, including the National Medal of Science, for his invention of the carbon dioxide laser. He has also received the Lomb Medal of the Optical Society of America, the Franklin Institute's Ballantine Medal, the Pake Prize of the American Physical Society, and the Coblentz Society's Coblentz Prize.

Henry Samueli – National Academy of Engineering

Dr. Henry Samueli was elected to the NAE in recognition of his "pioneering contributions to academic research and technology entrepreneurship in the broadband communications system-on-a-chip industry". Dr. Samueli has over 25 years of experience in the fields of digital signal processing (DSP) and communications systems engineering. He is widely recognized as one of the world's leading experts in the field of broadband communications circuits. He received his BS, MS and PhD degrees in electrical engineering from UCLA. Since 1985, Dr. Samueli has been a professor in the Electrical Engineering Department where he has supervised advanced research programs in DSP and broadband communications, and is also well known as the cofounder of Broadcom Corporation in 1991.

Jason Speyer – National Academy of Engineering

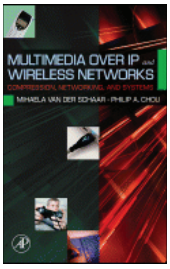
Professor Jason Speyer was elected to the National Academy of Engineering for "the development and application of advanced techniques for optimal navigation and control of a wide range of aerospace vehicles." He pioneered new optimal deterministic and stochastic control, team and differential game strategies, estimation, and model-based fault detection, identification, and reconstruction theories and algorithms, as well as matrix calculus of variations for the Apollo autonomous navigation system. He pioneered the development and mechanization of periodic optimal control with applications to aircraft fuel-optimal cruise and endurance. His efforts in differential carrier phase GPS blended with an inertial navigation system, was applied to formation flight for drag reduction, and achieved centimeter accuracy in flight tests. Dr. Speyer is a fellow of AIAA and IEEE (Life Fellow) and received the IEEE Third Millennium Medal as well as several AIAA Awards.

Eli Yablonovitch – National Academy of Engineering, National Academy of Sciences

Professor Eli Yablonovitch was elected as a member of the NAE "for introducing photonic bandgap engineering and applying semiconductor concept to electromagnetic waves in artificial periodic structures". An integral component of these accomplishments is the photonic crystal. Photonic crystals are being used as one of the design paradigms for forthcoming photonic integrated circuits, and also lead to the smallest electromagnetic cavities with the highest Q-factors. They are now used in many quantum information devices. In the same year that he was elected to the National Academy of Engineering (2003), Prof. Yablonovitch was also elected to the National Academy of Sciences, "for field-opening contributions to quantum electronics and photonic materials, including the invention of the photonic bandgap, photonic crystals, and the strained quantum well laser."

Multimedia over IP and Wireless Networks

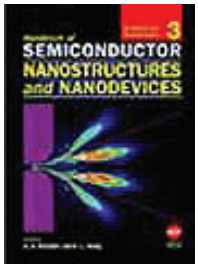
M. van der Schaar and P. Chou, editors *Elsevier, 2007*



This volume serves as an indispensable guide for professionals or researchers working in areas like networking, communications, data compression, multimedia processing, streaming architectures, and computer graphics. Beginning with a concise overview of the fundamental principles and challenges of multimedia communication and networking, this book then branches off organically to tackle compression and networking next before moving on to systems, wireless multimedia and more advanced topics. The Compression section advises on the best means and methodology to ensure multimedia signal (images, text, audio and data) integrity for transmissions on wireless and wired systems. The Networking section addresses channel protection and performance. In the Systems section the focus is on streaming media on demand, live broadcast and video and voice's role in real-time communication. Wireless multimedia transmission and Quality of Service issues are discussed in the Wireless Multimedia section. An Advanced Topics section concludes the book with an assortment of topics including Peer-to-Peer multimedia communication and multipath networks.

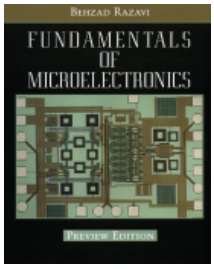
Handbook of Semiconductor Nanostructures and Nanodevices

A.L. Balandin and K.L. Wang, editors *American Scientific Publishers, 2006*

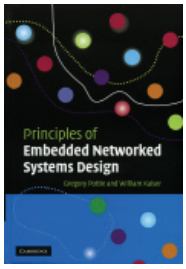


This five-volume handbook covers a wide variety of advanced and emerging developments in the field of semiconductor nanotechnology. It is the most up-to-date reference work available, summarizing two decades of pioneering research. Each volume is thematic, based on semiconductor nanostructured materials and their based nanodevices.

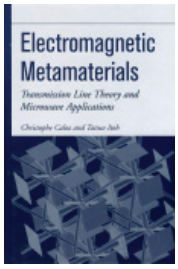
Volume 1: Self-Assemblies, Quantum Dots, and Nanowires
Volume 2: Nanofabrication and Nanoscale Characterization
Volume 3: Spintronics and Nanoelectronics
Volume 4: Nanophotonics and Optoelectronics
Volume 5: Nanodevices and Circuits



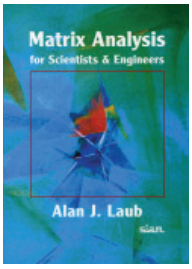
Fundamentals of Microelectronics
B. Razavi
John Wiley and Sons, 2006



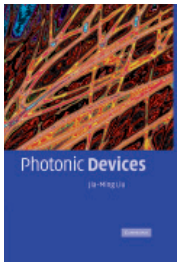
Principles of Embedded Networked Systems Design
G. Pottie and W. Kaiser
Cambridge University Press, 2005



Electromagnetic Materials
C. Caloz and T. Itoh
Wiley-IEEE Press, 2005

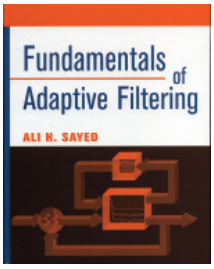


Matrix Analysis for Scientists and Engineers
A.J. Laub
SIAM Press, 2005

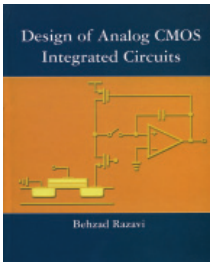


Photonic Devices
J-M. Liu
Cambridge University Press, 2005

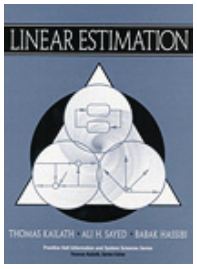
Convex Optimization
S. Boyd and L. Vandenberghe
Cambridge University Press, 2004



Fundamentals of Adaptive Filtering
(2005 Terman Award)
A.H. Sayed
Wiley, 2005



Design of Analog CMOS Integrated Circuits
B. Razavi
McGraw Hill, 2000



Linear Estimation
T. Kailath, A.H. Sayed, B. Hassibi
Prentice-Hall, 1999

Seminar Series in Electrical Engineering

During the academic year 2006-2007, the department was pleased to host a number of outstanding speakers covering a broad range of topics.

Fall 2006 (Signals and Systems Area)

Professor Ali H. Sayed, organizer

- G.B. Giannakis (University of Minnesota): *Distributed Estimation Using Wireless Sensor Networks with Noisy Links*
- S. Haykin (McMaster University): *Cognitive Dynamic Systems*
- J. Mendel (University of Southern California): *Signal Fusion Using Novel Weighted Averages*
- J. Moura (Carnegie Mellon University): *Topology Design in Distributed Inference in Sensor Networks*
- A.R. Teel (University of California, Santa Barbara): *Robust Hybrid Control Systems*
- P.P. Vaidyanathan (California Institute of Technology): *Signal Processing in Genomics*
- S. Verdu (Princeton University): *Current Trends in Information Theory*
- Y. Ye (Stanford University): *Semidefinite Programming Approaches to Graph Realization and Sensor Network Localization*

Winter 2007 (Circuits and Embedded Systems Area)

Professor Dejan Markovic, organizer

- S.Y. Borkar (Intel Corporation): *Extending and Expanding Moore's Law – Challenges and Opportunities*
- K. Nowka (IBM Austin Research Laboratory): *Variability, Power, and Robustness in Microprocessor Design*
- A. Behzad (Broadcom Corp.): *A Brief Introduction to 802.11n, and the Design of a Fully Integrated CMOS Draft-802.11n Radio*
- P.R. Kumar (Urbana-Champaign): *From Wireless Networks to Sensor Networks and onward to Networked Embedded Control*
- B. Nikolic (University of California, Berkeley): *Making Sense out of Variability in Scaled CMOS*
- T. Sakurai (University of Tokyo): *Meeting the Forthcoming IC Design – The Era of Power, Variability and NRE Explosion and a Bit of the Future*
- S. Tsividis (Columbia University): *Mixed-Domain Signal Processing*

Spring 2007 (Physical and Wave Electronics Area)

Professor Jason C.S. Woo, organizer

- J. Harris (Stanford University): *Spintronics and Beyond Road Map Electronics*
- R. Chau (Intel): *Advanced Silicon Nanotechnology and Emerging Non-Silicon Nanoelectronic Devices for High-Speed and Low-Power VLSI Applications*
- G. Patton (IBM Semiconductor Research and Development Center): *Ultra-Scaled Silicon Technology*
- Y.K. Chen (Bell Labs / Lucent): *Recent Advances in Photonic Signal Processing Techniques*
- H. Stork (Texas Instruments): *Challenges of Mobile System Integration with Next Generation CMOS Technology*
- P. Asbeck (University of California, San Diego): *High Speed HBT Devices and Circuits*
- T.P. Ma (Yale University): *Several Novel Techniques for Electrical Characterization of High-k Gate Dielectrics*
- D. Radack (Institute for Defense Analyses): *A Perspective on the Future of Microsystems Technology Research*

Professor Lei He, Chair; Prof. Mihaela van der Schaar, Co-chair

Our annual research review was held during Winter 2007. Its purpose was to provide a forum in which graduate students could present their latest research results and answer questions from industrial and government sponsors, and where attending guests can gain an update on recent and ground-breaking research.

- **C.K.K. Yang**: *Circuits and Embedded Systems Research*
- **K.L. Wang**: *From Nanoelectronics to Nanosystems*
- **G.J. Pottie**: *Next Generation Sensor Networks*
- R. Nanda, V. Wang, and **D. Markovic:** *Power-Area-Throughput Optimization of VLSI Signal Processing Algorithms*
- H-S Kim, W. Zhu, J. Bhatia, K. Mohammed, A. Shah, and **B. Daneshrad:** *A Hardware Friendly 4x4 Linear MIMO Detector for MIMO-OFDM Based Systems*
- G. Zhong and **A. Wilson**: *An Energy-Efficient Reconfigurable Multi-processor IC for DSP Applications*
- L.-M. Lee and **C.-K.K. Yang**: *An Adaptive Low-Jitter LC-Based Clock Distribution*
- S. Delshadpour and **S. Pamarti:** *A Spur Elimination Technique for Fractional-N Phase Locked Loops Based on VCO Phase Interpolation*
- H. Yu, Y. Hu, C. Liu, and **L. He**: *Minimal Skew Clock Embedding Considering Time Variant Temperature Variation*
- J-L. Hsu and **I. Rubin**: *Cross Layer Integrated Code Rate Control and Routing for Multi-hop Wireless Networks*
- S. Asgari, A. Ali, T.C. Collier, Y. Yao, C-E. Chen, R.E. Hudson, **K. Yao,** and C.E. Taylor**:** *Theoretical and Experimental Study of Isotropic and Non-isotropic 3D Arrays for Direction-of-Arrival Estimation*
- L. Balzano and **M.B. Srivastava:** *Blind Calibration of Distributed Networked Sensors*
- A.I. Vila Casado, M. Griot, and **R.D. Wesel**: *Informed Scheduling for Belief Propagation*
- T. Roh and **L. Vandenberghe**: *Design of Two-dimensional FIR Filters by Semidefinite Programming*
- **E. Yablonovitch:** *CMOS Integrated Nano-Photonics is Now a Commercial Technology*
- B. Bortnik, Y.-C. Hung, H. Tazawa, W.H. Steier, J. Luo, A. Jen, B-J. Seo and **H.R. Fetterman**: *Electro-optic Polymer Ring Resonator Modulation up to 165 GHz*
- R. Diaz, S-Ch. Chan, and **J-M. Liu:** *Dual-Frequency Multifunction Lidar*
- J. Stillman, **J.W. Judy,** and H. Helvajian: *Processing Parameters for the Development of Glass/Ceramic MEMS*
- Minghui Chen and **M.C.F. Chang**: *A 2.2 Gb/s CMOS Differential QPSK*
- K.M. Abdelfattah and **B. Razavi**: *Modeling Op Amp Nonlinearity in Switched-Capacitor Sigma-Delta Modulator*
- T. Larocca and **M.C.F. Chang:** *60 GHz CMOS Differential Power Amplifier Using On-Chip Transformers for Compact Design*
- R. Kumar, A. Singhania, A. Castner, and **M.B. Srivastava**: *A System for Coarse Grained Memory Protection in Tiny Embedded Processors*
- D. McIntire and **W.J. Kaiser**: *A New Energy-Aware Embedded Platform for Networked Sensing*
- T. Schmid and **M.B. Srivastava**: *Software Radio Implementation of Short-range Wireless Standards for Sensor Networking*
- G. Pola and **P. Tabuada**: *On-the-fly Synthesis of Correct-by-Design Embedded Control Software*
- F. Fu, Yi Su, and **M. van der Schaar**: *Game Theoretic Approaches for Multi-User Resource Allocation in Cognitive Radio Networks*
- D.-U Lee, H. Kim, S. Tu, M. Rahimi, **D. Estrin,** and **J.D. Villasenor**: *Energy-Optimized Image Communications on Resource-Constrained Sensor Platforms*
- Z. Quan, W.J. Kaiser, and **A.H. Sayed**: *A Distributed Sampling Scheme Based on Innovations Diffusion in Sensor Networks*
- K. Ni and **G.J. Pottie**: *Bayesian Selection of Non-faulty Sensors*
- M. Samuel and **M.P. Fitz**: *A 2x2 Multistrata Space-Time Block Code*
- C. Allen, D. Goshi, A. Lei, C-J. Lee, and **T. Itoh**: *Analysis and Applications of Microwave Electronics*
- K. Bahadori and **Y. Rahmat-Samii**: *A Miniaturized Elliptic-Card UWB Antenna for Wireless Communications*
- X. Xu and **Y. E Wang**: *Beyond the Performance Limit with Switched Electrically Small Antennas*
- M. Zhou, **C. Joshi,** and **W. Mori**: *Advanced Accelerator Research at UCLA: 40 GeV Energy Gain in Less than One Meter*

Workshops

Every year the department sponsors focused workshops on topics of heightened interest with the participation of faculty, students, industry, and invited speakers.

Workshop on Power-Constrained Multimedia Systems

Professor Mihaela van der Schaar, organizer — February 2, 2007

- K. Nahrstedt (University of Illinois, Urbana-Champaign) *Cooperative Energy-Constrained Resource Management in Mobile Multimedia*
- A. Ortega (University of Southern California): *Error-Tolerant Video Compression for Low Power Encoding via Voltage Scaling Environments*
- D. Sow (IBM T.J. Watson Research Center): *Information Rate, Complexity and Distortion Trade-offs*
- H. Jiang (Intel Research): *Balance of Power, Performance and Flexibility*
- J. Li (Microsoft Research, Redmond): *Efficient and Reliable P2P Content Delivery*
- J. Moura, M. Pueschel, and F. Franchetti (Carnegie Mellon): *Spiral: Joint Runtime/Energy Optimization and Hardware/Software Partitioning of Linear Transforms*
- P. H.N. de With (Eindhoven University of Technology): *Embedded Video Applications in Video Content Analysis*
- R. Gupta (University of California, San Diego): *Energy Efficient Multi-Radio Platforms for Mobile Applications*
- Y. Lu (Microsoft Research, Asia): *Complexity Constrained Video Coding*
- Z. He (University of Missouri): *Power-Rate-Distortion Analysis and Control for Energy-Aware Embedded Video Sensing*
- P. Frossard (Ecole Polytechnique Federale de Lausanne): *Low Complexity Scheduling of Packetized Media with Feedback*
- Mihaela van der Schaar (University of California, Los Angeles): *Theoretical Foundations for Power-Constrained Multimedia Applications on Multiple Processors*

Workshop on Emerging Antenna Research for Wireless Communications

Professors Yuanxun Ethan Wang and Yahya Rahmat-Samii, organizers — February 20, 2007

- Y. Rahmat-Samii (University of California, Los Angeles): *Antenna Design and Optimization for Modern Wireless and MIMO Applications*
- C. Balanis (Arizona State University): *Impact of Antenna Characteristics on Network Throughput and Communication Channel BER*
- J. Bernhard (University of Illinois, Urbana-Champaign): *Reconfigurable Antennas: State of the Art and Future Directions*
- H. Ling (University of Texas): *Electrically Small Antennas – Theory, Design and Challenges*
- T. Itoh (University of California, Los Angeles): *Progress on Metamaterial Based Antennas*
- J. Volakis (Ohio State University): *Anisotropic Media and Printed Circuits for Narrowband and Ultra-Wideband Antennas*
- M. Iskander (University of Hawaii): *Antenna Array Technologies for Advanced Wireless Systems*
- M. Jensen (Brigham Young University): *Antenna Design Principles for MIMO Wireless Communications*
- Y. E. Wang (University of California, Los Angeles): *On and Beyond the Capacity Limit of Space Constrained Radiation Platforms*

UCLA Telehealth Workshop

Professor William J. Kaiser, organizer — May 30, 2007

- D. Aberle, E. Savitsky, M. Sarrafzadeh: *Clinical Opportunities in Telehealth*
- D. Estrin, J. Burke and B. McCarthy: *Telehealth for Public Health and Wellness*
- A. Bui, M. Hansen, and M.B. Srivastava: *Security, Privacy, and Compliance in Telehealth*

Future Directions in Advanced Accelerator Research

Professor Chan Joshi, organizer — March 23-24, 2007

- M. Hogan (Stanford Linear Accelerator Center): *The SABER Facility for Advanced Acceleration Experiments*
- R. Ischbeck (Stanford Linear Accelerator Center): *Latest Analysis on Particle Trapping*
- E. Oz (University of Southern California): *Brightness Multiplier*
- I. Blumenfeld (Stanford Linear Accelerator Center): *Energy Gain Scaling Laws*
- K. Marsh (University of California, Los Angeles): *Plasma Sources for SABER*
- X. Wang (University of Southern California): *Positron Acceleration in Electron Wakes*
- M. Zhou (University of California, Los Angeles): *Head Erosion in PWFA*
- C. Huang: (University of California, Los Angeles): *Perturbation Theory for the Hosing Instability in Plasmas*
- P. Muggli (University of Southern California): *e+ Beam Halo Formation*
- C. Joshi (UCLA) and R. Bingham (Rutherford Laboratories, UK): *European vs. U.S. Programs*

14th Southern California Nonlinear Control Workshop

Professors Paulo Tabuada and Panagiotis Christofides, organizers — June 8, 2007

- D. Pekarek (California Technical Institute): *Optimal Control for Simple Hybrid Mechanical Systems*
- R.G. Sanfelice (University of California, Santa Barbara): *Hybrid Control Strategies for Robust Stabilization*
- A. Anta (University of California, Los Angeles): *Real-time Scheduling for Homogeneous Control Systems*
- S. Summers (University of California, San Diego): *Adjoint-based Model Predictive Control and Identification of Switched Nonlinear Systems*
- I. Al-Shyoukh (University of California, Los Angeles): *Switching Supervisory Control Using Calibrated Forecasts*
- S. Dubljevic (University of California, Los Angeles): *Optimal Mechano-electric Stabilization of Cardiac Alternans*
- A. Simpkins (University of California, San Diego): *Optimal Trade-off Between Exploration and Exploitation in Human Movement*
- A. Deshpande (University of California, San Diego): *Dimensionality and Complexity: Revoking the Two Curses*
- A. Mesquita (University of California, Santa Barbara): *Optimotaxis: A Random Multi-Agent On-site Optimization Procedure*
- P. Barooah (University of California, Santa Barbara): *Decentralized Control of Vehicular Platoons: Improving Closed-loop Stability by Mistuning*
- W. Dong (University of California, Riverside): *Cooperative Control of Multiple Robots*
- S.L. Smith (University of California, Santa Barbara): *A Geometric Assignment Problem for Robotic Networks*

Water Production: Desalination, Purification, and Reclamation

Professors William J. Kaiser (Electrical Engineering Department) and Yoram Cohen (Chemical and Bioengineering Department), organizers — February 23, 2007

- Breakout Sessions discussed
  - » *Framework for collaborative research*
  - » *Smart water systems technologies*
  - » *Agricultural water systems*
  - » *Municipal water systems research*
  - » *Modular technology transfer platforms*

Faculty Awards

Faculty Achievement Awards

Professor **Asad A. Abidi** was elected to the **National Academy of Engineering** for his contributions to the development of integrated circuits for wireless communication circuits in metal–oxide–semiconductor (CMOS) technology used to fabricate microprocessors and digital signal processors. He has also been selected by the IEEE Board of Directors to receive the prestigious **2008 IEEE Donald O. Pederson Award** in Solid-State Circuits for his "pioneering and sustained contributions in the development of RF-CMOS."

Adjunct Professor **Nicolaos G. Alexopoulos,** who is also Dean of the Henry Samueli School of Engineering at UC Irvine, was elected to the **National Academy of Engineering** for his important work in microwave circuits, antennas, and structures for low observable technologies, and for contributions in engineering education.

Professor **Bahram Jalali** received the **2007 R.W. Wood Prize** from the Optical Society of America "for the invention and demonstration of Raman lasing in silicon". Established by the OSA in 1975, this award recognizes an outstanding discovery, scientific or technical achievement, or invention in the field of optics.

Professor **William J. Kaiser** has been awarded the **2007 UCLA Gold Shield Faculty Prize** from the UCLA Gold Shield Alumnae. The annual prize is awarded to a full professor with extraordinary promise and accomplishment in research or creative activity, and with an outstanding record in teaching, especially of undergraduates. Kaiser's research concentrates on the development of distributed networked, embedded computing for linking the Internet to the physical world. In addition, his efforts to improve the educational experience for undergraduates have resulted in a new online tool that employs networked computing to create a student-centered learning method.

Professor **Behzad Razavi** received the 2007 UCLA Academic Senate Teaching Award. This award demonstrates UCLA's leadership in teaching and public service by honoring individuals who bring respect and admiration to the scholarship of teaching. The award recognizes distinguished teaching by considering impact on students and their career choices, scholarly approach to teaching, diversity of classes, and teaching evaluations.

Professor **Yahya Rahmat-Samii** received the **2007 Chen-To Tai Distinguished Educator Award** from the IEEE Antennas and Propagation Society for his "significant contributions to electromagnetics education and for inspiring new methodologies for the design, analysis, and measurement of complex antenna systems". This Award is given annually to an individual for: (a) involvement with and direction of students to prepare them for effective careers in electromagnetics, (b) curriculum development with the inclusion of current research and knowledge that reflects the state of the art in courses, and (c) authorship of research and course material.

Professor **Mihaela van der Schaar** received the **2007 IBM Faculty Award** in recognition of the quality of her research program on new video streaming techniques and fairness policies for real-time multimedia transmission over enterprise networks to industry.

Faculty Recognitions

- Deborah Estrin, who holds a joint appointment with the UCLA Computer Science Department and the UCLA Electrical Engineering Department, has been elected to the American Academy of Arts and Sciences. Those elected include scholars, scientists, artists, civic, corporate and philanthropic leaders. Prof. Estrin was also awarded the Anita Borg Institute's Women of Vision Award for Innovation. The Anita Borg Awards honor outstanding leaders who embrace Borg's lasting vision to increase the positive impact of technology on women.
- Professor Rajeev Jain was conferred an Honorary Membership in the Golden Key International Honor Society by the UCLA Dean of Students Office for "dedication and contribution to UCLA and its undergraduates".
- *Scientific American Magazine* published a feature article by Professor Bahram Jalali in its February 2007 issue on "Making Silicon Lase". Additionally, his work on energy harvesting in photonic devices was featured in the *New Scientist*.
- Professor Chan Joshi's research, leading to a breakthrough in accelerator technology that doubles particle energy in just one meter, was reported in the February issue of *Nature*.
- Professor Dejan Markovic received the Sakrison Award from UC Berkeley's Electrical Engineering and Computer Science Department. Established in memory of David J. Sakrison , the award is made annually to a graduate student who has completed what is deemed by a faculty committee to be a truly outstanding piece of research.
- Professor Warren Mori has been elevated to the grade of IEEE Fellow for his contributions to plasma physics.
- Professor Stanley Osher, who holds joint appointments in electrical engineering and mathematics, was recently presented with an Honorary Degree from the Ecole Normale Superieure de Cachan for his lifelong work on representing, with a computer, continuous and infinitely accurate phenomena.
- Professor Yahya Rahmat-Samii has been appointed to the Northrop Grumman Endowed Chair in Electromagnetics.
- Professor Behzad Razavi received the 2006 Lockheed Martin Excellence in Teaching Award in October of 2006. The award was given to Razavi for his dedication to his students, a vigorous commitment to high academic standards, and his many contributions to electrical engineering education.
- Professor Ali H. Sayed was elected to the Board of Governors of the IEEE Signal Processing Society.
- Professor Mihaela van der Schaar received the 2006 Okawa Foundation Award for her work on "Proactive Cross-layer Design for Non-collaborative Multi-User Wireless Multimedia Resource Management Using Game-Theory". The Okawa Foundation Award recognizes achievements in telecommunications research.
- Professor Kang L. Wang has been appointed to the Raytheon Endowed Chair in Physical Science.
- Adjunct Professor Giorgio Franceschetti has been awarded the 2007 IEEE Geoscience and Remote Sensing Society Distinguished Achievement Award. The award recognizes individuals who have made significant technical contributions, usually over a sustained period of time, within the scope of the Society.
- "In-Band Motion Compensated Temporal Filtering", by Y. Andreopoulos, A. Munteanu, J. Barbarian, M. van der Schaar, J. Cornelis, and P. Schelkens, was selected as the most cited paper for the journal *Signal Processing: Image Communications*, between the years 2004-2006.

Alumnus and Student Awards

- On November 3, 2006, at the UCLA Henry Samueli School of Engineering and Applied Science Annual Awards Dinner, electrical engineering alumnus **Dr. Linda Katehi** (MS '81, PhD '84), was honored with the UCLA School of Engineering Alumnus of the Year Award, for her considerable accomplishments in academia. Dr. Katehi is provost and vice-chancellor of the University of Illinois, Urbana-Champaign, and has also been invited by President Bush to participate in the President's Committee on the National Medal of Science.
- Alumnus **Dr. James Plummer** (BS '66), Dean of the Stanford School of Engineering, received the 2006 UCLA School of Engineering Alumni Achievement in Academia Award for his many contributions to engineering education. Plummer was honored for his major contributions to the field of silicon devices and technology, including the integration of CMOS logic and high voltage lateral DMOS devices on a single chip, the development of silicon process modeling standards, and designing nanoscale silicon devices for logic and memory.

Alumnus of the Year Dr. Linda Katehi and UCLA Engineering Dean Vijay K. Dhir

- Alumnus **Ani Garabedian** (BS '99) was presented the Distinguished Young Alumnus Award for her exceptional technical skill, as well as her extraordinary drive to give back to UCLA.
- Graduate Student **Ani Mehrnia** (PhD '06) received the 2006 Edward K. Rice Outstanding Doctoral Award from the UCLA School of Engineering

- PhD student **Cheng-Jung Lee** of the UCLA Microwave Electronics Laboratory (Prof. Itoh, Director) received the EuMC Young Engineering Prize at the recent 36th European Microwave Conference held in Manchester, UK September 10-15. The prize was based on his paper, "Compact Dual-Band Antenna Using an Anisotropic Metamaterial", co-authored with K. Leong and T. Itoh. The prize is given to two top rated papers presented by the first author who is less than 30 years of age.
- PhD student **Farhad Razavi** (Prof. Rahmat-Samii, advisor) was awarded the Best Conference Paper Award at the Annual International Conference of the Antenna Measurement Techniques Association for his paper, "A New Look at Phaseless Planar Near Field Measurements: Limitations, Simulations, Measurements and a Hybrid Solution".
- A paper by Professor Rubin and his PhD student **Runhe Zhang** received the best unclassified paper award at the 2006 IEEE MILCOM conference.
- PhD student **Varun Raghunathan** (Prof. Jalali, advisor) won the Best Student Paper Award at the Advanced Solid State Photonics (ASSP) Conference for his paper entitled "A Self-Imaging Silicon Waveguide Raman Amplifier".
- Graduate student **Koon-Lun Jackie Wong** (PhD 2007, Professor K. Yang, advisor) won the Best Student Paper Award at the 2007 VLSI Circuit Symposium.
- A chip designed by PhD student **Guichang Zong** (Professor A. Willson, advisor), was selected as the "Operational Category Winner" of the 2007 ISSCC/DAC Student Design Contest.

2007 Outstanding Student Awards

- Christina Huang Memorial Prize: **Ling Chung Lau**
- Outstanding Senior Award: **Ling Chung Lau**
- Outstanding MS Awards: **Laura Balzano** and **Yiyu Shi**
- Outstanding PhD Award: **Aman Kansal**

Danijela Cabric
(Circuits and Embedded Systems)

Assistant Professor

Ph.D. ,University of California, Berkeley, 2007

Wireless communications system design; Cognitive radio networks; VLSI architectures of signal processing and digital communication algorithms; Performance analysis and experiments on embedded system platforms.

Diana Huffaker
(Physical and Wave Electronics)

Associate Professor

Ph.D., University of Texas, Austin, 1994

Directed and self-assembled nanostructure solid-state epitaxy, optoelectronic devices including solar cells and III-V/Si photonics.

Puneet Gupta
(Circuits and Embedded Systems)

Assistant Professor

Ph.D., University of California, San Diego, 2007

Manufacturing, device, circuit and CAD techniques to enable design aware manufacturing and manufacturing aware design. Test structure design for generating abstracted process and variation models. Techniques for leakage power modeling and reduction.

Aydogan Ozcan
(Physical and Wave Electronics)

Assistant Professor

Ph.D., Stanford University, 2005

Photonics and its applications to nano- and bio-technology, including but not limited to (a) imaging the nano-world, especially in bio-compatible settings; (b) providing powerful solutions to global health related problems such as measurement of the cell count of HIV patients in resource limited settings; (c) rapid and parallel detection of hundreds of thousands of molecular level binding events targeting microarray based proteomics and genomics; and (d) monitoring of the biological state of 3D engineered tissues.

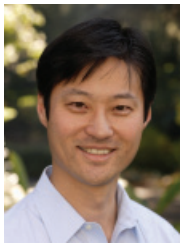
Adjunct Professors

N.G. Alexopoulos
C. Chien
M. Eshaghian-Wilner
M.P. Fitz
G. Franceschetti
B. Houshmand
B. Kolner
W.H. Mangione-Smith
F. Paganini
J.N. Schulman
I. Verbauwhede
M.C. Wu

Emeriti Professors

F.G. Allen
F.F. Chen
R.S. Elliott
N. Levan
F.W. Schott
C. Viswanathan
J. Willis

Faculty: Circuits and Embedded Systems Area



Chi-Kong Ken Yang, *Area Director*
Ph.D., Stanford University, 1998

High-speed data and clock recovery circuits for large digital systems, low-power, high-performance functional blocks and clock distribution for high-speed digital processing, and low-power high-precision capacitive sensing interface for MEMS.

Asad A. Abidi
Ph.D., UC Berkeley, 1981

CMOS RF design, high speed analog integrated circuit design, data conversion, and other techniques of analog signal processing.

- Fellow, IEEE, 1996
- National Academy of Engineering, 2007

Deborah C. Estrin
Ph.D., MIT, 1985

Wireless sensor networks, environmental monitoring, participatory mobile sensing.

- Fellow, IEEE, 2004
- Fellow, AAAS, 2001
- Fellow, ACM, 2000

Danijela Cabric
Ph.D., UC Berkeley, 2007

Wireless communications system design; Cognitive radio networks; VLSI architectures of signal processing and digital communication algorithms; Performance analysis and experiments on embedded system platforms.

Puneet Gupta
Ph.D., UC San Diego, 2007

Manufacturing, device, circuit and CAD techniques to enable design aware manufacturing and manufacturing aware design. Test structure design for generating abstracted process and variation models. Techniques for leakage power modeling and reduction.

Mau-Chung Frank Chang
Ph.D., National Chiao-Tung University, 1979

CMOS RF design, high speed analog integrated circuit design, data conversion, and other techniques of analog signal processing.

- Fellow, IEEE, 1996

Lei He
Ph.D., UC Los Angeles, 1999

Computer-aided design of VLSI circuits and systems, interconnect modeling and design, power-efficient computer architectures and systems, and numerical and combinatorial optimization.

Babak Daneshrad
Ph.D., UC Los Angeles, 1993

Digital VLSI circuits: wireless communication systems, high-performance communications integrated circuits for wireless applications.

William J. Kaiser
Ph.D., Wayne State University, 1984

Development of distributed networked, embedded computing for linking the Internet to the physical world: applications include distributed systems for factory automation, biomedical research, health care, space science, security, and defense.

- Fellow, American Vacuum Society (American Institute of Physics), 1990

Dejan Markovic

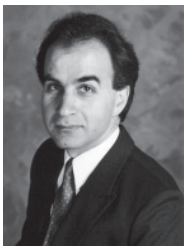
Ph.D., UC Berkeley, 2006

Power/area-efficient digital integrated circuits, VLSI architectures for wireless communications, optimization methods and supporting CAD flows.

Sudhakar Pamarti

Ph.D., UC San Diego, 2003

Mixed-signal IC design, signal processing and communication theory, especially the design of highly integrated wireless and wireline communication systems with particular emphasis on lowering cost and power consumption; design, silicon IC implementation, and verification of mixed-signal blocks.



Behzad Razavi

Ph.D., Stanford University, 1992

Analog, RF, and mixed-signal integrated circuit design, dual-standard RF transceivers, phase-locked systems and frequency synthesizers, A/D and D/A converters, high-speed data communication circuits.

- Fellow, IEEE, 2003

Vwani P. Roychowdhury

Ph.D., Stanford University, 1989

Models of computation: parallel systems, quantum information processing, nanoscale and molecular electronics, statistical algorithms for large-scale information processing, combinatorics and complexity and information theory, bioinformatics, cryptography.

Henry Samueli

Ph.D., UC Los Angeles, 1980

Digital signal processing, communications systems engineering, and CMOS integrated circuit design for applications in high-speed data transmission systems.

- Fellow, IEEE, 2000
- Fellow, American Academy of Arts and Sciences, 2004
- Member, National Academy of Engineering, 2003

Majid Sarrafzadeh

Ph.D., UI Urbana-Champaign, 1987

Embedded and reconfigurable computing; VLSI CAD; design and analysis of algorithms.

Mani B. Srivastava

Ph.D., UC Berkeley, 1992

Mobile and multimedia networked computing systems, design and synthesis of DSP systems, and low-power systems.

- Vice-Chair of Graduate Affairs

Alan N. Willson, Jr.

Ph.D., Syracuse University, 1967

Theory and application of digital signal processing including VLSI implementations, digital filter design, nonlinear circuit theory.

- Fellow, IEEE, 1996

Faculty: Physical and Wave Electronics Area

Jason C.S. Woo, *Area Director*
Ph.D., Stanford University, 1987

Solid state technology, CMOS and bipolar device/circuit optimization, novel device design, modeling of integrated circuits, VLSI fabrication.

- Fellow, IEEE, 2005

Chi-On Chui
Ph.D., Stanford University, 2004

Heterostructure semiconductor devices and technology involving the application of novel device concepts and fabrication techniques to explore the quantum and strain effects at the nanoscale.

Harold R. Fetterman
Ph.D., Cornell University, 1968

Optical millimeter wave interactions, femtosecond evaluation of high-frequency devices and circuits, solid state millimeter wave structures and systems, biomedical applications of lasers.

- Fellow, IEEE, 1990
- Fellow, Optical Society of America, 1980

Warren S. Grundfest
M.D., Columbia University, 1980

Lasers for minimally invasive surgery, magnetic resonance-guided interventional procedures, laser lithotripsy, micro-endoscopy, spectroscopy, photodynamic therapy, optical technology, biologic feedback control mechanisms.

- Fellow, SPIE, 1996
- Fellow, American Institute of Medical & Biologic Engineers, 1996

Diana Huffaker
Ph.D., UT, Austin, 1994

Directed and self-assembled nanostructure solid-state epitaxy, optoelectronic devices including solar cells and III-V/Si photonics.

Tatsuo Itoh
Ph.D., UI Urbana-Champaign, 1969

Microwave and millimeter wave electronics, guided wave structures, low power wireless electronics, integrated passive components and antennas.

- Fellow, IEEE, 1982
- Member, National Academy of Engineering, 2003

Bahram Jalali
Ph.D., Columbia University, 1989

RF photonics, fiber optic integrated circuits, and Datacom systems.

- Fellow, IEEE, 2003
- Fellow, Optical Society of America, 2004

Chandrashekar Joshi
Ph.D., Hull University, England, 1979

Laser fusion, laser acceleration of particles, nonlinear optics, high-power lasers, plasma physics.

- Fellow, IEEE, 1993
- Fellow, Institute of Physics (U.K.), 1998
- Fellow, American Physical Society, 1990

Jack W. Judy
Ph.D., UC Berkeley, 1996

MEMS, microsensors, micro-actuators, microsystems and micromachining; magnetism and magnetic materials; neuro-engineering and neuro-silicon interfaces; distributed sensors, actuators, and information.

Jia-Ming Liu
Ph.D., Harvard University, 1982

Ultrafast optics and electronics, opto-electronics and semiconductor lasers, nonlinear optics, and optical-wave propagation.

- Fellow, American Physical Society, 2003
- Fellow, Optical Society of America, 1990

Warren B. Mori
Ph.D., UC Los Angeles, 1987

Laser plasma interactions, advanced accelerator concepts, advanced light sources.

- Fellow, American Physical Society, 1995
- Fellow, IEEE, 2007

Christoph Niemann
Ph.D., University of Technology, Darmsstadt, 2002

Laser-plasma interactions, high-energy density physics, and inertial confinement fusion.

Aydogan Ozcan
Ph.D., Stanford University, 2005

Photonics and its applications to nano- and bio-technology.

Dee-Son Pan
Ph.D., California Institute of Technology, 1977

New semiconductor devices for millimeter- and submillimeter-wave generation and amplification, transport in small geometry semiconductor devices, generic device modeling.

C. Kumar Patel
Ph.D., Stanford University, 1961

Condensed matter physics, especially the structure and dynamics of "interesting systems", broadly defined; spectroscopic techniques and detection methods; development of new laser systems.

- National Medal of Science, 1996
- Member, National Academy of Engineering, 1978
- Fellow, IEEE, 1975
- National Academy of Sciences, 1974

Yahya Rahmat-Samii
Ph.D., UI Urbana-Champaign, 1975

Satellite, personal communications, microstrip, fractal, remote sensing, and radio astronomy antennas; electromagnetic bandgap structures; computational and optimization techniques, measurement and diagnostic techniques.

- Fellow, IEEE, 1985

Oscar M. Stafsudd
Ph.D., UC Los Angeles, 1967

Quantum electronics, especially IR lasers and nonlinear optics; solid-state IR detectors.

Kang L. Wang
Ph.D., MIT, 1970

Nanoelectronics and optoelectronics, MBE and superlattices, microwave and millimeter electronics/optoelectronics, quantum computing.

- Fellow, IEEE, 1992

Yuanxun (Ethan) Wang
Ph.D., UT Austin, 1999

High performance antenna array and microwave amplifier systems for wireless communication and radar; numerical modeling techniques; fusion of signal processing and circuit techniques in microwave system design.

FACULTY: Physical and Wave Electronics Area

Benjamin Williams

Ph.D., MIT, 2003

Quantum cascade lasers in the terahertz frequency range, and the development of terahertz components based on subwavelength dimension for use in beam control, sensing, and imaging. Development of inter-subband and inter-sublevel based devices in low-dimensional nanostructures for electronic and optoelectronic applications.

Eli Yablonovitch

Ph.D., Harvard University, 1972

Optoelectronics, high speed optical communications, nanocavity lasers, photonic crystals at optical and microwave frequencies, quantum computing and communication

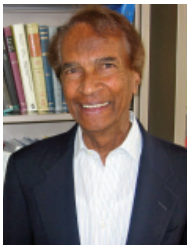
- Member, National Academy of Engineering, 2003
- Member, National Academy of Sciences, 2003
- Fellow, IEEE, 1992
- Fellow, American Physical Society, 1990
- Fellow, Optical Society of America, 1982

Electrical Engineering Faculty take a break during the 2007 Commencement ceremonies. Left to right: Professors W.J. Kaiser, T. Itoh, M.B. Srivastava, E. Yablonovitch, H.R. Fetterman, J.W. Judy, G. Pottie, A.H. Sayed, O.M. Stafsudd, and K.L. Wang.

Abeer A. Alwan, *Area Director*
Ph.D., MIT, 1992

Speech processing, acoustic properties of speech sounds with applications to speech synthesis, recognition by machine and coding, hearing aid design, digital signal processing.

- Fellow, Acoustical Society of America, 2003



A.V. Balakrishnan
Ph.D., University of Southern California, 1954

Laser beam distortion in atmospheric turbulence, control design for smart structures, and flight systems applications of adaptive control, nonlinear aeroelasticity, and wind power.

- Life Fellow, IEEE, 1996

Alan J. Laub
Ph.D., University of Minnesota, 1974

Numerical linear algebra, numerical analysis, high-end scientific computation, and computer-aided control system design, especially algorithms for control and filtering.

- Fellow, IEEE, 1986

Paganiotis D. Christofides
Ph.D., University of Minnesota, 1996

Process control, dynamics and optimization, computational modeling and simulation of complex systems, and mathematics with the central objective of development of novel methods for the systematic and rigorous solution of complex process control and systems.

Stanley J. Osher
Ph.D., Courant Institute, New York University, 1966

Innovative numerical methods for applications ranging from image science to control to electromagnetics to computational physics and beyond.

- Member, National Academy of Sciences, 2005

Stephen E. Jacobsen
Ph.D., UC Berkeley, 1968

Operations research, mathematical programming, non-convex programming, applications of mathematical programming to engineering and economic systems.

Gregory J. Pottie
Ph.D., McMaster University, 1988

Communication systems and theory, with applications to personal communications, channel coding, and wireless sensor networks.

- Fellow, IEEE, 2005

Rajeev Jain
Ph.D., Katholieke Universiteit, Leuven, Belgium, 1985

Embedded hardware/software design for signal processing systems-on-a-chip; CAD tools for design of high-performance signal processing architectures and development of ASICs for spread-spectrum modems and image compression.

- Fellow, IEEE, 1999

Izhak Rubin
Ph.D., Princeton University, 1970

Telecommunications and computer communications systems/networks; mobile wireless, optical, multimedia IP, ATM, satellite, and CATV networks; queueing systems, C3 systems/networks, network simulations and analysis, traffic modeling/engineering.

- Fellow, IEEE, 1987

FACULTY: Signals and Systems Area

Ali H. Sayed

Ph.D., Stanford University, 1992

Adaptive and statistical signal processing, distributed processing, filtering and estimation, signal processing for communications, wireless networks, algorithms for large-scale structured computations.

- Fellow, IEEE, 2001
- Department Chairman

Stefano Soatto

Ph.D., Caltech, 1996

Computer vision, nonlinear estimation, control theory.

Jason Speyer

Ph.D., Harvard University, 1968

Stochastic and deterministic optimal control and estimation with application to aerospace systems; guidance, flight control, and flight mechanics.

- Member, National Academy of Engineering, 2005
- 2000 IEEE Third Millennium Medal
- Life Fellow, IEEE
- Fellow, AIAA, 1985

Mani B. Srivastava

Ph.D., UC Berkeley, 1992

Mobile and multimedia networked computing systems, design and synthesis of DSP systems, and low-power systems.

- Vice-Chair of Graduate Affairs

Paulo Tabuada

Ph.D., Technical University of Lisbon, Portugal, 2002

Design of networked embedded control systems. Modeling, analysis and design of discrete-event, timed and hybrid systems. Hierarchical and distributed control design, geometric and algebraic control theory for nonlinear and Hamiltonian control systems, categorical systems theory.

Mihaela van der Schaar

Ph.D., University of Technology, Eindhoven, 2001

Theory and design of novel algorithms, standards and systems for multimedia coding, processing and ubiquitous communication over Internet and wireless networks.

Lieven Vandenberghe

Ph.D., Katholieke Universiteit, Leuven, Belgium, 1992

Optimization in engineering, applications in systems and control, circuit design, and signal processing.

- Vice-Chair of Undergraduate Affairs

John D. Villasenor

Ph.D., Stanford University, 1989

Communications, signal and image processing, joint source and channel coding, lattice vector quantization, wavelet filter design, wireless multimedia communications, and low complexity image and video coding architectures and algorithms.

Paul K.C. Wang

Ph.D. UC Berkeley, 1960

Control systems, nonlinear distributed-parameter system theory with applications to micro-optoelectromechanical systems, microrobots and microspacecraft.

Richard D. Wesel

Ph.D., Stanford University, 1996

Communication theory with a particular interest in coded modulation including trellis codes and turbo codes for applications including mobile wireless communication systems, multiple antenna systems, and satellite communication systems.

Alan N. Willson, Jr.

Ph.D., Syracuse University, 1967

Theory and application of digital signal processing including VLSI implementations, digital filter design, nonlinear circuit theory.

- Fellow, IEEE, 1996

Kung Yao

Ph.D. Princeton University, 1965

Communication theory, signal, acoustic, and array processing, wireless communication systems, sensor networks, chaos system theory, and VLSI and systolic algorithms and architectures

- Fellow, IEEE, 1994

Industrial Affiliates Program

Professor R. Jain

The Electrical Engineering Department supports strong outreach programs to industry. About 25% of our current research funding originates from industry sources. The department maintains an active Industrial Affiliates Program, initiated in 1981, and currently led by Professor R. Jain, the Vice-Chair of Industry Relations. It has been playing a key role in building a vital interface with industry ever since. The program:

- fosters interaction with industry
- promotes collaborative research
- assists in recruiting of highly talented graduate students
- exchanges information and talent
- provides access to state-of-the-art research facilities at UCLA

The department also serves as an invaluable consulting resource for the Affiliate Member. In turn, a company's participation in the Industrial Affiliates Program provides essential program enhancement and aid to students with a portion of the funds held in reserve for laboratory, instructional and other equipment needs.

There are two levels of membership in the program: as an associate member or as a full member. More details are available at the Industrial Affiliates Program website, www.ee.ucla.edu/~iap.

- **Full Members:** Mobile Communications, Sony
- **Associate Members:** The Aerospace Corporation, Broadcom, Lockheed Martin, Northrop Grumman, Raytheon, Rockwell, and Toshiba Corporation

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