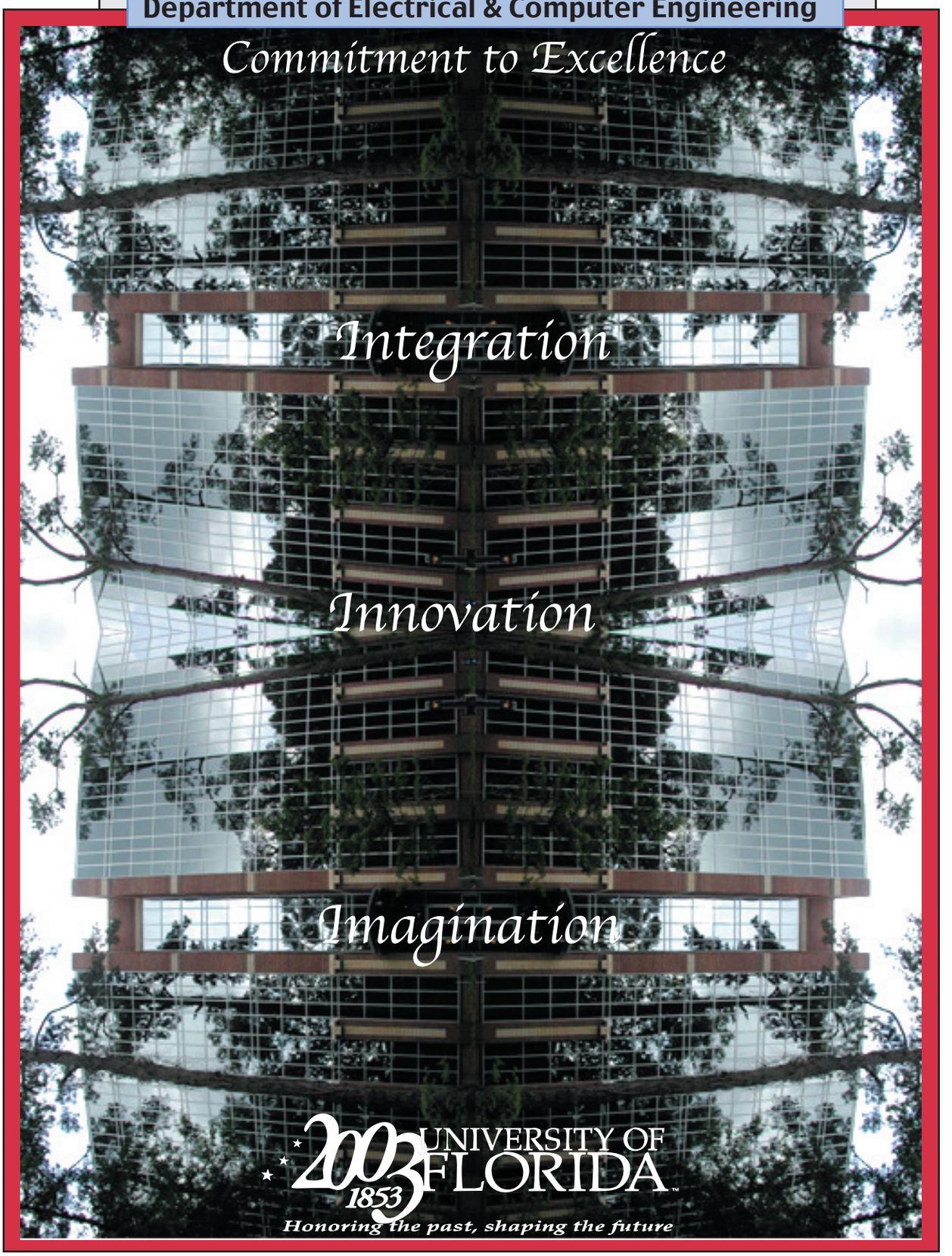
ECE NEWS

Department of Electrical & Computer Engineering



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ECENews Inside

2003

Introducing: Dr. Mark Law, Chair 3
Faculty Honors & Awards 4
Welcome New Faculty 7
Thank You: Dr. Martin Uman 8
Research: Virtual Machines 10
Research: In Search of Chaos 12
Research: The Future of Communications 14
Research: Small, Smaller, Smallest Radio! 16
Research: Multifaceted MEMS 18
Accomplished Students 20
ICASSP Conference 22
GOMACTECH Conference 23
On Sabbatical: Higher Education in Kuala Lampur 24
In Memory: Dr. Julius Tou 25
Friends we will MISS 27
Thanks to our Donors 28
FYI: FEEDS Online & EMS 30
Keep In Touch & Donations 31

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Introducing

Dr. Mark E. Law

Professor and Chair

Professor Mark Law became Chairman of the Department of Electrical and Computer Engineering at the University of Florida in August 2003. Dr. Law is an IEEE Fellow, and is co-Director of the SoftWare and Analysis of Advanced Materials Processing (SWAMP) Center.

Dr. Mark E. Law

I'm very excited about becoming Chair of the Electrical and Computer Engineering Department at the University of Florida. I think the Department is well-positioned to become better recognized, make significant research contributions, and to continue our mission of outstanding education. Dr. Martin Uman has stepped down as Chair after ably serving the Department for twelve years. He leaves the Department in very good shape and deserves our gratitude for his role in shaping and leading ECE.

Our fall enrollments show 760 undergraduate students and 516 graduate students, making us one of the largest departments on campus. We have increased undergraduate admissions standards over the last several years, so not only do we have one of the largest undergraduate populations, we may have the best quality students on campus. Our graduate program continues to be very attractive, as we had over 3000 applicants, of whom 116 were admitted in the fall semester.

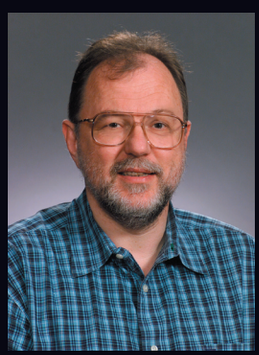
In the last year, we have streamlined our Master's program. It is now possible to get a one-year Master's degree. Since Master's students currently earn a premium of 20 to 25% on their starting salary compared to Bachelor's, this is an attractive option for students. We encourage students to enroll in our dual Bachelor's / Master's program, which allows them to count some credits toward both degrees. I expect this program to continue to skyrocket in popularity as industry begins to focus more and more on recruiting Master's students.

In this issue, we profile some of our newest faculty. Dr. Renato Figueiredo's work on virtual machines and grid based computing is highlighted. Dr. Jianbao Gao is using chaos theory to develop new ways to process signals and extract data. Dr. Jenshan Lin's work on communications circuits and devices is also highlighted. Dr. Huikai Xie is working on MEMS devices for many applications. All of these faculty have joined us in the last two years. We also feature Ken O's work on radio and antennas on chip on page 16.

We appreciate that many of you have given back to the Department in the last several years. Donated funds are used for so many vital activities, including faculty recruiting efforts, student organization support, and renovations. The Sias family has recently completed an endowment to support undergraduate student scholarships, and such gifts are greatly appreciated and can leave a lasting legacy. We would really be lost without your continuing generosity. Please give back to help support our mission and improve the Department. Information on how to donate is contained on the last page of the newsletter.

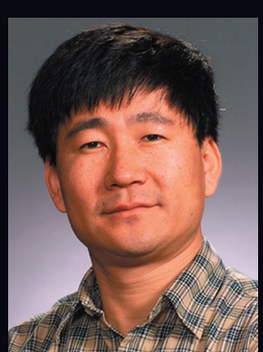
Mark E Law

Faculty Honors & Awards



Dr. Gijs Bosman

- Editor of the Proceedings of the 16th International Conference, Noise in Physical Systems and 1/f Fluctuations, ICNF 2001.



Dr. Yuguang "Michael" Fang

- Received the ONR Young Investigator Award, 2002. The Young Investigator Program supports basic research by exceptional faculty at U.S. universities who received a Ph.D. or equivalent degree within the preceding five years. Grants to their institutions provide up to $100,000 per year for three years.

Dr. Jerry Fossum

- Received a University of Florida Research Foundation (UFRF) Professorship award. These three-year professorships were created by UFRF to recognize the faculty who have established a distinguished record of research and scholarship that is expected to lead to continuing distinction in their field. The term of this professorship is 2002 ~ 2004.

Dr. Mark Law

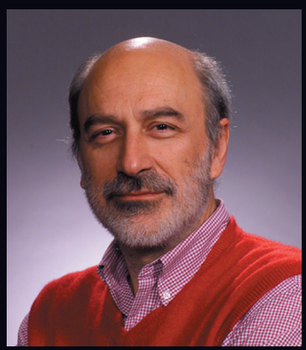
- Received a gift of $90,000 from Integrated Systems Engineering, Inc. to fund research in the SoftWare and Analysis of Advanced Materials Processing (SWAMP) Center.

Dr. Jian Li

- Received a University of Florida Research Foundation (UFRF) Professorship award. These three-year professorships were created by UFRF to recognize the faculty who have established a distinguished record of research and scholarship that is expected to lead to continuing distinction in their field. The term of this professorship is 2003 ~ 2005.

Dr. Martin Uman

- Distinguished Professor in ECE, effective Fall 2003.

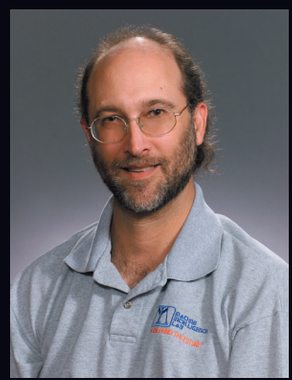


Dr. Jose Principe

- Distinguished Professor in ECE, effective Fall 2002.
- One of five recipients of the 2002 Doctoral Dissertation Advisor/Mentoring Award.
- President-Elect of the International Neural Network Society Board of Governors—a three year service.
- Editor-in-Chief of the IEEE Transactions on Biomedical Engineering.
- Member of the Scientific Board of the Food and Drug Administration, 2002 ~ 2004.

Dr. Muhammed H. Rashid

- One of six IEEE Fellows elected as the Distinguished Lecturers of the IEEE Industry Applications Society for the two-year term, 1/1/02 ~ 12/31/03.
- Received the IEEE Educational Activities Board Meritorious Achievement Award in Continuing Education, "for contributions to the design and delivery of continuing education in power electronics and computer-aided-simulation."

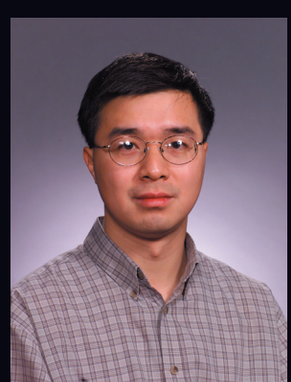


Dr. Eric Schwartz

- One of three UF faculty chosen Teacher of the Year, 2002 ~ 2003.

Dr. Vladimir Rakov

- Awarded the prestigious standing of IEEE Fellow, effective January 2003, "for contributions to the understanding of lightning discharge phenomena."
- Received a University of Florida Research Foundation (UFRF) Professorship award, 2001 ~ 2003.
- Elected a Fellow of the American Meteorological Society, 2003. Election to the grade of AMS Fellow serves as a recognition of outstanding contributions to the atmospheric or related oceanic or hydrologic sciences, or their applications, during a substantial period of years. Two-tenths of one percent of memberships are approved as Fellow each year.



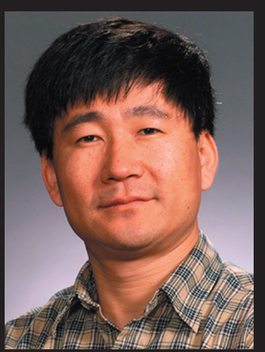
Dr. Tan F. Wong

- Editor-in-Chief of the IEEE Transactions on Vehicular Technology.

In Press

Lightning: Physics and Effects. Vladimir A. Rakov amd Martin A. Uman. Cambridge University Press, 687 pgs., 2003.

Promotions

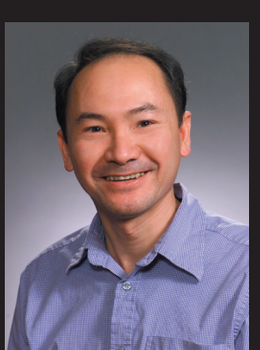


Dr. Yuguang "Michael" Fang

- Associate Professor with Tenure

Dr. Haniph Latchman

- Professor



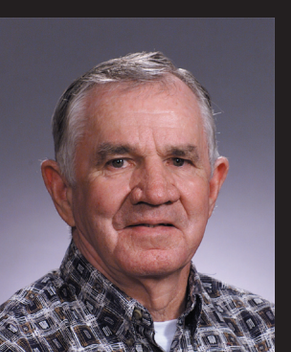
Dr. Khai Ngo

- Professor

Retiring

Dr. Tom Bullock

Professor Emeritus
1974 ~ 2003



Mr. Jim Fitzgerald

Asst. Chairman Emeritus
1980 ~ 2003

Dr. Michel Lynch

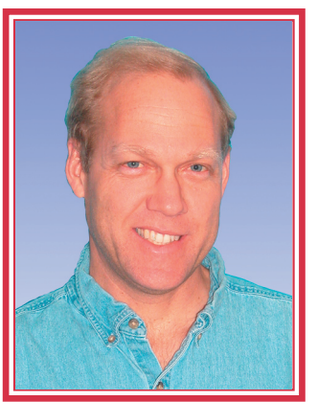
Lecturer
1985 ~ 2002

New Faculty

Welcome

Dr. Clint Slatton

Assistant Professor
PhD, University of Texas at Austin, 2001
Remote sensing, multiscale estimation, data fusion, statistical signal processing, lidar and radar applications



Dr. Scott Thompson

Assistant Professor
PhD, University of Florida, 1992
Advanced silicon device technologies and structures, nanoscale devices, electronic properties of materials, novel materials for advanced devices

Dr. Ant Ural

Assistant Professor
PhD, Stanford University, 2001
Carbon nanotubes, semiconductor nano-wires, and related nanostructures; integration of nanotechnology with silicon microfabrication processes; molecular electronics, nanoscale MEMS, and nanobiotechnology

Dr. Dapeng Wu

Assistant Professor
PhD, Carnegie Mellon University, 2003
Communications and computer systems and networks

Ms. Wenhsing Wu

Assistant in Engineering
MSEE, University of California, Los Angeles, 1991
Semiconductor electronics, measurement and analysis, wireless network testing

Thank you

Dr. Martin A. Uman

Department Chairman
1991 ~ 2003

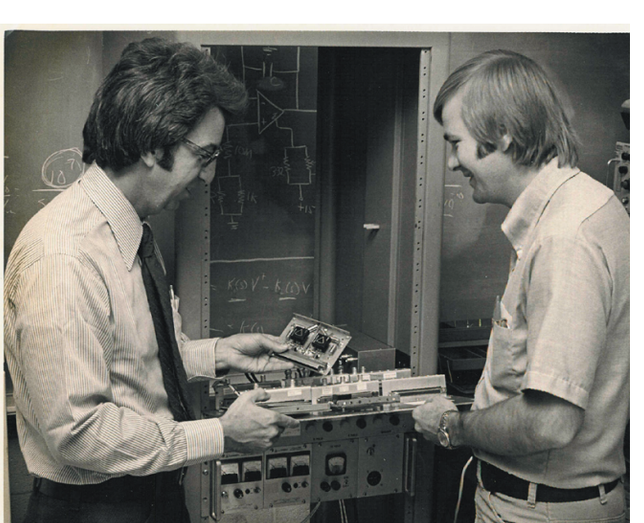
Dr. Martin A. Uman

by Mary Barbarette

Scientist, educator, leader, and artist: all these terms help to paint the portrait of Distinguished Professor Martin Uman. An alumnus of Princeton University and aptly called one of the world's leading experts on lightning, Dr. Uman served as ECE's Department Chairman from 1991 to 2003. He joined UF in 1971 as an ECE professor, moving to UF from the Westinghouse Research Laboratories in Pittsburgh.

The Department flourished under Dr. Uman's leadership, and he leaves it poised along the continuum of success. "I think ECE is going in the right direction," he says. "Research is up, funding is up, and we're hiring a lot of good faculty. In my last year as Chair, our rankings in US News and World Report reflect the quality of our program: 19th among all undergraduate universities and 12th among public universities in the US."

Dr. Uman's administrative legacy is marked by departmental growth and enrichment of labs and facilities, including expansion into a new engineering building. His research and teaching career is equally a testament to his talent, success, and committment to excellence in his field.



Dr. Uman with his first graduate student in the 1970s.

Dr. Uman opened UF's Lightning Research Lab soon after joining the ECE faculty. Since then, his innovations in lightning science and technology have completely transformed the way industry deals with this powerful and often destructive force.

Based on his research and co-development of the technique of wideband-gated magnetic direction finding with Dr. E.P. Krider of the University of Arizona, in 1975 Drs. Uman and Krider co-founded Lightning Location and Protection, Inc. (LLP), a company which they operated until 1983. LLP developed the National Lightning Detection Network, now owned by Vaisala, Inc. "The present network enables us to locate practically all cloud-to-ground lightning in North America with an accuracy of a few hundred meters," says Uman. "One can look on a PC and see where all the lightning strikes are in almost real time." This invention has had worldwide impact in how power companies operate, and has opened up new avenues of weather research, such as predicting the ending of severe storms based on the pattern of lightning strikes. The locating system has been documented to save tens of millions of dollars annually in early detection

"Creativity is rooted in the fully unencumbered process of intuition acting on a strong foundation of knowledge and discipline. It is the result of the incomprehensible power of the human brain to sort through vast amounts of data to find relationships between seemingly unrelated objects, concepts, observations, and experiences. It is the paradoxical combination of unlearning and learning." —Dr. Martin Uman

of forest fires and in more efficient electric utility operation. It is even used by the UF Athletic Department to decide whether to halt practices and games, and when to restart them.

Basic research and the protection of power lines and aircraft are Dr. Uman's primary research interests. He and a team of engineers conduct experiments year-round at the International Center for Lightning Research and Testing at Camp Blanding, FL, which Uman co-directs with fellow ECE Professor Vladimir Rakov. Established in 1993, this well-equipped facility is the world's leading center for lightning research, bringing together scientists from 13 different countries and four continents during its 10 years of operation. Triggered-lightning experiments at the site send rockets over 1000 feet into the air—higher than the Empire State Building—to induce lightning strikes from natural thunderstorms. One project that is funded by Florida Power and Light tests power line equipment failure in both above- and below-ground lines.

Another experiment at Camp Blanding hopes to capture natural lightning strikes. "We have a one-square kilometer area covered with antennas for both the FAA and the NSF that measure the electric and magnetic fields of lightning. If any natural lightning strikes anywhere in there, then we measure really up close all its characteristics," Uman says.

Outside of academia, Dr. Uman does consulting on lightning death and damage cases, and he is a talented artist. His oil on canvas paintings, which he describes as "solitary and lonely," grace his and the Department's offices. He has a penchant for seascapes with open skies, and sultry landscapes with gently bending oaks and palms. His portrait of Benjamin Franklin hangs behind his desk. In what remains of his spare time he plays tennis and cycles.

Martin Uman's name has become synonymous with lightning research. He has published 5 books and over 165 papers in reviewed journals and over 190 other articles and reports. His contribution to science, technology, and society is as vibrant as the electric plasma he studies.

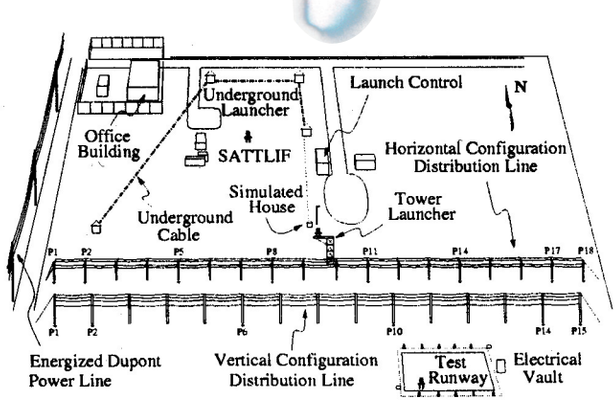


Diagram of the Camp Blanding site

ECE applauds Distinguished Professor Martin Uman, for his excellence in service and leadership as Chairman of the Department.

Research

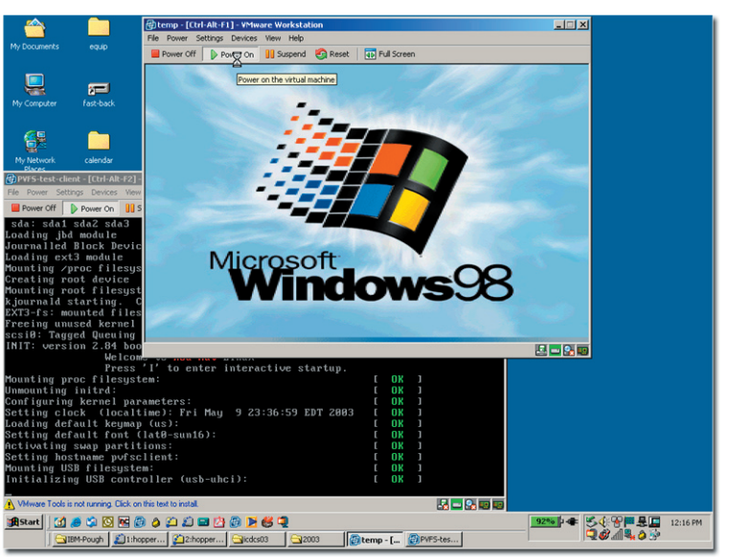
Virtual Machines

by Mary Barbarette

Dr. Renato Figueiredo

Virtual machines (VM) are like windows into limitless possibility. They are the portals between the user and computational grids, bringing to life the infinite variety of users' computer needs. (Think of a computational grid as analagous to a generator in a factory that provides power to the factory.) For Dr. Renato Figueiredo, "sharing, security, flexibility, and the cabality of transferring virtual machines are what make them interesting."

IBM pioneered VM technology in the 1970s. Their goal was to mirror a single physical machine's operating system onto multiple computers. Each multiple system looks like the original OS, but is unaware of other systems running in the same machine. Furthermore, the programs that run on the real machine will run on the virtual machine. In essence, virtual machine monitors provide a duplicate view of the requested resource, with little to no overhead expended. Even applications that traditionally run on a grid, and demand a lot of computing, can experience performance overhead as little as 2 to 5 percent with respect to a physical computer.



Snapshot of the execution of two virtual machines (Windows 98, Linux) on a "real" Machine (Intel/Windows 2000). The virtual machine monitor in this example is a commercial product developed by VMware, Inc.

The purpose of VMs is to allow sharing. "For example,you can have a combination of flavors of Microsoft Windows® on your VM—Windows 98, 95, Windows 2000, and Linux. All of these different operating systems are running concurrently and independently, and you're sharing." says Dr. Figueiredo. This sharing is termed multiplexing, and it spans users and resources across administrative domains. Time is a defining function of multiplexing. "I can assign a computer to you for one day and then take you off and sign another user on the next day. You have the system for a small amount of time, but you have the impression that you have the whole system dedicated to you," says Dr. Figueiredo. Users not only share mailboxes or disk space, but bandwidth and computer cycles as well.

While this process yields a fruitful shared partnership, it also raises the question of security. "Users don't know with whom they are sharing on the grid, and that's part of the problem," Dr. Figueiredo says. "You want to share these resources in a way so that you know you're not going to be compromised." In the current model, the service provider knows who's sharing and can authorize who uses the

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"Sharing, security, flexibility, and the capability of transferring Virtual Machines are what make them interesting."

resources, but the user has no control over who is sharing. Fortunately, VMs contain thousands of lines of code and are much easier to secure than full-fledged operating systems, which run on millions of lines of code.

Virtual machines are remarkably flexible. They are not bound to a specific physical machine, nor are they bound to a network—unless they are involved with group computing. Furthermore, and most importantly, VMs are transferrable.

"You can think of an entire VM as files that you can store on a CD or DVD-ROM," Dr. Figueiredo says. "You can see them as just another form of data." When he transferred to Florida from Northwestern, Dr. Figueiredo brought his website with him. "I had my website as an entire VM—the OS, the webserver, PHP extension, database, everything, in a VM. I just transferred it literally as a CD-ROM and I plugged it in and it works perfectly, without any changes. The only difference is now it has a different name on the network."

This transferrability forms the basis of Dr. Figueiredo's research. " I need to transfer the VM over the network, and I need to transfer it on demand, and fast, as the user requests it," he says.

The typical approach to dynamic data transfer is to restructure the applications so they can interface with the grid. Dr. Figueiredo's approach, however, is based upon a unique, grid-centric perspective. "I'm looking at a fundamentally different way of sharing resources on a grid. People have been developing these mechanisms that take for granted that you have a physical machine interface, and are built on top of this idea. Once you have VMs, and you have an efficient way of moving them around and setting them up, that actually makes the job, the software that controls the grid, much easier."

Dr. Figueiredo calls his data transfer technique Virtual File System. "It virtualizes file systems in such a way that the application thinks that the file is in a local disk and it turns out the file is somewhere else in a different node on the grid."

Virtual machines are the next step in the personal computing revolution, and the enabling tools that may completely transform the way we use computers. What Dr. Figueiredo predicts is the virtualization of all of the computer's component parts—including the network, the devices, the displays—everything that makes up the physical machine. Hard drives and monitors will become obsolete, and virtual machines will be the link to making users' needs a reality.

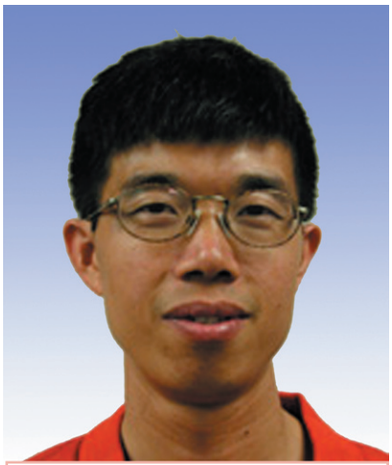
Dr. Renato Figueiredo joins BellSouth Eminent Scholar Dr. José Fortes in the Advanced Computing and Information Systems Lab. His focal research areas are computer architecture, network computing, and distributed systems.

Dr. Figueiredo, a native of Campinas, Brazil, received his PhD from Purdue University in 2001. In 2002, he transferred to UF from Northwestern University, and we are proud to have him as part of our team of dedicated faculty.

Research

In Search of Chaos

by Mary Barbarette



Dr. Jianbo Gao

Every so often, an engineer comes along with an eye for the unusual. The toolbox he carries may raise an eyebrow or incite curiosity. His methods are different, his perspective is unique, and his results are profound. For ECE at UF, that engineer is Dr. Jianbo Gao.

"My research doesn't belong to a standard EE practice," says Dr. Gao. His approach is centered within a nonlinear framework, where the theories of chaos and fractal mathematics inform his research practice.

Scientists and mathematicians began hashing out the ideas behind nonlinearity in the 1970's, and since then the insights provided by chaos and fractal theory have been applied to a wide range of disciplines. Dr. Gao's research endeavors span myriad fields, most notably biomedical engineering and bioinformatics, telecommunications and networking, noise, and radar engineering.

Chaos, often called deterministic chaos, has a powerful geometric language that offers unique perspectives to complex problems. In Dr. Gao's research, nonlinearity functions as an intelligent voice that is particularly useful for signal detection. By using what he calls, "simple math and new concepts," Dr. Gao has developed a universal detection method that covers seemingly unrelated fields. His model helps pinpoint the start times of epileptic seizures, clarifies breaks between words in speech recognition systems, and identifies interesting patterns in genome sequences.

Epilepsy treatment is effective for many patients, but severe side effects are a concern with daily medication. Even worse, patients may become drug-resistant not long after treatment begins. Timely seizure detection is therefore crucial to making medication more effecive. Dr. Gao is collaborating with ECE Professor Jose Principe to develop novel nonlinear tools for detecting and predicting seizures. "The method our group has developed turns out to be more accurate, simpler, and at least 10 times faster than the best method available in the literature, and we are working to automate it for clinical use," he says. "We have also been working to elucidate the mechanisms of seizure occurrence, in particular the spatial-temporal patterns of the EEG activities right before seizures, in hopes of finding a simple way to inhibit seizure occurrence."

Decoding the complete human genome will require new, faster computational methods for the study of genome sequences. Conventional approaches are largely based on statistical analysis of these sequences, but Dr. Gao's group has been developing methods based on nonlinear dynamics theory and fractal theory. Preliminary results indicate that his methods are able to detect genes and other functional units along a long genome sequence with much less computational time.

Dr. Gao uses the fable of the tortoise and the hare to illustrate one of the foundational principles of fractal theory. In essence, the length of an irregular curve changes with the measuring unit. Hence, the hare's bounding leaps make the distance it has to cover much shorter than that of the tortoise.

“My research doesn’t belong to a standard EE practice.”

The Butterfly Effect:
A foundational principle of chaos theory is Sensitive Dependence on Initial Conditions. The idea is that the flapping of a butterfly’s wings in New York could dramatically affect the weather in California.

An integral question outlining Dr. Gao’s work is, how does one test for chaos? “First, one must define the type of motion they’re studying: regular (including periodic), chaotic, or stochastic (or simply noisy),” answers Dr. Gao. “The most stringent test available now is actually my method published in 1993-1994. The method essentially tests whether exponential divergence between nearby trajectories objectively exists or not. The key here is objective: this ensures that different researchers can always obtain the same results.”

Dr. Gao has developed two very powerful network traffic models based on multifractal theory. As communication technology and the internet continue to grow, a key task is to characterize and control network traffic. Dr. Gao notes that the World Wide Web is often the “World Wide Wait,” and his research demonstrates that conventional and popular traffic models, largely based on the Poisson model, are insufficient.

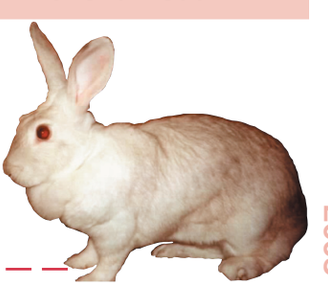
Dr. Gao’s investigation of noise and its effects on dynamical systems has led him to develop an efficient algorithm that measures the amount of noise contained in a signal. He has also developed a powerful algorithm that measures the nonlinear effects of noise on solid state device physics.

Dr. Gao is also engaged in the multifractal analysis of sea clutter. Sea clutter refers to backscattered returns from a patch of the ocean’s surface illuminated by a transmitted radar pulse. This study is particularly useful for detecting “point” targets such as submarine periscopes on the sea surface.

Using the test for chaos he developed, Dr. Gao has shown that sea clutter signals are not chaotic, but rather multifractals. He has further proposed an effective method of detecting point targets by examining the change in multifractal properties due to point targets. This method is equally effective for the study of land clutter, and hence homeland security.

Fractal and chaos theory are the defining tools of Dr. Gao’s eclectic research endeavors. The practical applications of his research are far-reaching and can have a significant impact on how we detect and treat illness, develop and refine electronic communications and even defend our borders. While nonlinearity is an unconventional framework for most electrical engineers, Dr. Gao's work proves that it is an efficient path to effective solutions.

Dr. Jianbo Gao received his PhD from UCLA in 2000. He is an Assistant Professor in the Digital Signal Processing, Communications, and Computer Systems and Networks areas. He is also a member of the Computational NeuroEngineering Lab: www.cnel.ufl.edu



Research

The Future of Communications

by Mary Barbarette

Dr. Jenshan Lin

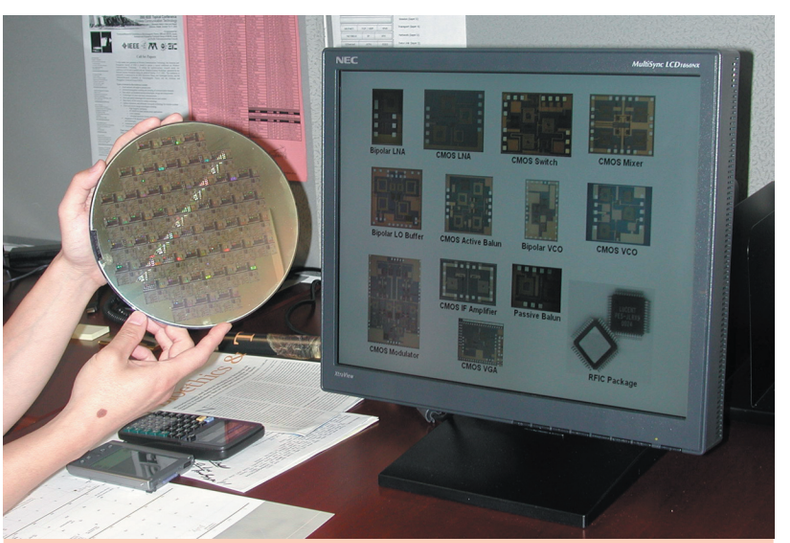
ECE warmly welcomes Dr. Jenshan Lin, an Associate Professor in the Electronic Circuits area. He received his PhD from the University of California, Los Angeles in 1994 and worked extensively in industry (including Bell Labs and Agere Systems) until joining the UF faculty in 2003.

Dr. Lin specializes in radio frequency circuit and system design, high speed broadband circuit system design, and their applications. "It's actually a pretty broad field," he says. "I like to use device technologies like either silicon or compound semiconductors that push the capability to very high speed, very high frequency, highly integrated, for either low power or high power applications."

Integration is the foundation of Dr. Lin's research. He seeks to merge mobility and broadband, computers and communication. The computer and communication industries are fueling this integration, and concurrently pushing technology to smaller, lighter, cheaper, and more functional dimensions.

Consumers' needs are also a driving force of this technological merger. Consumers want the convenience of mobile connection while traveling, with the speed and high functionality of broadband. Wireless LAN is a rapidly developing manifestation of this desire. "We're building an infrastructure right now, and eventually there will be a lot of access points around," says Dr. Lin. "We already have it in the classroom."

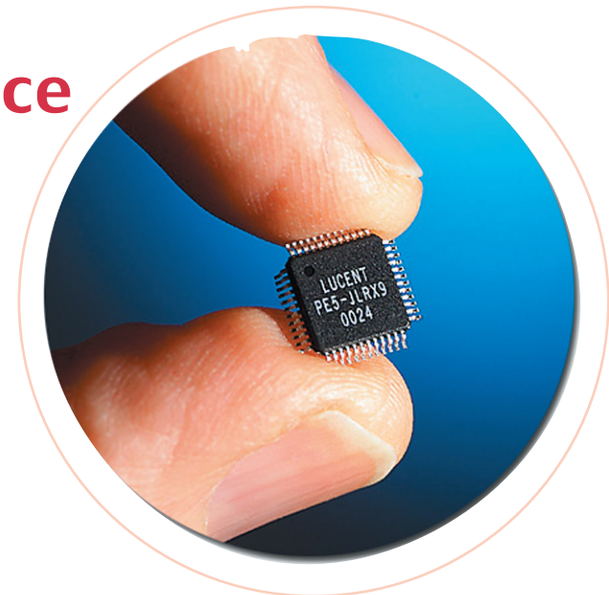
Small size combined with functionality is the cornerstone of effective electronics. In this realm, Dr. Lin is currently working on an innovative handheld device concept he calls the Universal Wireless Assistant (UWA). The UWA consolidates cell phone, cordless phone, high speed wireless LAN, GPS, PDA or Pocket PC and can even include a health monitor or other sensors. "Why carry three or four devices," asks Dr. Lin, "when you can just carry one?" Dr. Lin has been collaborating with Bell Labs colleagues (now at the University of Hawaii) and a group at Stanford University on a CMOS direct-conversion Doppler radar chip that monitors heart and respiration rates, making it an invaluable tool for the elderly. With this portable device they could monitor their vital signs and communicate with doctors from home or anywhere, without the need of going to a hospital or doctor's office.



Dr. Lin holds a silicon wafer next to die photos of Bipolar, CMOS, and RF circuits.

Dr. Lin is working with Professors Ken O and Joe Brewer on a project in collaboration with Motorola and funded by DARPA. The aim of this endeavor is to create a "micronode" radio frequency (RF) transceiver that can be used in a variety of applications. (See article on page 16).

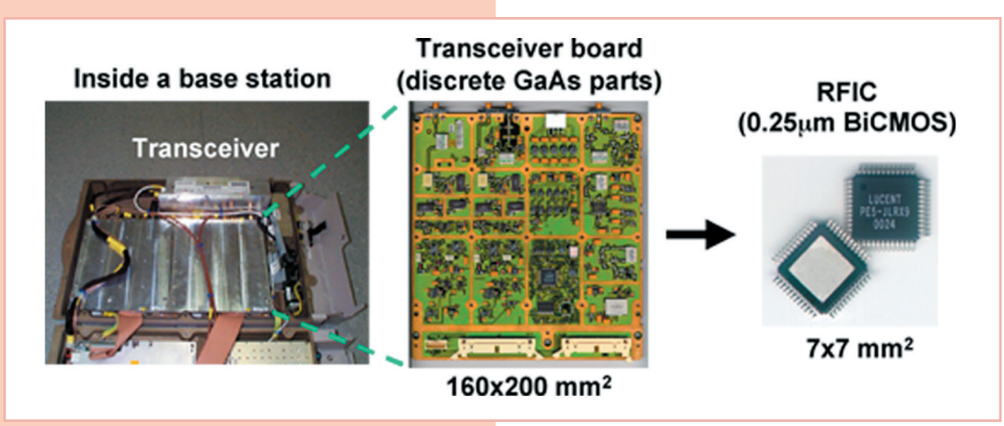
“We’re kind of on the science fiction track.”



Dr. Lin notes that the RF component of communication devices is always a bottleneck of integration, either at the user end or within the network infrastructure. Higher integration translates into small size and lower cost. High level integration on the user end has shown significant impact, as cellular phones are getting smaller and smaller. However, much work remains to improve network infrastructure.

Dr. Lin has been working on the miniaturization of wireless base stations. Typical cell phone basestations have a hefty price tag—more than $100,000 each. Grandiose in size, they are located in a small house at the base of the tower. “Our project is fueled by size and cost reduction of basestations, and with CMOS technology, we get a 100x reduction in cost, 100x reduction in size,” says Dr. Lin. His team in Bell Labs successfully integrated a receiver and a transmitter, and the next step is to integrate digital electronics.

Dr. Lin’s multi-disciplinary research covers electronic circuits, communications, electromagnetics, and solid state devices. His innovative vision, however, reaches into a novel genre of artificial intelligence. “We are kind of on the science fiction track,” he says. “Eventually the machine, with sensors and broadband wireless communication capabilities (they talk to each other much faster than talking to humans), will be powerful enough to advance humanity, or destroy it.



This fascinating interplay of man and machine is limitless in scope, yet it demands a cautious approach be taken. “Security and privacy become important issues, because eventually this technology will invade on our privacy,” Dr. Lin says. “How much privacy do we want to give up for security? How much do we push in technology?”

These challenging questions outline the frontier of Dr. Lin’s research. Integration, innovation, and a good dose of imagination direct his path into the future of communication technology.

Dr. Lin is active on several committees in IEEE, including the steering committee for the IEEE Radio Frequency IC Symposium 2004.

Research

Small, Smaller, Smallest Radio!

By Mary Barbarette

Dr. Ken O

ECE Industry Professor Joe Brewer and Dr. Ken O, in alliance with Motorola and DARPA, are creating a new single-chip communication technology called μNode that might just be the stuff of storybook endings—an ideal marriage between military instrumentation and state-of-the-art electronics.

The smart sensor is so small, it fits into the "O" of "IN GOD WE TRUST" on the one dollar bill.

"You have an integrated circuit that can basically do everything," explains Dr. O. "We're putting all of the functions usually found on a circuit board onto a single chip. It's *really* a single chip radio. There's nothing else!" Even the battery will be directly mounted onto the chip. The goal for this small wonder is a size of 3 mm x 3 mm x 1 mm. For a visual representation, take out a dollar bill. The single chip radio will fit inside the "O" of "IN GOD WE TRUST."

Because of their small size, the military has a keen interest in this IC technology. One possible scenario of the tiny chip harkens back to Grimm's fairy tales and the lore of Hansel and Gretel. "A soldier could have a satchel of these things and toss them onto the ground and surrounding brush as he walks. Then, like the pebbles Hansel uses to find his way back home, the little sensors could light the soldier's return path," explains Dr. O.

The goal is to create sensor networks that will out-perform the functions of a single sensor. "The vision is that these radios will be able to communicate over distances of up to 5-10 meters. You have to pay some penalties, right? When you build such a small radio, the distance is small. But the idea is you put many of these things around so they can communicate over short distances. The information basically hops from one radio to another to get somewhere else." Lab experiments are yielding fruitful results, with communication between the antennas already reaching 15 meters.

A further goal of the project is to equip the tiny radio with some kind of sensing device. Possibilities include temperature and pressure sensors, or microphones and cameras. "There are some very exciting applications," says Dr. O, "such as disaster recovery." Sensors mounted onto the walls of buildings can help locate people in the rubble of a collapsed building. When a building collapses from an earthquake, for example, parts of the building fall together. Tiny sensors mounted to the building's walls could alert rescue teams to where different parts of the building are, and consequently find missing people.

In another scenario, sensors that are imbedded into bridges and buildings could measure the stress and aging levels of the structure and radio that information to workers as they walk by.

Professor Joe Brewer

A key aspect of creating the single-chip radio is developing circuits that do not require an external (off-chip) precise timing reference. Present day radios use crystal oscillators that are separate from the radio chip. Such oscillators and crystals are large and expensive, and are incompatible with the μNode concept. Motorola is working on this end of the problem.

The possible applications of this technology are endless, yet Dr. O acknowledges it's potential harm if it is taken in the wrong direction. "There are implications to privacy. Unfortunately, with any technology there's always the down side and up side to it. It's really how you use it."

The foundation of Dr. O's research mission is to ensure the μNode radio remains in good hands.

Dr. O working with his students in the Silicon Microwave Integrated Circuits and Systems Research Lab

Silicon Microwave Integrated Circuits and Systems Research Laboratory

The mission of the Silicon Microwave Integrated Circuits and Systems Research Group (SiMICS) is to increase applications of low cost silicon technologies in the frequency range between 1 and 20 GHz. The lab's goal is to lower the cost of communication devices to bring the benefits of communication technology to a wider cross-section of the population. Currently, there are 13 graduate students in the group developing circuits and components for systems operating from 900 MHz to 20 GHz using silicon based technologies.

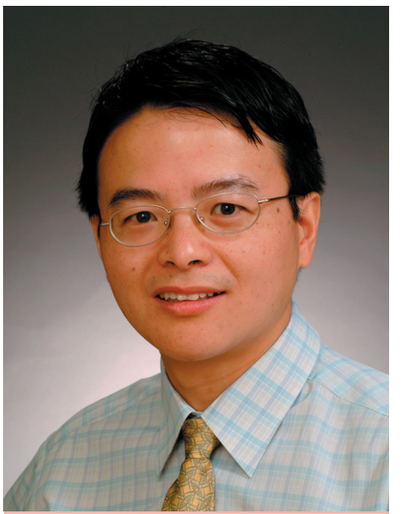
Recent accomplishments of the group include demonstration of 13-GHz CMOS amplifiers in a 0.1-µm CMOS technology on silicon-on-oxide and silicon-on-sapphire films in collaboration with IBM T.J. Watson Research Center and the U.S. Navy; demonstration of a 1.2-dB Noise Figure 900-MHz amplifier and a 1-GHz voltage controlled oscillator with phase noise of −126 dBc/Hz at a 600-kHz offset in a 0.8-µm CMOS technology; demonstration of on-chip wireless communication using integrated antennas; and development of a design oriented Q-extraction technique for integrated inductors.

The SiMICS group is well poised to study circuits, components and systems up to 20 GHz. Their activities have been sponsored by the Semiconductor Research Corporation, National Science Foundation, and Navy, as well as numerous semiconductor companies including International Business Machines Inc., Texas Instruments Inc., Analog Devices Inc., and Conexant Systems Inc.

Research

Multifaceted MEMS

by Mary Barbarette



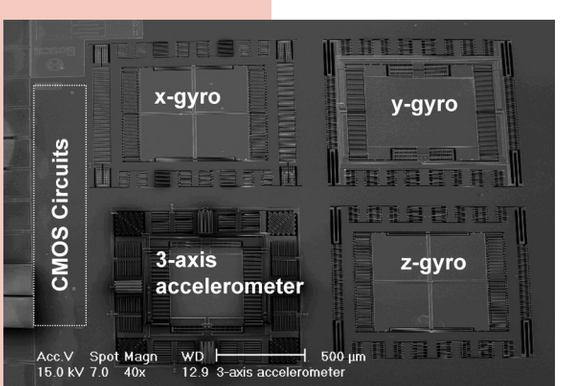
Dr. Huikai Xie

ECE proudly welcomes Dr. Huikai Xie, a 2002 alumnus of Carnegie Mellon University. Dr. Xie joins the Device and Physical Electronics area and the Photonics area. His expertise is in semiconductor devices, integrated microsensors and microactuators, optical MEMS, biosensors, biomedical imaging, fiber optics, micro/nano fabrication technology, and multi-domain simulation.

Dr. Xie's current research projects are grounded in MEMS (micro-electro-mechanical-systems) technology, and span the areas of navigation, biomedical imaging, and optical communication.

"Bascially, my focus is integration," he says. Dr. Xie creates smart, compact systems that combine sensors and actuators with the computing power of CMOS circuits. By using a special process to achieve large proof mass on CMOS chips, he gains a significant increase in sensitivity and adds wireless communication capability.

Dr. Xie is currently building an Inertial Measurement Unit (IMU) that can be used for navigation in automobiles and aircraft. Each IMU contains mechanical sensing devices such as accelerometers and gyroscopes. MEMS accelerometers measure speed and are employed in airbags for shock detection.



Integrated monolithic 6 Degrees-of-Freedom IMU chip

Gyroscopes measure rotation rate. Combined together, the two sensors can measure location. The Global Positioning System is currently used for navigation, but there are many situations in which the signal may be unavailable. High resolution IMU's pose a useful alternative to the potentially blocked signals of GPS.

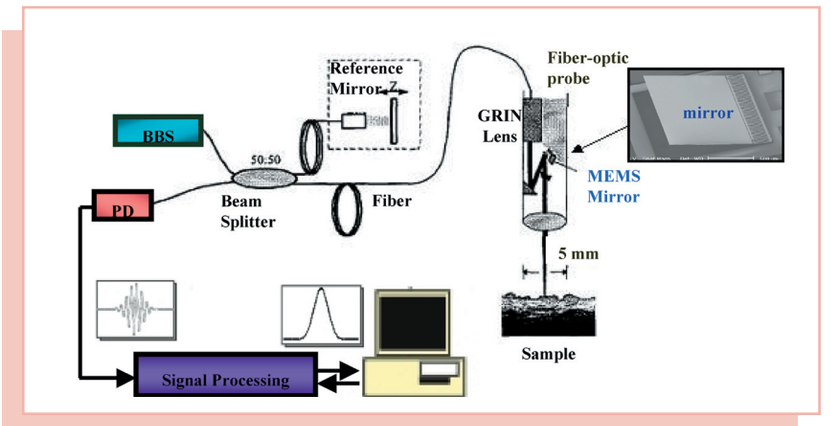
Dr. Xie's biomedical research using micromirror technology is opening up new avenues in pre-cancer detection. "We want to detect cancers early, in-vivo and non-invasively by using optical coherence imaging," he says.

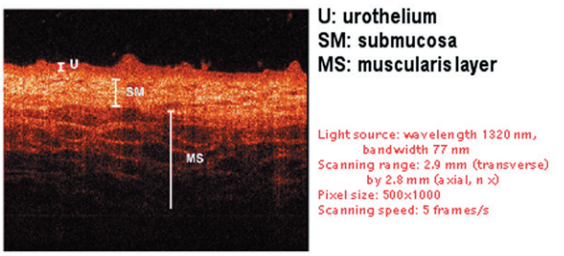
Performing biopsy and surface detection are the traditional methods of detecting cancer. Dr. Xie's approach takes it a step further by going within the tissue — the branchia of the lung, for example — to obtain a cross-sectional view of the tissue.

"Often, by the time you detect something on the surface it's already too late," he says. "Plus, biopsy is painful, risky and time-consuming, and can even accelerate the propagation of the cancer. Our in-vivo method is minimally invasive since we use optical imaging, but we don't do any cutting."

Dr. Xie's innovative technique can directly utilize a conventional bronchoscope. (A fiber optic imaging probe is threaded into the biopsy channel of

“We want to detect cancers early, in-vivo and non-invasively by using optical coherence imaging.”





The micromirror technique can be used on many internal organs. Above, an in-vivo 2D image of bladder tissue.

the bronchoscope.) A MEMS micromirror is assembled at the tip of the imaging probe. Once inside the body, the mirror performs very fast, high resolution laser scanning.

“The technology we use is low coherence optical imaging,” says Dr. Xie. “The smaller the coherence length of the light source, the higher the spatial resolution, which means you can scan at a finer depth.” The mighty micromirror performs pixel by pixel scanning, generating an image every few tenths of a second and covering x, y, and z axes. Software enables 3D image reconstruction in real time, and aids in identifying abnormalities.

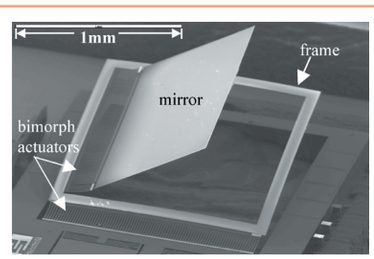
This is a crucial advancement in a field where early detection is critical for success. As Dr. Xie notes, “with the micromirror technology, we will not ignore any possibility.”

Micromirrors are also a valuable tool for laser scanning display. Very simple, small systems can be created with a laser source and a micromirror, with any flat surface functioning as a screen.

Another focus of Dr. Xie’s MEMS research is integrating micromirrors with motion detectors for optical communications. Vibration sensors such as accelerometers are crucial for the high precision “analog” optical switches in which each micromirror can steer a laser beam from one optical fiber to multiple ouput optical fibers.

Subterranean MEMS sensors lend a hand in earthquake and oil detection. To detect the distance of oil beneath the earth, explosives are set off and the sensors measure the response at different locations. As Dr. Xie notes, traditional sensors are costly and difficult to network. CMOS-MEMS sensors, on the other hand, are smaller and cheaper, they get higher resolution, and they can communicate by themselves. “Our ultimate goal is to make wireless sensor networks,” he says.

Dr. Xie’s research offers exciting advancements in MEMS technology. Dr. Xie is in charge of the newly established Biophotonics & Microsystems Laboratory: http://www.mems.ece.ufl.edu. Also visit him online as a member of the Interdisciplinary Microsystems Group, a lab devoted to MEMS research: http://www.img.ufl.edu.



Laser Scanning Display Using 2-D Micromirror (4 x 4 pixel raster scan)

Accomplished Students

The Department is proud to honor these students for their outstanding achievements

Electrical E Award

Daryush Mehta

SM 03

Ian St. James

SM 02

Tracee Worel

SP 02

Christopher Drake

SM 02

David Bueno

SM 03

SP 03

Cyril Kurien

F 03

Ryan Palacheck

SP 03

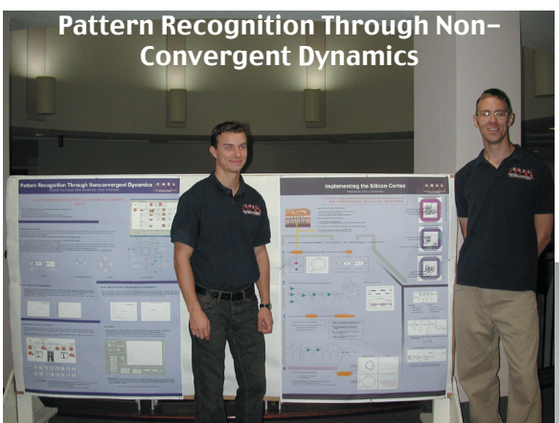
Samit Thakkar

These students have earned the Electrical and Computer Engineering Department's Highest Honor with an Overall GPA Exceeding 3.9

ECE Research Frontiers: CNEL Day

On November 21, 2003, the Computational NeuroEngineering Lab presented a portfolio of research projects. Students proudly displayed their work with posters, demonstrations, and their newest hardware and software designs.

The brain is a model for many of the projects at CNEL. Using techniques inspired by the brain's funtion, researchers in the lab are creating tools for speech and face recognition, multiple-image combination for MRI, and innovative VLSI handheld devices, to name a few. The BMI project has aligned animal and machine so that when a monkey thinks to move its arm, a robot arm moves. An exciting goal of this research is to develop a prosthetic arm for paralyzed individuals.



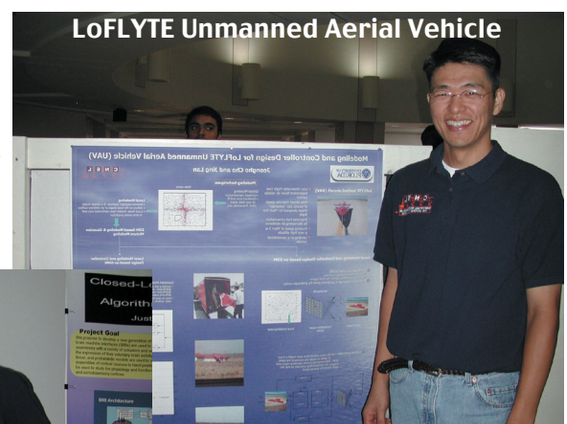
Peter Vesterberg and Thomas Holz

Peter and Thomas are studying how neurons work in assembly.

Brain Machine Interface (BMI)

Justin is developing algorithms that translate the activity from an animal's brain.

Justin Sanchez



Jeongho Cho

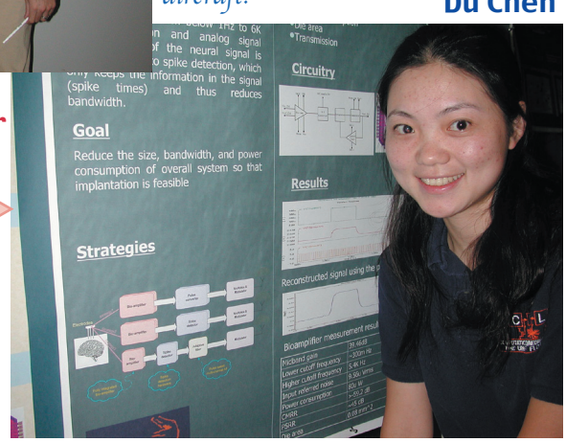
Jeongho is working on a controller to cope with noise, with the goal of making an inverse controller for the aircraft.

Du Chen

Christy Rogers

Analog Hardware for Implantable Neural Recording

Du and Christy are creating strategies to amplify and record neural signals for spike detection and pulse conversion, and then modulation.



Student Excellence

Kudos to **Jose Bohorquez** and **Christopher Drake,** who have received the International Engineering Consortium's (IEC) *William L. Everitt Student Award of Excellence*. The award is given each year at universities affiliated with the IEC, and it honors outstanding seniors who have demonstrated an interest in the communications field. Award recipients receive a commemorative Cross pen set, and their names are added to the University's Everitt Award Plaque.

Intel Education

Congratulations to **Nicole Staszkiewicz**, whose proposal "Gallium Nitride Based MEMS Sensors" has been selected to receive a $2000 grant from the *Intel Student Research Contest for Undergraduate Students*. On March 11-12, 2004, Nicole will participate in Student Research Day at Intel's Santa Clara site, where she will give a short presentation to Intel judges and other participants. The top presenters at Student Research Day will win more cash awards. Good luck Nicole!

International Conference on Acoustics, Speech, and Signal Processing

May 13–17, 2002

Faculty from UF's Department of Electrical and Computer Engineering brought the 27th International Conference on Acoustics, Speech, and Signal Processing (ICASSP) to Florida.

ECE's DSP faculty made up a significant support team for the conference. The lineup was as follows: Dr. Fred Taylor - General Chair; Dr. Jose Principe - Technical Program Chair; Dr. Jian Li - Tutorials; Dr. John Harris - Registration; Dr. John Anderson - Plenary.

Dr. Taylor says of the conference, "ICASSP is the largest, most important, and prestigious yearly conference sponsored by the IEEE Signal Processing Society." According to Dr. Principe, "ICASSP has been a centerpiece for the creation, orchestration and dissemination of digital signal processing as one of the enabling technologies for the information age revolution."

ICASSP 2002 featured over 1,200 technical presentations, in the form of regular oral and poster presentations, student forum presentations, special sessions, tutorials, and plenary sessions. It offered workshops from Motorola, Texas Instruments, and StarCore.

The conference took place in Orlando, FL at the Renaissance Orlando Resort. For more information, visit the conference website at http://www.icassp2002.com/

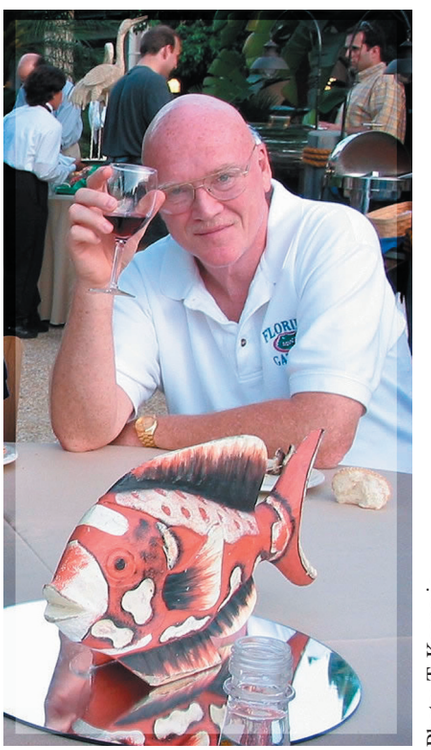


Photo: T. Kasparis

Cheers! "The conference ran very smoothly and the location was excellent!" says Dr. Taylor. About 1800 people attended.

Photo: T. Kasparis

Dr. Anderson introduces the keynote speaker, Dr. James Moorer

GOMACTech 2003

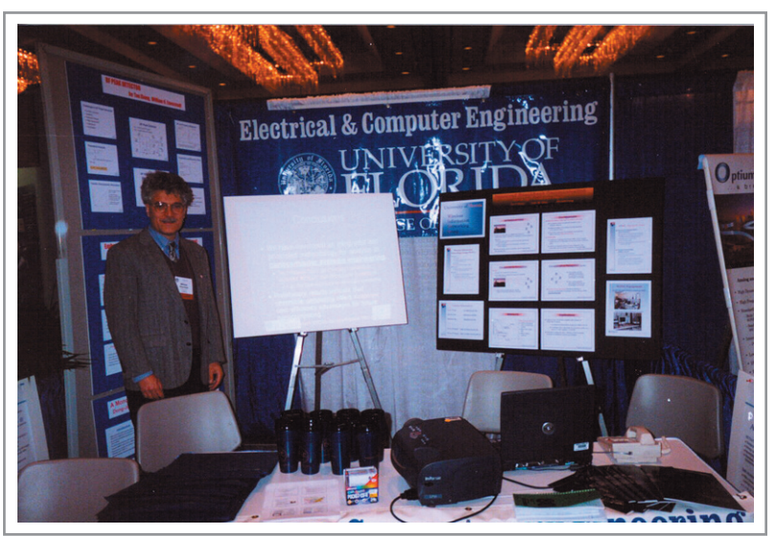
Countering Assymetric Threats

GOMACTech is a conference established primarily to review developments in microcircuit applications for government systems. Established in 1968, the conference has focused on advances in systems being developed by the Department of Defense and other government agencies and has been used to announce major government microelectronics initiatives such as VHSIC and MMIC, and provides a forum for government reviews.

Industry Professor Joe Brewer spearheaded ECE's participation in GOMACTech. Several ECE faculty and graduate students trekked to Tampa for the conference, bringing with them the skills and smarts of our department, and the possibilities of new collaborations and partnerships.

"In terms of direct contact with potential funding sources for ECE research funding, GOMACTech '03 was a great success," states Brewer.

Dr. Jose Fortes, BellSouth Eminent Scholar, and Professor Brewer participated in a Nanotechnology technical session. Dr. Alan George gave a paper in the Sensor Technology session.



ECE's booth at GOMACTech attracted a lot of high-power visitors, including DARPA and SRC.
Above: Dr. William Eisenstadt. Below: graduate students Monica Ciocan (left) and Sarah Knight.

GOMACTech '04 will take place in Monterey, CA.

On Sabbatical

Higher Education in Kuala Lampur

UNITEN is located about 15 miles south of the capital city of Kuala Lumpur (fondly known as KL)

Dr. Ramakant Srivastava writes of his sabbatical experience in Malaysia from December 01, 2001 to May 6, 2002

Many asked me why I chose to go to Malaysia, especially so soon after September 11. The main reason was to go outside the United States for a fuller international experience. Besides the highly developed countries such as Japan and Singapore, there are several rapidly developing and progressive countries that are keen on investing in higher education, with special emphasis on information and communication.

My host institution was UNITEN, Universiti Tenaga Nasional, a private, for-profit institution owned and operated by Tenaga Nasional, the largest power generation and transmission company in Malaysia. Primarily an undergraduate school offering degrees in engineering and business until five years ago, it was recently elevated to the university level. It has over 3,000 students but graduate education is still in its infancy.

My mission was to teach an undergraduate course in fiber optics to electrical engineering seniors and provide help in establishing a graduate program in photonics, along with a laboratory similar to the one I started at the University of Florida in 1993.

I had 128 students, evenly divided into two lecture sections. The ethnic distribution in my class reflected the population distribution rather accurately. The big surprise was the percentage of women: a whopping 40 percent! For comparison, the fraction is close to 15% at UF.

There was no laboratory associated with the course and I had no access to any facility where I could demonstrate any of the components or systems I was teaching about. I lectured 3 hours per week per section and attendance on any given day was over 90 percent.

Malaysian students in private universities are not as well prepared for higher education as their counterparts in public universities, where entrance exams screen out poor students. UNITEN, like other private schools, charges hefty tuition and admits as many students as possible to make a profit. The faculty members are mostly young and inexperienced. Of the few PhD instructors, almost 50% are from other countries such as Pakistan, India, Egypt, Bangla Desh, and European countries. Most Malaysian instructors have no PhD or equivalent degree. Many are trained in the United Kingdom or Australia. All are fully loaded with courses (12-15 hours/week) and no teaching assistants are provided in most courses.

From the beginning I noticed a profound mismatch between my style of teaching and the students' style of learning. Whereas I emphasized concepts and ideas, students were interested in memorization without inquiry. Needless to say, my scores had to be curved steeply to pass a minimum percentage of students as required by the university rules. Yes, UNITEN requires that a minimum percentage of students must pass in each course! I must say I let the administrators know of my disagreement with this policy.

> "While my experience has enhanced my understanding of the deficiency in the current system of higher education in Malaysia, it has also created an awareness of the need for sharing the expertise with developing countries."

I enjoy teaching and it was fun to interact with young students of diverse backgrounds, cultures, and work habits. While my experience has enhanced my understanding of the deficiency in the current system of higher education in Malaysia, it has also created an awareness of the need for sharing the expertise with developing countries. I derive a great deal of satisfaction in this achievement.

In Memory Dr. Julius T. Tou

Funeral Homily
by Reverend Ivan Tou
June 29, 2002
Forest Meadows Chapel
Gainesville, FL

Today the world feels a little darker, a little more somber. Today, the tempo of the world feels like it skipped a beat. We seem rather left behind, slightly out of sync. There is an emptiness in the air. Today we grieve the sad loss of my father, professor Julius T. Tou.

My mother, my brothers and sister, and I thank you, our friends, for coming to pay respects to my father, to grieve with us, but also more importantly, to celebrate his life and to give God thanks for the gift of my father and for the hope and promise of life eternal for him and all of us.

I always felt if reincarnation were true, then my dad would have been a powerful Chinese general in some ancient glorious past. He led our family like a tight ship. There was always a strict Confucian order to family life. We had a chain of command leading from the children to mom up to dad. Dad was the boss and the rock of the family. Though we faced many tumultuous times, we sailed through and overcame through dad's leadership and direction.

My father was a prideful man, but not prideful in the bad sense. Rather he was a man of pride balanced with humility. He was a man of pride in that he knew he was gifted with incredible intelligence and energy.

And as we all know, he used his intelligence with great productiveness. My father advanced the world's knowledge from control systems to information systems and from database technology to vision technology to machine translation.

The academic challenges were not enough for my father. He also had energy to spare and pursued various business endeavors, with my mother, from starting restaurants to investing in rental units and real estate. He provided employment for many and instilled in them the same spirit of initiative, self-responsibility, and taking charge of one's life that he taught his children.

In the midst of all these endeavors, he raised a family of four putting up with squawking clarinets, a blaring trumpet, and the early morning bellows of an accordion. He instilled in his children a value of learning and doing one's best. Yoda's creed of "try not, rather do or do not do," I heard first from my father.

My father showed us how to live the Buddhist spirit of tenacity we heard in the 2nd reading. Rather than sleep or waste the hour, he instilled in us the value of seizing each moment and making the most of it, employing our mind, body, and spirit. We were to keep one foot in the present moment, while also looking toward and preparing for the beyond. In many ways, my dad's ability to reinvent himself throughout his lifetime to make the most of every opportunity, influenced my ability to reinvent myself and thus go from engineering to Catholic priesthood.

The strange thing was I did not know much about my father's achievements until I was in college when one of his research colleagues shared with me some of my father's achievements. Then while at MIT, I came across several books and papers he wrote. And finally, I would work with my father at his company, CITAC Computer, Inc. and be amazed at the tremendous wealth of ideas and knowledge that would flow from his head. There was never a lack of new ideas to test and implement.

In all his successes, my father had an air of humility. He never flaunted his successes. He lived a very simple life personally. He would wear clothes that he has had for ages until the threads were bare thin. He would drive the same car forever. From his days struggling as a poor immigrant graduate student, he remembered the value of money and the need to plan for the future. He was constantly helping students and young professors. And in looking toward the future, he set up a foundation to continue his spirit of giving and helping others.

So we give thanks to God for the gift of Julius; for all the bless-

ings he has been for all of us. The good times and the bad times with Julius, they have all borne much fruit in our lives in many varied ways, through the grace of God. God's goodness comes in many packages. In Julius, God's goodness came in a very unusual package, where the gift is all the more precious and special.

So today we come to grieve the tragic loss of Julius. Words cannot capture the loss experienced. There is an emptiness inside that reveals to us how interconnected we truly are with Julius and with each other. When one is missing or one is hurt, we all feel it. This is our true nature. Not as independent individuals each on our own course in life, but united together as God's children, God's family.

Biography of Julius Tou, written by Fred Tou

Julius T. Tou, Graduate Research Professor Emeritus at the University of Florida and President of CITAC Computer, Inc., died on June 22, 2002 at his home in Gainesville, Florida at the age of 76.

Professor Tou was born in Shanghai, China, on August 15, 1925. He grew up in China and attended Shanghai Jiao-Tong University, where he received a Bachelor's degree in Electrical Engineering in 1947. He came to the United States in 1949 for graduate studies and received a Master's degree from Harvard University in 1950 and a Doctor of Engineering degree from Yale University in 1952.

Professor Tou served on the faculties of the University of Pennsylvania, Purdue University, Northwestern University, and Ohio State University before joining the faculty of the University of Florida in 1967, serving as a Graduate Research Professor in Electrical Engineering and the Director of the Center for Information Research.

In addition to his faculty positions, Professor Tou served as the Director of Research at the Battelle Memorial Institute in Columbus, Ohio, and was the founding Director of the Institute of Information Science of the Academia Sinica.

Professor Tou pioneered research in digital and sampled-data control systems, pattern recognition, image understanding and computer vision, machine intelligence, software engineering, knowledge-based expert systems, computer-based automation, and machine translation. He invented TBS (TeleBrowsing System), MEDICS (MEDIcal Knowledge System), VIREC (VIsual RECognition system), AUTORED (AUTOmatic Reading of Engineering Drawings), APRIKS (Agricultural Knowledge System), and CITAC (Chinese Translation Computer) and held 7 patents in the United States, the People's Republic of China and the Republic of China (Taiwan).

To promote education and to stimulate research, he organized the first International Symposium on Software Engineering and edited the conference proceedings into a book entitled *Software Engineering*. A prolific writer, Professor Tou has authored, co-authored or edited 26 books and published over 250 technical papers. He was Editor-in-Chief of the *International Journal of Computer and Information Sciences*, Editor of the *Advances in Information System Science* book series, and an editor of several journals, including the *Journal of the Franklin Institute*, the *Pattern Recognition Journal*, and the *Journal of Pattern Recognition and Artificial Intelligence*.

Professor Tou received numerous honors in his lifetime, including election as a Fellow and Life Member of the Institute of Electrical and Electronics Engineers, recipient of the Distinguished Alumni Award from Yale University, appointment as an Honorary Professor of the Shanghai Jiao-Tong University, recipient of an honorary Doctoral degree from Fudan University (China), and election as an Academician of the Academia Sinica of the Republic of China (Taiwan).

Professor Tou's interests extended well beyond academia, and his entrepreneurial spirit led him and his wife Lisa to found TVL, Inc. in 1975 to manage the Shanghai Garden restaurant and JLT Development Corp. in 1982 to develop real estate, including the Aloha Garden Apartments and Evergreen Mall office complex. After retiring from the University of Florida in 1992, Professor Tou founded CITAC Computer, Inc., a software company that applied his research in machine translation to applications for Chinese language translation and tutoring.

In addition to a full and varied career in education and business, Professor Tou and his wife of 45 years, Lisa, raised a family of four children, Albert, Fred, Ivan, and Sylvia. He instilled a strong work ethic in his children, an attitude that every task must be done to the utmost of one's ability, and the importance of education as a lifetime process. His four children have received a combined 11 college and graduate degrees from MIT, the University of Florida, Georgia Tech, American University, UCLA, and Catholic University of America. Albert is a statistician living in Bethesda, Maryland. Fred is an engineering manager in Cupertino, California, married to Ellen, with two daughters, Alyssa and Erin. Ivan holds a doctorate in computer science from UCLA and is a Catholic priest in Austin, Texas. Sylvia is a busy mother in Albany, New York, married to Tom Gray, with four children, Tommy, Scott, Jennifer, and Kenny.

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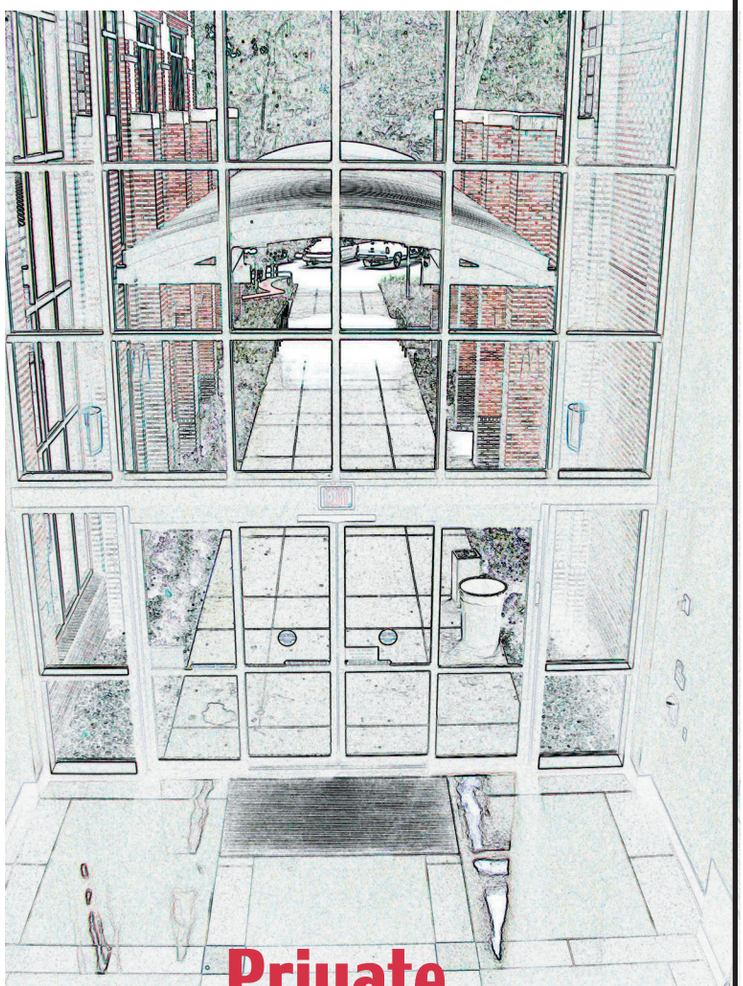

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Dr. Jack Smith, Professor Emeritus of ECE at UF, made a generous donation of $10,000 to the UF Foundation, "as a token of my appreciation for Dean Wayne Chen's contributions to the University of Florida." Dr. Smith directs his funds to the research of Dr. Ken O, "[whose] research has extraordinary potential and should be encouraged."

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Social & behavioral sciences C29-40
ence, technology, & mathematics C40-44
Professional fields C44-51

ADMINISTRATIVE POSITIONS
Academic affairs C53-61
Student affairs C62-65
Business affairs C66-76
Technology C77

COMPLETE INDEX: C87

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Presidents
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C79-86

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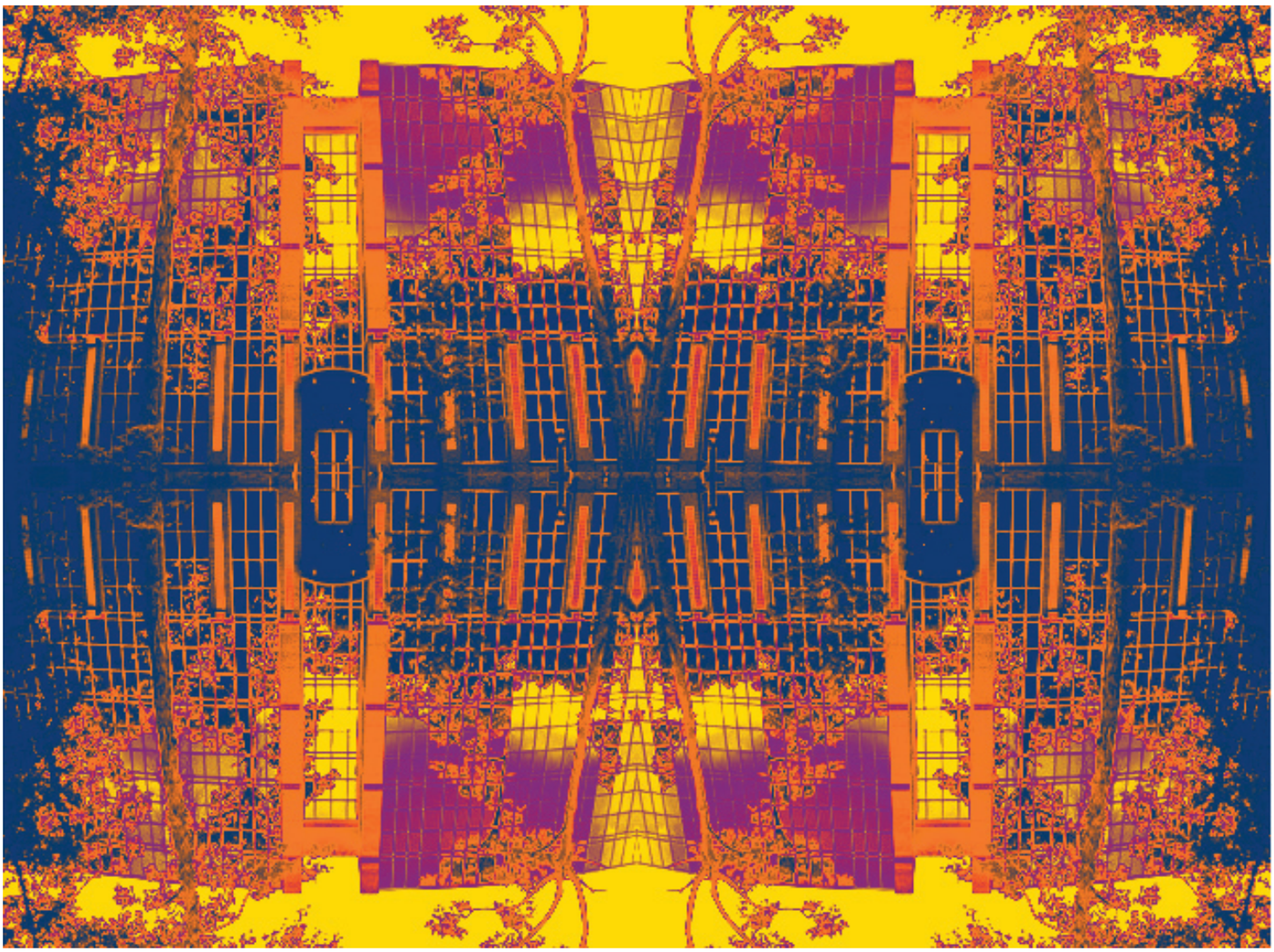

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